Science@School Book 5E

Earth and beyond

Teacher's Guide

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The pupil book explained unit by unit

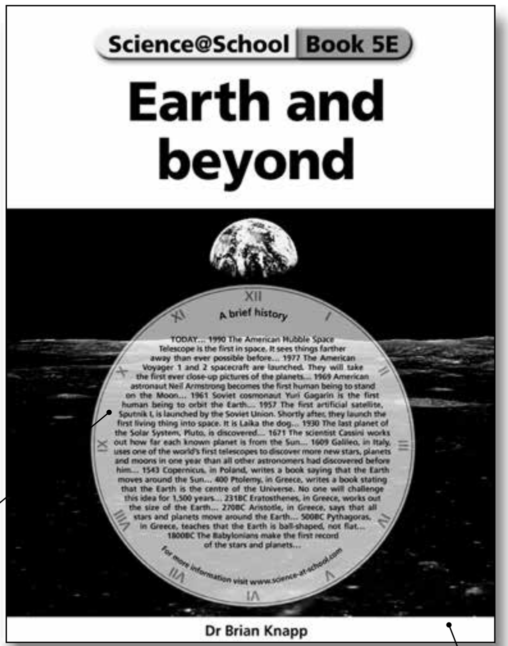
Although the pupil book – *Earth and beyond* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Earth and beyond*.

It is possible to use *Earth and beyond,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 11 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.



A time clock giving additional historical information about the topic.

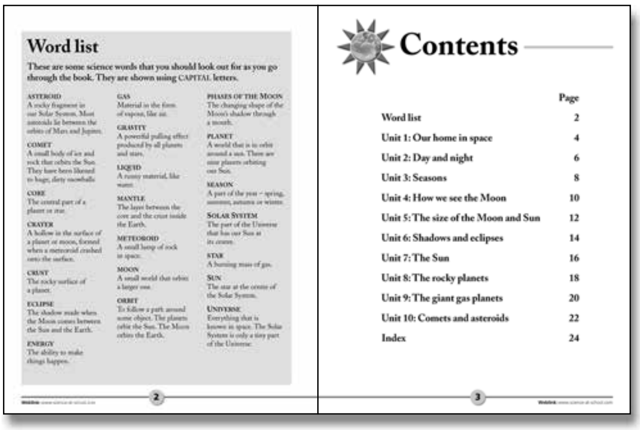
The picture shows a view of the Earth from the Moon.

Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.



Word list

These are some science words that you should look out for as you go through the book. They are shown using CAPITAL letters.

ASTEROID
A rocky fragment in our Solar System. Most asteroids lie between the orbits of Mars and Jupiter.

COMET
A small body of ice and rock that orbits the Sun. They have been likened to huge, dirty snowballs.

CORE
The central part of a planet or star.

CRATER
A hollow in the surface of a planet or moon, formed when a meteoroid crashed onto the surface.

CRUST
The rocky surface of a planet.

ECLIPSE
The shadow made when the Moon comes between the Sun and the Earth.

ENERGY
The ability to make things happen.

GAS
Material in the form of vapour, like air.

GRAVITY
A powerful pulling effect produced by all planets and stars.

LIQUID
A runny material, like water.

MANTLE
The layer between the core and the crust inside the Earth.

METEOROID
A small lump of rock in space.

MOON
A small world that orbits a larger one.

ORBIT
To follow a path around some object. The planets orbit the Sun. The Moon orbits the Earth.

PHASES OF THE MOON
The changing shape of the Moon's shadow through a month.

PLANET
A world that is in orbit around a sun. There are nine planets orbiting our Sun.

SEASON
A part of the year – spring, summer, autumn or winter.

SOLAR SYSTEM
The part of the Universe that has our Sun at its centre.

STAR
A burning mass of gas.

SUN
The star at the centre of the Solar System.

UNIVERSE
Everything that is known in space. The Solar System is only a tiny part of the Universe.

2

Contents

3

The entire contents are given on page 3. The book is organised into double page spreads, each double page spread covering one unit.

The units

Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

Body

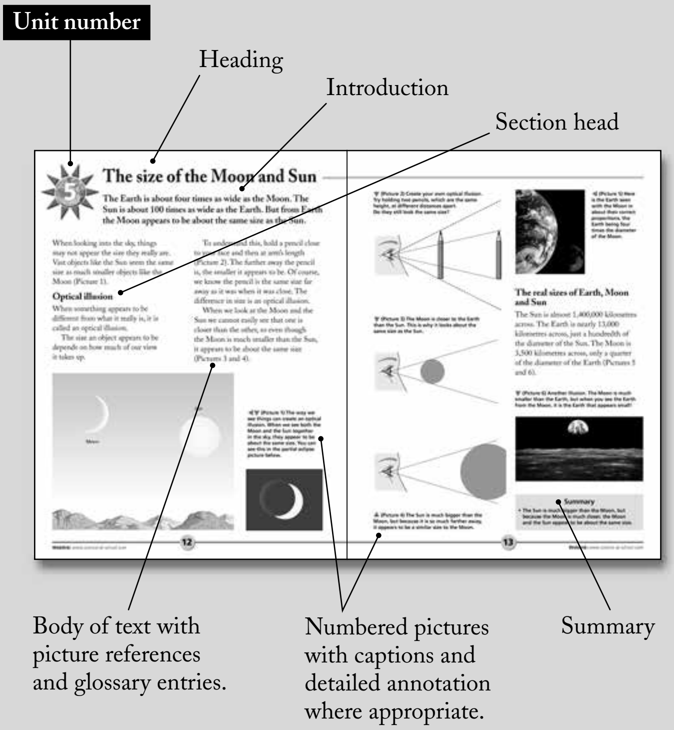
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.



1 Our home in space

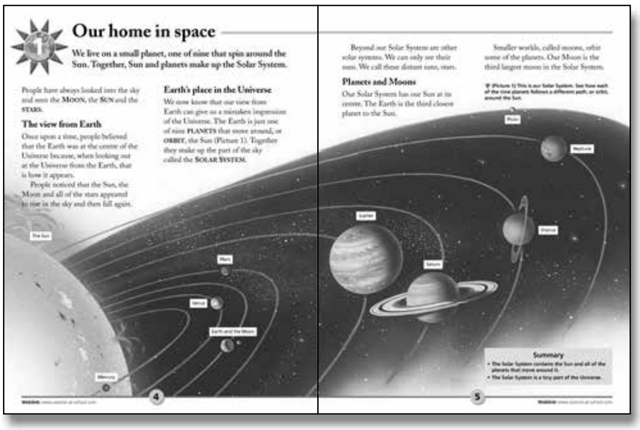
This introductory unit sets the scene by illustrating the place of the Earth in space. It shows the planets in the Solar System and their relationship to the Sun and to each other.

The purpose of the diagram is to indicate that the Sun is a fiery ball that sends out light into the blackness of space.

The unit gives you an opportunity to look at how the Earth fits into the Solar System, and to consider how the Solar System is really arranged, as opposed to how it appears from the Earth. All of these features are considered in detail in later units, but for now, the idea of planets moving in orbits is all that is needed.

Moons are introduced as small rocky worlds that orbit the planets, much as the planets orbit the Sun.

Many children like to display their knowledge of the Solar System and a general discussion about


Our home in space

We live on a small planet, one of nine that spin around the Sun. Together, Sun and planets make up the Solar System.

the Sun and the planets may provide a stimulating introduction. The activity lets the children make a scale model of the Solar System, using themselves as planets, to appreciate the relative distances between the planets and the Sun.

2 Day and night

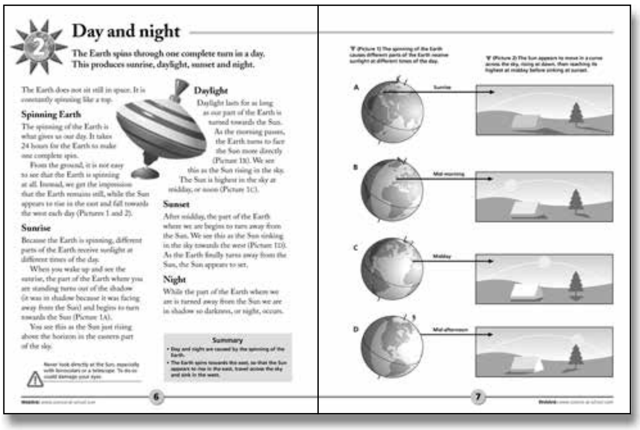
This unit is concerned with the way that the Earth spins around once every 24 hours. The main diagram shows the way in which, as the Earth spins, it turns in towards the Sun and thus the Sun appears to rise in the sky.

Pupils' attention should be drawn to the way that the position of the continents has changed between subsequent diagrams, indicating the spinning of the Earth. The Sun is always shining from the right.

The idea that night is the part of the spin cycle when the observer is facing away from the Sun is the final point made in this unit.

It may be helpful to have a torch and a ball (or, better still, a globe) to show, in 3D, the way that sunrise and sunset occur using a light from a constant direction. Mark the position of Britain on the ball.

The activity takes the suggested introductory demonstration further and directs the children to


Day and night

The Earth spins through one complete turn in a day. This produces sunrise, daylight, sunset and night.

find out about conditions in other parts of the world when it is day or night in Britain.

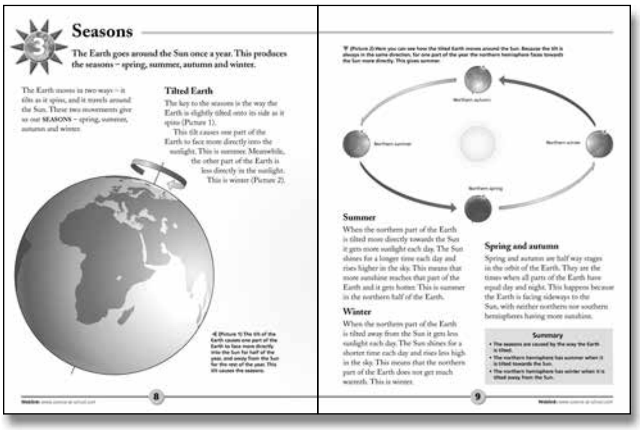
3 Seasons

This unit is concerned with the way that the seasons are produced. Notice that the key to this is the way the Earth is tilted, and that the tilt stays the same throughout the year. The tilt of the Earth was shown on the previous unit but was not discussed there because tilt was not needed for an explanation of day and night.

Again, a torch and a globe or a ball are invaluable to help with this idea. Summer is the time when the Sun's rays strike the Earth most directly. It is experienced by the part of the Earth facing more directly into the Sun.

Notice that this also explains why people near the Equator do not have summer and winter: the Equator faces the Sun in exactly the same way throughout the year.

The orbit of the Earth is shown on the right hand page. The orbit is nearly circular. Children should not get the idea that the Earth is closer to the Sun at any time of year, it is the effect of the tilt that is important. The equinoxes are times when the tilt is 'sideways on' to the Sun and so neither northern nor southern hemisphere have any advantage.



The activity takes up one consequence the tilt of the Earth has on the amount of heat it receives. The children can investigate the heat produced when a lamp is shining directly over an area and when the lamp is to one side so that its light rays are striking the area at a slant.

4 How we see the Moon

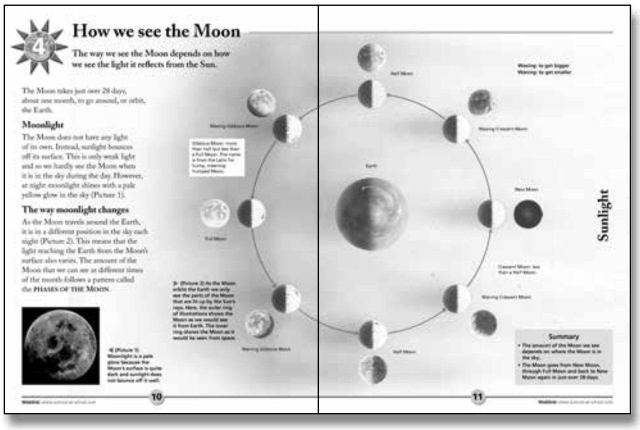
The Moon is a fascinating celestial body to observe. Two things are most striking: the features on its surface, and the amount of the Moon's surface that we can see. The surface of the Moon is made of dark-coloured lava and dust which do not reflect the sunlight well. This is why the Moon glows with a pale yellow light.

The shape of the visible disc helps to prove that the Moon is a sphere. The curved shape of the Crescent and Gibbous Moon phases cannot occur unless the sunshine falls on a sphere.

Notice that the Moon rotates in such a way that it orbits the Earth while keeping the same face to Earth all of the time.

The shape of the phases of the Moon can be demonstrated with a ball and torch. Notice that the diagram shows both the real illumination of the Moon and the way we see the Moon from the Earth.

Remind pupils that it is perfectly safe to look at the Moon and encourage them to use binoculars to explore the surface. At the same time, remind them that it is dangerous to look at the Sun in this way because the intensity of light is too great.



In the supporting activity, the children make a 'Moon Diary' for a month. This activity may also encourage them to look for other objects in the night sky including planets, constellations and shooting stars.

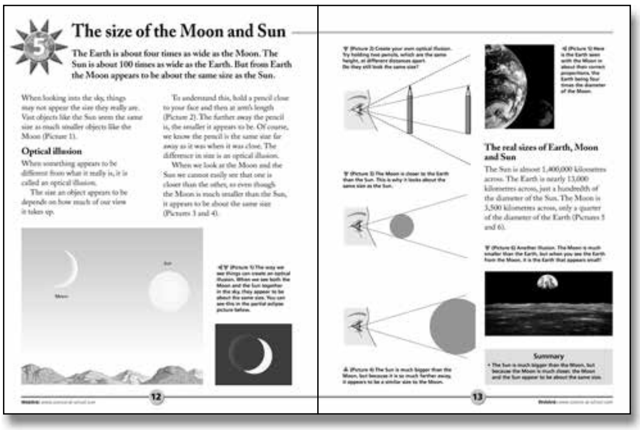
5 The size of the Moon and Sun

In the previous units, we examined the way that the Sun and Moon are seen from the Earth. Although we may have looked at the relative distances between the Sun and planets in Unit 1, we have not linked them to the relative sizes of the objects in the Solar System.

In this unit, we discuss the nature of size and distance. Pupils can do this for themselves using a pea held up close and a ball held by a friend at a distance, positioning the friend until both objects appear to be the same size.

Point out that we know the objects are different sizes because we have a frame of reference all around us and we knew what they were to start with. In space we have no such frame of reference and so we do not necessarily appreciate how big or small things are, nor how far away they might be.

Picture 2 is a simple ray diagram which helps the more able to see how objects take up less of our field of view when they are farther away. Or how they may take up the same field of view if they are larger but farther away. Data on the relative sizes of the Moon and Sun are given.


The size of the Moon and Sun

The Earth is about four times as wide as the Moon. The Sun is about 100 times as wide as the Earth. But from Earth the Moon appears to be about the same size as the Sun.

The last picture helps show that the Earth can look small, too – when seen from the Moon. Incidentally, this picture shows a curved shadow, which is one way of proving that the Earth is a sphere.

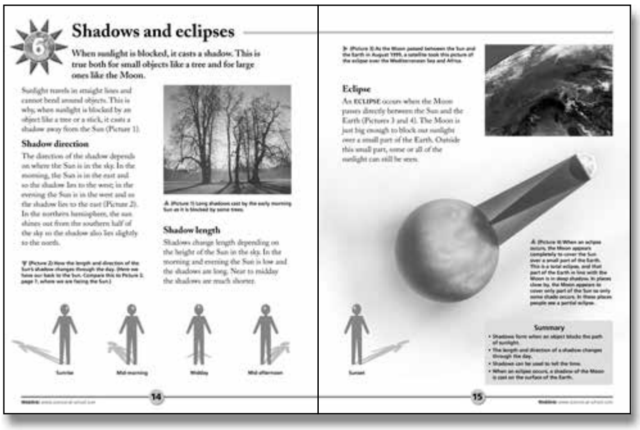
In the supporting activity, the children investigate the relationship between objects of different sizes, and the distance at which they appear the same size. They can use the relationship they discover to make predictions.

6 Shadows and eclipses

In this unit we look at the shadows produced when objects block sunlight. Shadows illustrate two things: they show that light travels in straight lines, because the shadows all have sharp edges (light cannot bend around an object), and they show the way that the Earth moves relative to the Sun.

The diagrams at the bottom of page 14 can be reproduced by children in a school playground. Mark a cross on the playground, get a child to stand on it and then use chalk to draw his or her shadow. Repeat hourly during the school day. In this way a child's shadow can be used to make a sundial.

It has not been that long since the last full eclipse, and eclipses are very dramatic. There is not much difference between the shadow made by an eclipse and an ordinary shadow, except for the fact that during an eclipse, the object getting in the way is the Moon. The size of total and partial eclipses can be demonstrated by moving a tennis ball first close to a torch, and then farther away. Watch the shadow on a distant wall.


Shadows and eclipses

When sunlight is blocked, it casts a shadow. This is true both for small objects like a tree and for large ones like the Moon.

In the activity, the children build on the playground activity described above to make a shadow clock. They can use the pattern in their results to predict shadow lengths and directions at any time of day.

An intriguing picture from a satellite taken during the last eclipse over the Mediterranean Sea and Africa is also given on this unit.

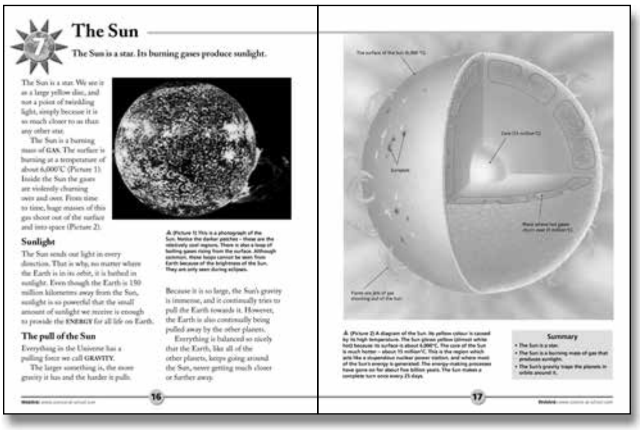
7 The Sun

It is important that pupils know that the Sun is a star and, like any other hot thing, it is burning up fuel. So, in a manner of speaking, the beam of a torch and sunlight are both due to the light emitted as fuel is burned.

The cross section of the Sun will help children understand that it is a fireball of churning gases right to the centre. This means that it is not like a planet with a rocky centre.

The bright yellow patches on the Sun's surface are formed where burning gases boil out of the Sun's surface.

Examining the Sun also provides the opportunity to think about how the Solar System is tied together by the Sun's gravity. It may be helpful to twirl a ball on a string, so that it makes an orbit, to demonstrate the force involved. The Earth's orbit is like the ball. If the string suddenly vanished, the ball (Earth) would fly out into space. The string is like the force of gravity always holding the Earth in place. Similarly, if the Earth stopped orbiting the Sun, then the force of gravity would pull it into the Sun. So both orbiting and gravity are needed to maintain balance.



The activity extends the concept of the Sun as a star by looking at star brightness and visibility and establishing a relationship between them. From this work, the children can then go on to look at real stars in the night sky and pick out constellations.

8 The rocky planets

In this unit, we return to look more closely at the planets in the Solar System. In particular, we look at the Earth and then compare it with its other rocky neighbours.

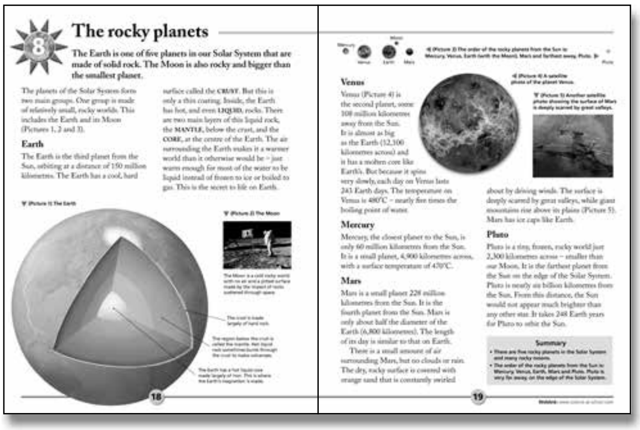
Children should understand that the cold rocky surface of the Earth is no thicker, in proportion to the diameter of the Earth, than the skin of an apple. Below the rocky surface crust, the Earth is molten. Hence the source of volcanoes.

Children should also notice that the Earth is hottest at its centre, and that the centre of the Earth is made from iron (the source of the Earth's magnetism).

The Earth also has an atmosphere – which many other planets do not. The atmosphere contains oxygen and water vapour, which almost none of the other planets have.

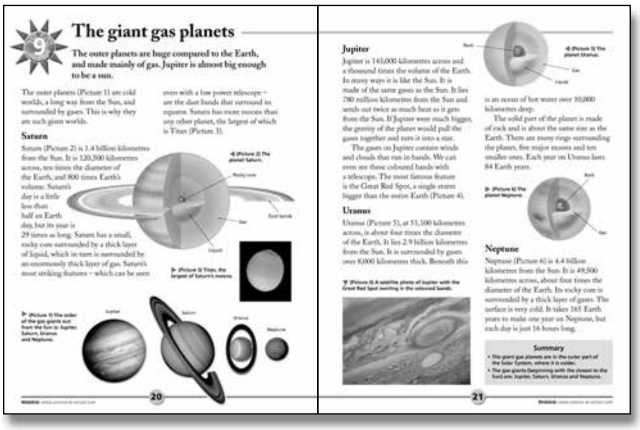
However, the other planets are not geologically dead worlds, but have their own spectacular features, such as the vast mountains on Mars.

Children could also note that the other rocky planets rotate on their axes and orbit the Sun at different rates to the Earth and so have different length days and years. A planet's distance from the Sun also affects how hot it is.



In the activity, the children construct another model of the Solar System, but this time they consider the relative sizes of the planets and look for a pattern in their work.

9 The giant gas planets



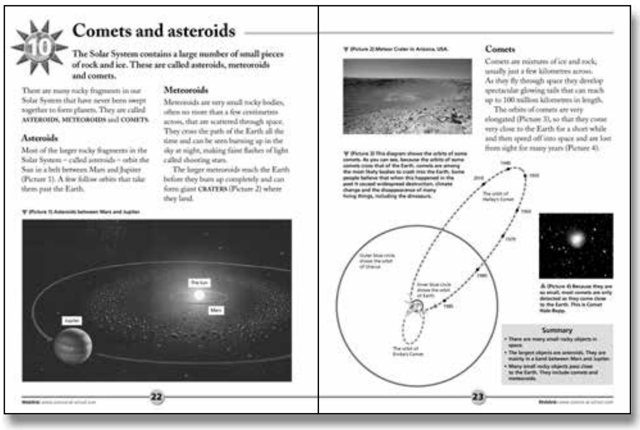
In this unit we look at the most spectacular features of the Solar System, the giant planets, including Saturn and Jupiter, and the way they are all made of gas and liquid, unlike the solid rocky planets.

Note that one reason these planets have thick, gaseous atmospheres is that they are very distant from the Sun and so the atmospheres have not boiled off. They also have rocky cores. All the gas giants have many Moons orbiting them.

The gas giants are amazing worlds. Although they are huge compared to the Earth, they spin much more quickly, and thus have much shorter days. Jupiter spins round the fastest, taking only 9 hours 50 minutes to make one revolution. The revolution times for the other planets are Saturn – 10 hours 39 minutes, Uranus – 17 hours 14 minutes and Neptune – 16 hours 7 minutes. You might like to speculate with the children how they would have to reorganise their day if they lived on a planet that revolved faster than the Earth. You may end this speculation by pointing out that if they tried to land on any of the gas giants they would sink into a thick cloud of gas and eventually land on an ocean of either liquid hydrogen or a mixture of liquid methane, ammonia and water.

In the previous activity, the children have begun to appreciate how different the planets are from each other. This activity takes this concept a stage further by looking at how some planets spin.

10 Comets and asteroids



In this final unit, children can begin to appreciate how planets interact. The small rock and ice bodies that are scattered around the Solar System sometimes come within view during their orbits as comets, or are sometimes captured by the Earth's gravity, where they burn up in the Earth's atmosphere as shooting stars, or fall to Earth as meteors. Meteor Crater, Arizona, is the best known impact crater on Earth, but children can be encouraged to look back to pictures of the Moon and notice that many of the features on the Moon are also due to impacts. There is also the suggestion that a large impact was responsible for the death of the dinosaurs (and other giant reptiles) some 65 million years ago.

Most of the asteroids in our Solar System are in orbit between Mars and Jupiter. When space voyages are planned, attention has to be given to the way that probes, and eventually manned spacecraft, will be able to negotiate these small, rocky fragments. Meteoroids are already a threat to satellites (and space stations) orbiting the Earth.

In the activity, the children study the way craters are made and look for relationships between the size of the impacting object and the width and depth of the crater.

Index

There is an index on page 24.

Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of the properties of materials in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are provided here.

Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration. Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content.

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

You can find the learning objectives for each unit in this *Teacher's Guide*.

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this Teacher's Guide to provide a test. The learning objectives are for these comprehension worksheets and relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are provided. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers. However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

Resources

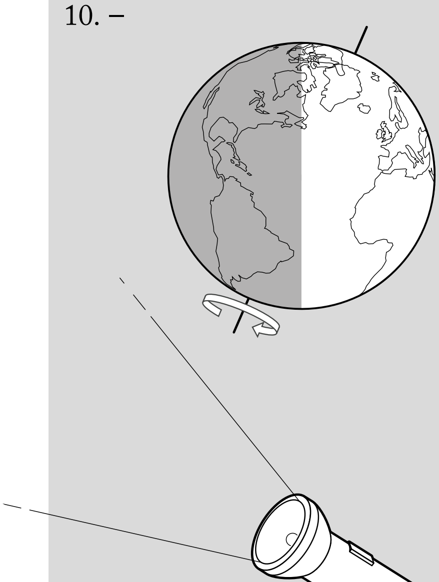
The three lists below show the resources needed to support the photocopiable worksheets.

- ▶ List 1 shows resources for demonstrations suggested for starting a unit.
- ▶ List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- ▶ List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. –
2. Torch, ball or globe
3. Torch and globe
4. Torch and ball
5. Pea and ball
6. Playground, chalk
7. Ball and string
8. Apple cut open to show the thickness of the skin.
9. –
10. –



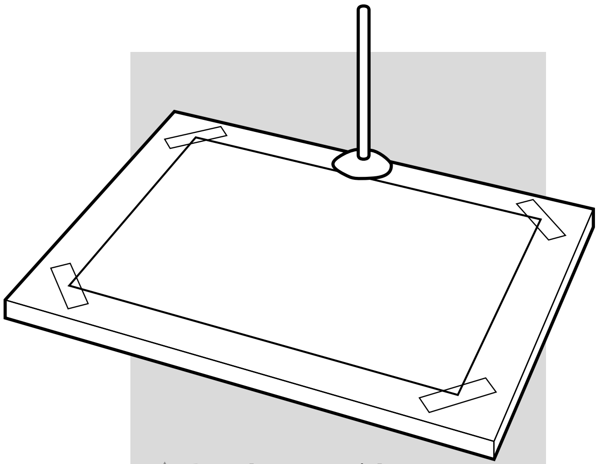
▲ *Torch and globe for the demonstrations in Units 2 and 3.*

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. –
2. Site for safe Moon watching.
3. Calendar, desk diary with details of sunrise and sunset, a 'sky at night' column from a broadsheet newspaper.
4. Tracing paper and the 'sky at night' column from broadsheet newspaper.
5. Selection of different sized spherical objects, such as balls and fruit, or Plasticine.
6. Large ball, globe, tennis ball, lamp.
7. Secondary sources about stars.
8. The 'Sky at night' column from a broadsheet newspaper.
9. Secondary sources about gas giants, newspaper articles about discovering new planets.
10. Secondary sources about comets.



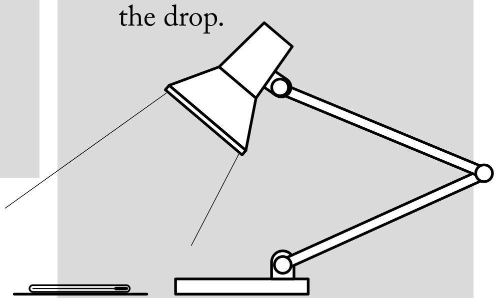
▲ *Board, paper, sticky tape, Plasticine and pencil for Unit 6.*

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Pictures of planets.
2. Globe, Plasticine, torch, pieces of plastic straw.
3. Thermometer, black card, desk lamp, half-metre ruler, clock.
4. –
5. Marble, tennis ball, football, orange, onion, apple, half-metre ruler and metre ruler.
6. Board, paper, sticky tape, Plasticine, pencil.
7. Black card, pin and pencil for making holes, torch, metre ruler or long measuring tape.
8. Pair of compasses, paper, pencil, scissors, coloured pencils, ruler.
9. Globe and torch.
10. Box or plastic bowl of dry sand, objects such as pebbles, ruler, metre ruler for measuring the height of the drop.



▶ *A thermometer, black card and desk lamp used in Unit 3.*

Learning objectives

Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

Unit 1

- The Solar System is in the Universe.
- The Solar System consists of the Sun, nine planets and their Moons.

Unit 2

- Day and night are related to the spin of the Earth.

Unit 3

- The Earth orbits the Sun once a year.
- The Earth tilts in the same direction as it moves round the Sun.
- The tilt and the movement of the Earth in its orbit create the seasons on Earth.

Unit 4

- The Moon moves in an orbit round the Earth.
- The Moon takes about one month to complete its orbit.
- The appearance of the Moon changes due to the amount of sunlight reaching the side we see.

Unit 5

- The Sun, Moon and Earth are approximately spherical.
- The size of an object in the sky is related to its distance from the Earth.

Unit 6

- The position of the Sun in the sky appears to change, and this causes shadows to change.

Unit 7

- The Sun is a star.
- The Sun's gravity helps hold the planets in their orbits.

Unit 8

- There are five rocky planets in the Solar System and four of them are close to the Sun.

Unit 9

- There are four huge planets made mostly of gas in the Solar System.

Unit 10

- Space objects such as asteroids and comets are part of the Solar System.

Learning objectives

Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

Unit 1
- ▶ Identify simple patterns in observations.

Unit 2
- ▶ Use observations to draw conclusions.

Unit 3
- ▶ Use simple equipment.
- ▶ Take measurements.
- ▶ Make comparisons in observations.
- ▶ Make a prediction.
- ▶ Construct a table and fill it in.

Unit 4
- ▶ Identify simple patterns in observations.
- ▶ Use scientific knowledge and understanding to explain observations.

Unit 5
- ▶ Make comparisons in observations and measurements.
- ▶ Construct a table and fill it in.

Unit 6
- ▶ Make comparisons and identify simple patterns.
- ▶ Make a prediction.

Unit 7
- ▶ Make comparisons in measurements.
- ▶ Construct a table and fill it in.

Unit 8
- ▶ Interpret data.

Unit 9
- ▶ Use observations to draw conclusions.

Unit 10
- ▶ Carry out a fair test.
- ▶ Use measurements to draw conclusions.

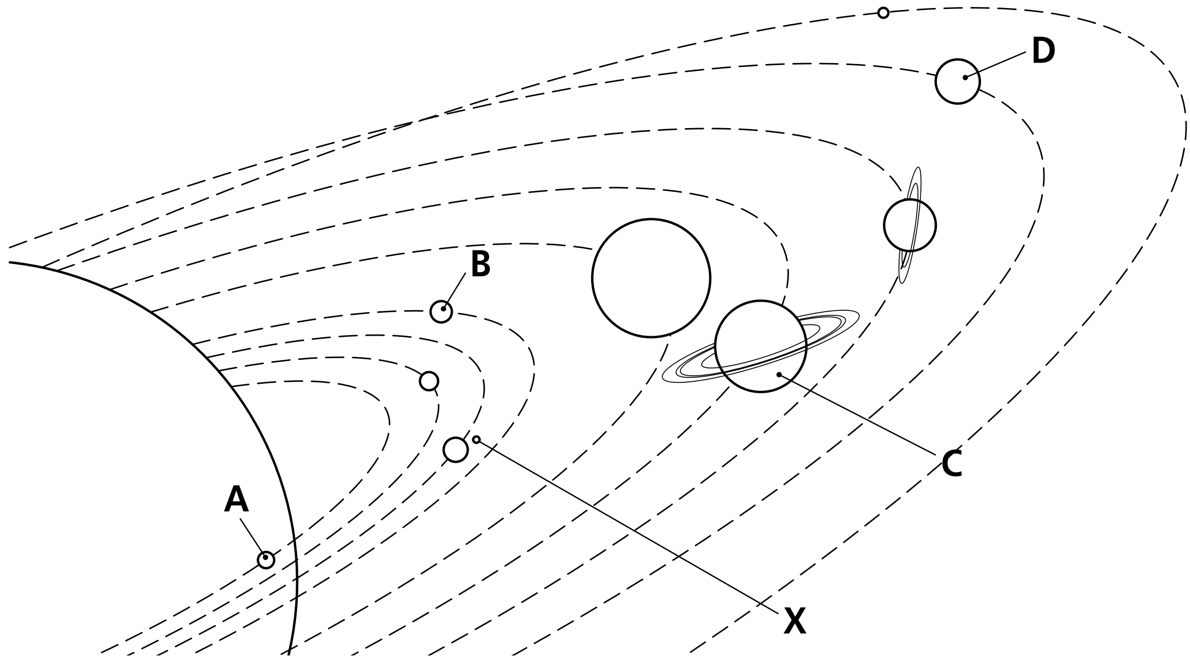
1

Name: .... Form: ....

See **pages 4 and 5** of *Earth and beyond*

Our home in space

We live on a small planet, one of nine that spin around the Sun. Together, Sun and planets make up the Solar System.



Q1. Name the planets marked A, B, C and D.

A ✎........................ B ✎........................ C ✎........................ D ✎.........................

Q2. What is X?

✎..

Q3. From Earth, how do the Sun, Moon and stars appear to move in the sky?

✎..

Q4. Where did people once believe the centre of the Universe to be?

✎..

Q5. Why did they believe it to be the centre of the Universe?

✎..

Q6. What is the definition of a planet's orbit?

✎..

1 Teacher's sheet: comprehension

See **pages 4 and 5** of *Earth and beyond*

Answers

1. **A is Mercury, B is Mars, C is Saturn, D is Neptune.**

2. **X is the Moon.**

3. **They rise and then set.**

4. **The Earth.**

5. **Because the Sun, Moon and stars seemed to move around it.**

6. **Its path around the Sun.**

Complementary work

(a) To focus on the idea of the Earth moving in its orbit, tell the children that the effect of the swirling gas cloud that formed the Solar System can still be detected as the movement of the planets in their orbits. The Earth travels in its orbit at 10,400 km/hour. Ask the children to calculate how far the Earth travels in its orbit in a day.

(b) Another effect of the swirling gas cloud is the spinning of the Sun and planets. The children can use the book to find answers to questions about the rotation of the Sun and planets. For example: How fast does the Sun spin? (See page 17) How fast do Venus and Mars spin? (See page 19)

Teaching notes

The children will have some notion about the Earth and space from general interest and may even wish to talk about aliens! As they look at the picture on pages four and five, they may be keen to display their knowledge of the names of the planets. As some children confuse the Solar System with the Universe, it may be useful to discuss each separately and show the relationship between them.

You may wish to begin by telling the children about how we think the Universe formed and say that it started with an explosion called the Big Bang. In this explosion two gases formed called hydrogen and helium, which then came together into swirling clouds which formed stars. When many of the stars finished glowing, they exploded and produced other substances which became dust in space. The swirling gas clouds and the dust collected around some of the developing stars. As the dust particles crashed into each other they formed larger rocky lumps. Some of these lumps formed planets, or the cores of planets like Jupiter, which then became surrounded by other gases.

You may like to add that, beginning in the middle of the 1990s, planets have been discovered around other stars. So there is a possibility that other stars may have something similar to our Solar System around them and on some distant planets there may even be life.

1

Name: .... Form: ....

Based on **pages 4 and 5** of *Earth and beyond*

The scale of the Solar System

Try this...

1. Here are the distances of the orbit of each planet from the Sun. The figures are in millions of kilometres.

Planet	Distance from the Sun
Mercury	58
Venus	108
Earth	150
Mars	228
Jupiter	778
Saturn	1,427
Uranus	2,870
Neptune	4,497
Pluto	5,900

2. You can see how these distances compare by using a scale of one centimetre to every million kilometres and having people stand apart at these distances.

3. You will need an open space like a playground or sportsfield.

4. Place a person or object in the centre of this open space. This represents the Sun. Now arrange other people in a line at the different planetary distances.

5. When everyone is in place ask them all to take three steps in the same direction as if they were walking in a circle round the person who is the Sun.

Looking at the results.

6. Describe how the 'planets' are arranged in their orbits.

✎...

✎...

7. Describe how the 'planets' move round the Sun.

✎...

✎...

Teacher’s sheet: activity

Based on **pages 4 and 5** of *Earth and beyond*

Introducing the activity

(a) Begin by saying that any picture of the Solar System cannot show how the planets are really arranged, because of the great distances between their orbits, but we can get some idea of the arrangement if we look at the distances and then use a scale (see note (i)).

(b) You may choose to give each person a name of a planet or let them carry a scale picture or model of the planet (see note (ii)).

Using the sheet

(c) Give out the sheet, let the children fill in their names and form, then go through tasks 1 to 4 with them.

(d) Let a group of children set themselves out as a Solar System while the rest of the class watches them.

(e) Let the group try task 5.

(f) Repeat steps 4 and 5 with the other groups in the class. Make sure everyone sees how the planets are arranged and how they move (see note (iii)).

Completing the activity

(g) Let the children complete tasks 6 and 7.

Conclusion

The inner planets are bunched together while the outer planets are more spread out. The inner planets complete their orbits much more quickly than the outer planets and will complete many orbits in the time it takes an outer planet to complete just one.

Teaching notes

(i) You may like to arrange the class into groups and see how they can work together to demonstrate their ‘Solar System’ to the rest of the class.

(ii) The scale used to make the planet pictures or models is not the same scale as the distances. You may feel that this is a confusion you wish to avoid and simply have the children use names. However, if you wish to use scale models see the activity plan for Unit 8.

(iii) With a well behaved group you can let the planets take more steps. When it is realised that the inner planets orbit more quickly, they can be stopped and the other outer planets can be allowed to move further, to show how they spread out in their orbits.

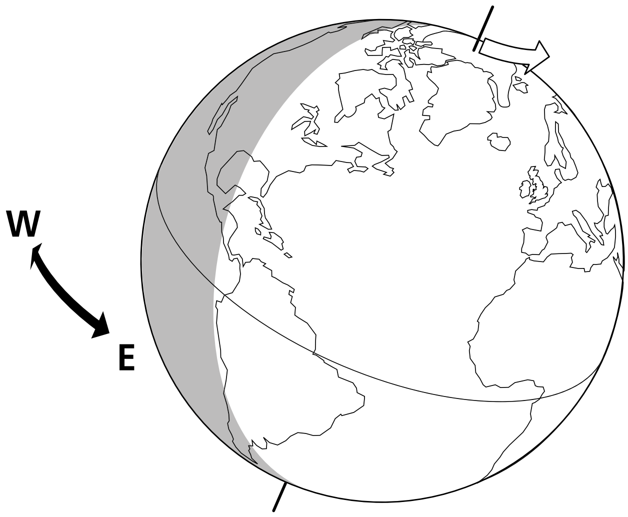
2

Name: .... Form: ....

See **pages 6 and 7** of *Earth and beyond*

Day and night

The Earth spins through one complete turn in a day. This produces sunrise, daylight, sunset and night.



Q1. What do the letters E and W stand for in the diagram above?

E ✎............................ W ✎............................

Q2. Is the Sun shining on the right or the left of the Earth in the diagram above?

✎..............................

Q3. Explain your answer to question 2.

✎...

Q4. How long does it take the Earth to spin completely around once?

✎...

Q5. When a place on the Earth is in daylight, does it face towards the Sun or away from it?

✎...

Q6. Imagine it is midday. Describe how the sky will change in the next twelve hours. Give a reason for the change.

✎...

✎...

2 Teacher's sheet: comprehension

See **pages 6 and 7** of *Earth and beyond*

Answers

1. **E stands for east or eastern horizon, W stands for west or western horizon.**
2. **On the right of the Earth.**
3. **The shadow occurs on the left of the Earth.**
4. **24 hours.**
5. **Towards the Sun.**
6. **It will become dark because the place will turn away from the Sun.**

Complementary work

(a) In autumn and winter, when it gets dark during school hours, or relatively early in the day, ask the children to look at the position of the stars and the Moon at different times to see if they change position.

(b) At the time of a Full Moon, ask the children to sit in a position where the Moon is about to appear over a roof top. Ask them to time how long it takes to appear over the roof top. Make sure that they understand that it is the movement of the Earth and not the Moon that they are timing.

Teaching notes

If you have talked about the formation of the Universe, and the swirling of gases and dust to make the Solar System, in the previous unit, it may be helpful to remind the children of it again and say how this swirling still greatly affects our daily lives today. It may be useful to remind the children of the directions north, south, east and west, and how they are found by using a compass. (The geographic North and South Poles about which the planet spins are not at the same place as the magnetic north and south poles, but are fairly close. The children do not need this fact, but if local maps are used the directions of the magnetic north and geographic north may be seen in the margin.)

Make sure the children can recognise east and west directions and understand that the horizon is a distant line at which the Earth and the sky appear to meet.

You may get the children to link movement and horizon by asking them to close one eye, turn their head over their right shoulder then slowly turn their head until it is over their left shoulder. All the time they should stare directly ahead of them and note how the objects come into view from the left, cross their field of view, and disappear to their right. Ask the children to imagine that their heads were the Earth and their view was the sky. The left is then the east and the right is the west. In a similar way, when the children look south with both eyes, the eastern horizon is on their left and the western horizon is on their right.

Seek the support of parents and carers for the children to try the complementary work or try it as part of an astronomy evening at school.

Name: .... Form: ....

Based on **pages 6 and 7** of *Earth and beyond*

The spinning Earth

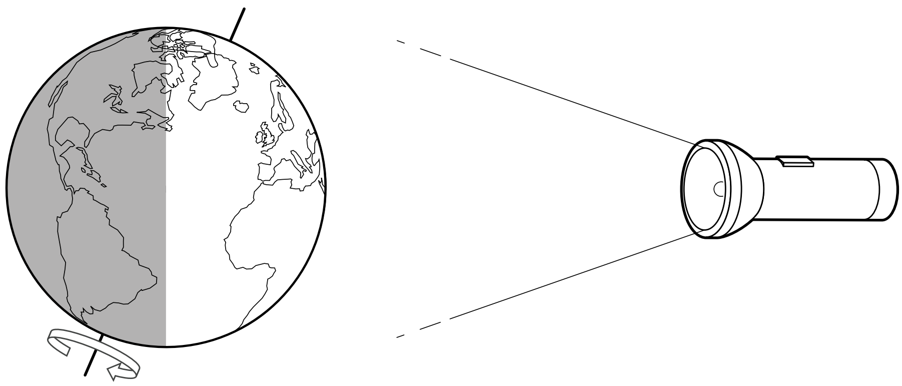
Try this...

1. Find Britain on a globe.

2. Put a piece of Plasticine on it and stick a piece of plastic straw in the Plasticine so that Britain is easy to see.

3. Make similar markers for Japan, the centre of the United States and the centre of Australia.

4. Set up the globe with a torch, as in the diagram, and make the room dark. The torch represents the Sun.



5. Turn the globe anticlockwise, as the arrow shows, until Britain is directly facing the Sun. This shows the position of Britain at midday. Look at the parts of the Earth in the sunlight. Name three countries which have midday at the same time as Britain.

1 ✎................................ 2 ✎................................ 3 ✎................................

6. Look at the three other countries with markers and write down whether they are in the light or dark.

Australia ✎........................ Japan ✎............................ USA ✎............................

7. Turn the globe anticlockwise until it is midday again in Britain. In what order did the other countries with markers come into the light?

1st ✎.............................. 2nd ✎.............................. 3rd ✎..............................

8. When it is midday in the USA, is it daylight in

(a) Brazil? ✎............................ (b) India? ✎............................

Teacher's sheet: activity

Based on **pages 6 and 7** of *Earth and beyond*

Introducing the activity

(a) Begin by saying that scientists sometimes use models to try and understand how things happen and this technique is also useful to us. In this activity the children are going to make a model of how the Earth spins in sunlight. For this they need a globe to represent the Earth and a large torch to represent the Sun.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form then go through tasks 1 to 4 with them.

(c) Let the children work through tasks 1 to 4.

(d) Check that they have assembled and placed their markers properly. Check that the torch illuminates half the globe.

(e) Let the children try tasks 5 to 8 (see note (i)).

Completing the activity

(f) Go through the answers with the children (see note (ii)) and make sure they know which way the Earth spins.

Conclusion

The Earth spins in an anticlockwise direction when seen looking down from the North Pole. When a part of the Earth turns into the light daytime begins in that place. When a part of the Earth turns into the dark night-time begins in that place. These changes are due to the movement of the Earth. The Sun does not change its position.

Teaching notes

(i) You may wish to add further tasks. These could be

(a) When it is sunrise in Britain, what is it like in Australia? (answer – night)

(b) When it is sunset in the USA, name two other countries where the Sun is also setting. (answer – Canada and Mexico)

(c) When it is sunrise in Brazil, what is it like in Britain? (answer – day)

(ii) Answers to 5 to 8

(5.) France, Spain, Morocco, Algeria, Mali, Mauritania, Guinea, Liberia, Upper Volta, Ghana, Ivory Coast

(6.) Australia – dark, Japan – dark, USA – dark or coming into the light

(7.) USA, Japan, Australia – if the top of the globe is pointing to the Sun. Australia, then Japan, then USA – if the top of the globe is pointing away from the Sun.

(8.) (a) Yes (b) No

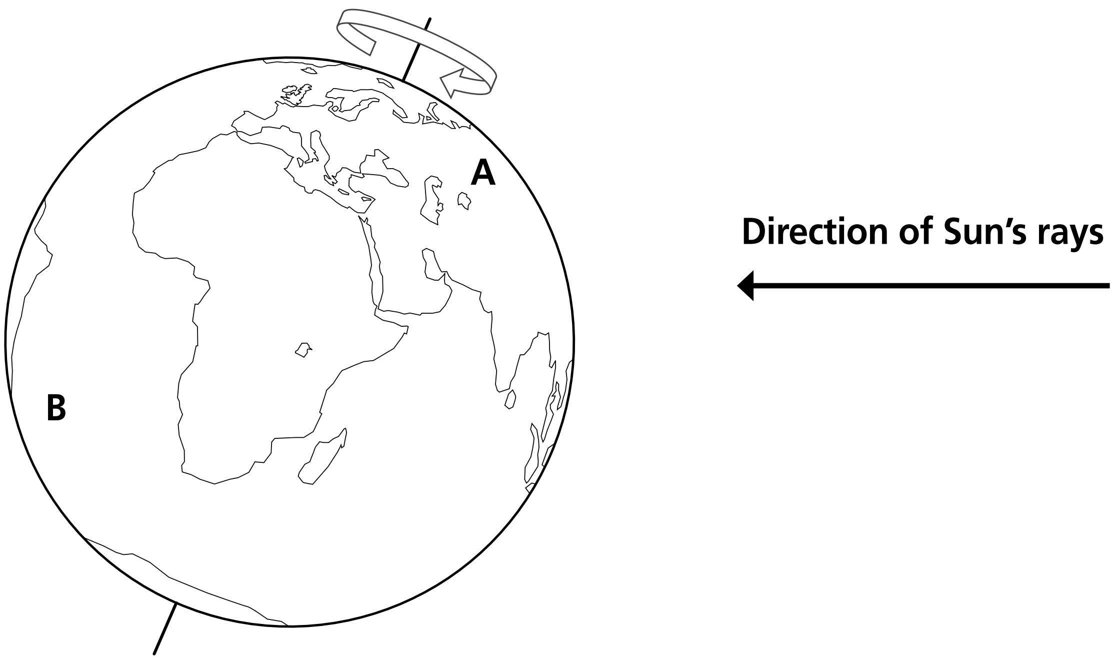
3

Name: .... Form: ....

See **pages 8 and 9** of *Earth and beyond*

Seasons

The Earth goes around the Sun once a year. This produces the seasons – spring summer, autumn and winter.



Q1. Shade in the part of the Earth which is in darkness.

Q2. In which place, A or B, does the Sun rise higher in the sky?

✎.......................

Q3. In which place, A or B, does the Sun stay in the sky for a shorter time?

✎.......................

Q4. What season is it at A.?

✎..

Q5. What will be the next season at B?

✎..

Q6. What causes the seasons as the Earth moves round the Sun?

✎..

3 Teacher's sheet: comprehension

See **pages 8 and 9** of *Earth and beyond*

Answers

1. **The left hand side of the Earth should be shaded. The line separating shade and light should run vertically down the globe and divide it into two halves.**
2. **A.**
3. **B.**
4. **Summer.**
5. **Spring.**
6. **The tilt of the Earth.**

Complementary work

(a) Introduce the word equinox – the period of equal night and day, and relate it to the Earth's position during the northern hemisphere spring and autumn. Also introduce the word solstice – the time when the Sun is highest or lowest in the sky at midday – and relate this to the Earth's position during the northern hemisphere summer and winter. The children can look for these words, on a calendar that features them, to find the dates.

(b) The children can use data about sunrise and sunset (available in newspapers daily or in desk diaries for the whole year) to plot graphs and see the pattern of change over the year. They can describe the pattern they see and link it to how day length varies over the year.

Teaching notes

Before the children begin this unit they should be secure in the knowledge from the previous unit that the Earth is a huge turning globe and that when it is light in some places it is dark in others. This unit takes the study of the movement of the Earth a stage further by considering the tilt and the path of the Earth around the Sun. It is best to demonstrate this and check the children's understanding at each stage.

First establish that the Earth moves round the Sun and that the Earth remains tilted in the same direction throughout its orbit. Do this by setting up a large sphere for the Sun, such as a beach ball, and moving a globe round it as shown on page 9 (Picture 2) of the pupil book.

Secondly, having established how the Earth moves round the Sun, look at this in terms of the amount of light shining on the Earth. Set up a globe tilting towards a lamp and show the children the area at the top which is in the light. Explain that this is the position in summer. Follow this by placing the globe so it is tilted away from the light and show that the top now has less light. This is the position in winter. Finally, show them the position when the Earth is 'sideways on' to the light and explain that this is the condition in spring and autumn.

You can also point out to the children that when they are in summer, the southern half of the globe is in winter (tilted away from the Sun).

3

Name: .... Form: ....

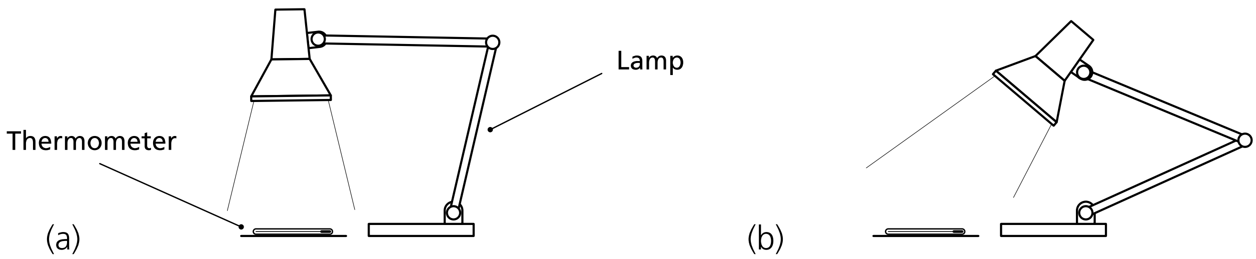
Based on **pages 8 and 9** of *Earth and beyond*

Investigating heat rays

Try this...

1. Put a thermometer on a piece of black paper and record its temperature.

2. Set up a desk lamp thirty centimetres above the thermometer, as shown in diagram (a), and leave it switched on for five minutes.



3. Record the temperature of the thermometer, then switch off the lamp and let it cool.

4. When the thermometer has returned to its original temperature, and the lamp is cool, set up the desk lamp as shown in diagram (b). Make sure the thermometer and lamp are about the same distance apart as before.

5. Record the temperature of the thermometer again, then switch on the lamp for five minutes.

6. Record the temperature of the thermometer then switch off the lamp and let it cool.

7. On the back of this sheet, or on a separate piece of paper, make a table for your results and fill it in.

Looking at the results.

8. Describe what the results show.

✎..

✎..

9. If you repeated the investigation with the light rays slanting even more how would you expect the temperature of the thermometer to change?

✎..

✎..

Teacher's sheet: activity

Based on **pages 8 and 9** of *Earth and beyond*

Introducing the activity

(a) Remind the children of how the maximum daily height of the Sun in the sky varies over the year. Demonstrate, using a torch and a piece of paper, how the amount of light shining on a place depends on whether the Sun is overhead or low in the sky (see note (i)). Explain that we now wish to find out if the rays of heat behave in a similar way.

Using the sheet

(b) Give out the sheet and let the children fill in their name and form then go through tasks 1 to 7 (see note (ii)).

(c) Let the children try the investigation and fill in the table as they go along.

(d) You may wish the children to write their answers to tasks 8 and 9 on the back of the sheet or on a separate piece of paper.

Completing the activity

(e) Let each group present their results to the other groups. Look for similarities in the results. Where any differences occur, challenge the children to discuss how the differences may have been produced.

(f) Link the results to the time of year when you have performed the investigation. Ask the children to predict how the temperature of their environment may change over the coming months and to explain their prediction.

Conclusion

The rays of heat from the Sun behave in a similar way to light rays. Just as an area is lit more brightly when the Sun is overhead than when it is lower in the sky, so an area is heated more strongly when the Sun is overhead than when it is lower in the sky.

Teaching notes

(i) Put the paper on the floor. Shine the torch from directly overhead. A small disc of bright light is seen on the paper. Now shine the torch at about the same height but from one side of the paper. An egg shaped area of weaker light is seen.

(ii) The children will need to produce a table. Thinking about what to include in the table is a good way to review the investigation plan and consider what is to be examined. You may also want to let the children discuss their ideas before steering them towards the following suggestion. The table should have four columns. The column titles: are 'Direction of rays', 'First temperature (°C)', 'Second temperature (°C)' and 'Temperature rise (°C)'. On the first line of the first column the phrase 'Straight down' should be written. On the second line the word 'Slanting' should be written (see example below).

Direction of rays	First temperature (°C)	Second temperature (°C)	Temperature rise (°C)
Straight down			
Slanting			

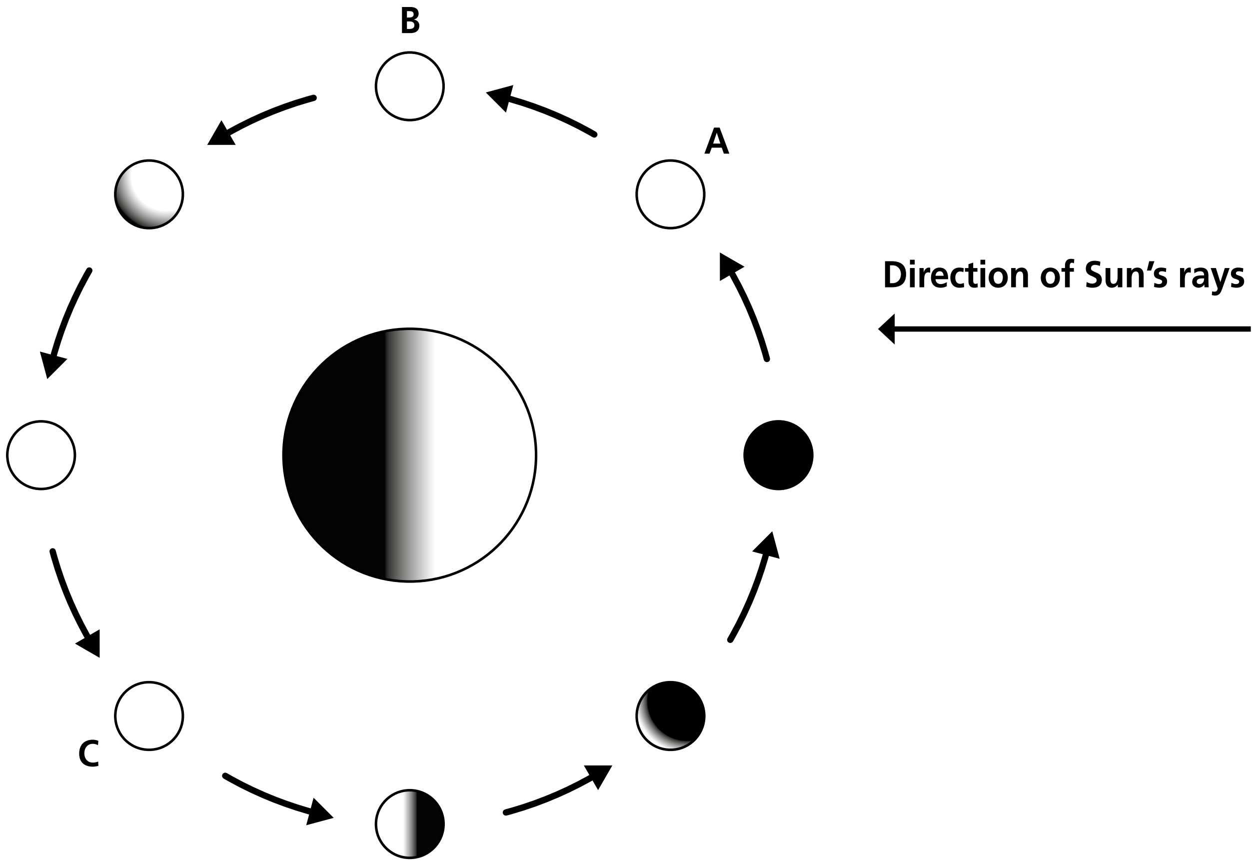
4

Name: .... Form: ....

See **pages 10 and 11** of *Earth and beyond*

How we see the Moon

The way we see the Moon depends on how we see the light it reflects from the Sun.



Q1. What is the path marked by the arrows?

✎...

Q2. How long does it take the Moon to go round the Earth?

✎..

Q3. Shade in how the Moon looks from Earth when it is at A, B and C.

Q4. Put an X on the position of the Moon when it is full.

Q5. Put a Y on the position of the Moon when it is new.

Q6. What makes the surface of the Moon light up?

✎...

Teacher's sheet: comprehension

See **pages 10 and 11** of *Earth and beyond*

Answers

1. **The orbit of the Moon around the Earth.**
2. **Just over 28 days – about a month.**
3. **A, unshaded Crescent towards Sun (waxing Crescent); B, Half Moon with the unshaded side towards Sun; C, shaded patch away from Sun (waning Gibbous).**
4. **The Moon on the far left of the Earth.**
5. **The Moon on the far right of the Earth.**
6. **The rays of the Sun.**

Complementary work

(a) If you look at the diagram on page 10 and 11, you will see that on the inner ring of Moons there is a red arrow on each Moon pointing at a crater. This shows how the Moon orbits the Earth. The children can be made more aware of this by letting them trace each Moon, starting with the New Moon. Each tracing should have the outline of the Moon and the crater. If the tracings are placed in a line the children can see how the crater moves anticlockwise as the Moon spins. The children may like to make a series of drawings based on their tracings and make a flick book to show how the Moon spins.

(b) The children can look at a newspaper weather or 'sky at night' section to find the current phase of the Moon. They can look in a desk diary, or perhaps a calendar, to see when New Moons, Full Moons or Crescent Moons can be seen throughout the year.

Teaching notes

In Unit 2 the children learned about how the Earth spins and how the changing position of the Moon in the sky is due to the movement of the Earth. In this unit they look at how the Moon itself moves.

In Unit 3 the pupils have seen that the Earth moves around the Sun, and may wonder how the Moon moves round the Sun, too. This will be dealt with in the next unit, when the relationships of the Earth, Sun and Moon are studied. In this unit the focus is on how the Moon moves round the Earth and the implications of this for the shape of the Moon we see in the sky.

It is important that the children realise that the Moon is not a luminous object. If it was, it would appear as a glowing globe every night. If the Sun was not present the Moon would just be a dark sphere of rock in space. The Moon is a huge reflector of sunlight.

4

Name: .... Form: ....

Based on **pages 10 and 11** of *Earth and beyond*

The phases of the Moon

Try this...

1. Every evening, look for the Moon and draw the part of it that is lit by the Sun. Make sure that you put the date on each drawing. Do this for a month.

Your record for each night should look like this:

Space for the date
Space for your drawing

You will need four or five sheets of paper for your drawings, one for each week in the month. On each sheet, draw a record box for each day of the week.

2. If the sky is cloudy do not draw anything that night.

Looking at the results.

3. Compare your results with the picture on pages 10 and 11 of your book. Are they more detailed or less detailed than the picture?

4. Describe any difficulties you had in making your observations.

✎...

✎...

✎...

5. Describe any other things you noticed in the night sky.

✎...

✎...

✎...

4

Teacher's sheet: activity

Based on **pages 10 and 11** of *Earth and beyond*

Introducing the activity

(a) Ask the children to look at the outer ring of Moons in the picture on pages 10 and 11 of the pupil book. Start by looking at the New Moon and move around the top of the page until the Full Moon is reached. Discuss how these pictures show the Moon as you would see it from Earth. Notice that the dark patches match those on the Moons in the inner circle. Now look at the three Moons in the lower part of the page. Explain that these also show how the Moon looks from the Earth, but their dark patches do not seem to match the patches on the Moons in the inner circle. This is because you have to imagine each of the inner circle Moons turned round to face you.

(b) In the activity, the children should try to look at the Moon every night for a month (see note (i)) to see if they can make a complete series of pictures showing how it changes.

Using the sheet

(c) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 5. Emphasise that they should look for other things in the night sky as they make their observations on the Moon.

(d) Let the children complete their activity as part of their homework.

Completing the activity

(e) Ask the children to compare their results and talk about difficulties such as bad weather and other things that they noticed (see note (ii)).

Conclusion

Over a period of one month, the phases of the Moon can be seen if there is a clear sky. In making one set of observations, other observations may be made which can then be investigated.

Teaching notes

(i) The phases of the Moon have been used by people for thousands of years to measure the passage of time. The word month comes from the word Moon, as people once measured a unit of time as being from one Full Moon to the next. They would measure in Full Moons or simply Moons.

(ii) The children may have noticed aeroplanes, stars with different colours, non-twinkling objects that change position every night (planets) and shooting stars. Each observation can lead to an investigation using secondary sources.

See also complementary work on Unit 8, page 47.

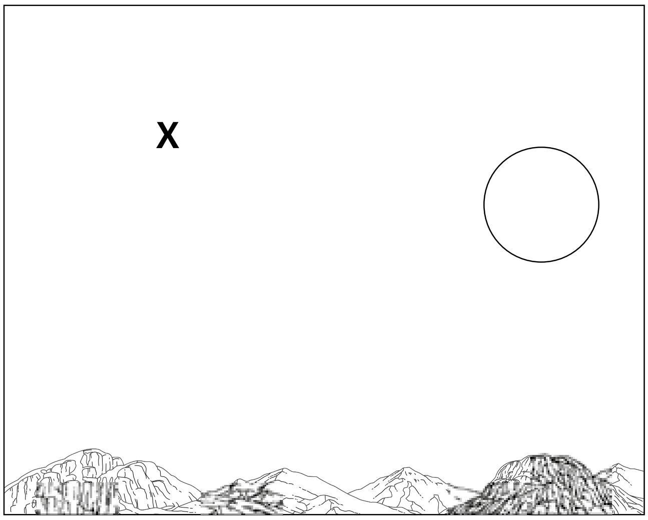
5

Name: .... **Form:** ....

See **pages 12 and 13** of *Earth and beyond*

The size of the Moon and Sun

The Moon is much smaller than the Sun but it appears to be the same size in the sky because it is much closer to the Earth.



Q1. Draw a Full Moon at point X in the sky.

Q2. Is the Sun (a) 10 times, (b) 100 times, (c) 1,000 times as wide as the Earth?

✎..

Q3. Is the Earth (a) 4 times, (b) 5 times (c) 8 times as wide as the Moon?

✎..

Q4. How can you make two pencils which are the same height appear to have different heights?

✎...

Q5. The Moon is much nearer the Earth than the Sun. How does this make them appear.

✎...

Q6. If you stood on the Moon and looked at the Earth would the Earth fill the sky? Explain your answer.

✎...

✎...

Teacher's sheet: comprehension

See **pages 12 and 13** of *Earth and beyond*

Answers

1. **It should be about the same size as the Sun.**
2. **(b) 100 times.**
3. **(a) 4 times.**
4. **Hold them at different distances from your eye.**
5. **They appear about the same size.**
6. **No. It would look small because the Earth is a long way from the Moon.**

Complementary work

(a) If the children have observed planets in the sky they could make models of them to the same scale as the Earth, Moon and Sun model. The planets most likely to be observed are Venus (roughly the same size as the Earth), Mars (half the size of the Earth), Jupiter (about 12 times larger) and Saturn (about 10 times larger). All these planets appear much smaller than the Moon in the sky. If the children make models, they should stick the planet on a wall, hold up the tiny Moon next to it, then carefully walk backwards until the planet appears smaller than the Moon.

Scale is also studied in the activity in Unit 8.

Teaching notes

The children may be working on the activity in Unit 4 for homework while they are studying this and subsequent units in the pupil book. It may be useful to ask about the observations in their homework and perhaps incorporate some of them into the work here. For example, the children may have seen a planet, found out what it was from the 'sky at night' column in a paper and looked up its dimensions. This can be used as a basis for complementary work.

After the children have read the introduction to this unit you may like to stop and ask them to consider the Earth as having a diameter of one centimetre. Let the children cut out a circle one centimetre in diameter. Direct the children back to the introduction to work out how big the Moon should be, using the same scale as the Earth (0.25 centimetres), and ask them to make a Moon that is in proportion to the Earth. Now ask them to estimate the size of the Sun on the same scale (one metre) and after they have done that, you can present the class with a one metre diameter disc. Let them hold their scale model Moons towards the model Sun and compare their sizes. If possible, move the Sun back as far as you can, or go in the hall, playground or sports field to enable them to see the two objects appear the same size. This activity will help them realise the great distance between the Sun and the Moon.

5

Name: .... Form: ....

Based on **pages 12 and 13** of *Earth and beyond*

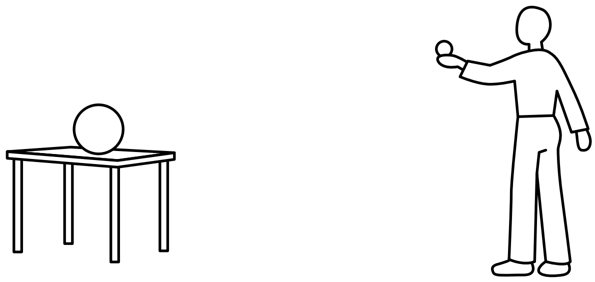
Size and distance

Try this...

1. Make a collection of round objects such as a marble, tennis ball, football, orange, apple, onion.

2. Put the largest object on a table by a wall. Arrange the other objects in order of size starting with the largest.

3. Take each object in turn, hold it in an outstretched hand (see diagram) and carefully move backwards until it appears the same size as the large object.



4. Put down the object you were holding at the distance it appeared the same as the large object.

5. Measure the distance between the two objects.

6. Record your results in a table on the back of this sheet, or on a separate piece of paper.

Looking at the results.

7. Which pair of objects had the greatest distance between them?

✎... ✎...

8. Which pair of objects had the least distance between them?

✎... ✎...

9. How does the distance change as you change the objects?

✎...

10. Find another object that you have not tested. Predict the distance that will be needed to make it appear the same size as the large object, then test your prediction.

Teacher's sheet: activity

Based on **pages 12 and 13** of *Earth and beyond*

Introducing the activity

(a) In the demonstration for the introduction to Unit 5, we investigated the idea that the distance between objects could make them appear the same size. In this activity, the children have to work out if there is a pattern or relationship between the sizes the objects appear and the distance between them.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form and go through tasks 1 to 6 (see note (i)).

(c) Let the children collect their objects and fill in the first column of the table (see note (ii)).

(d) Let the children carry out the practical tasks and fill in the table.

(e) Let the children try tasks 7 to 9 (see note (iii)).

Completing the activity

(f) Tell the children that when a relationship or pattern has been discovered it can be used in the prediction of further results. Give the children an object that they have not already used and ask them to try task 10.

(g) Let the children compare their work on task 10.

Conclusion

When a phenomenon like two different-sized objects appearing to be the same size is investigated, a relationship can often be established and used in the prediction of further results.

Teaching notes

(i) It may be best to go through all of the practical work with the children to make them familiar with each aspect. Having done that, direct them to construct a table. It should have two columns. The headings should be 'Object' and 'Distance to largest object (cm)'. The name of the large object used should be written in the second column. The table will then need about six lines (see example below).

(ii) The objects should be in order of size, starting with the largest.

(iii) The objects with the greatest distance between them will be the ones which differ most greatly in size. The objects with the least distance between them will be the ones with the least difference in size. The greater the difference in size between the objects, the larger the distance needed to make them appear to be the same size.

Object	Distance to largest object (cm)

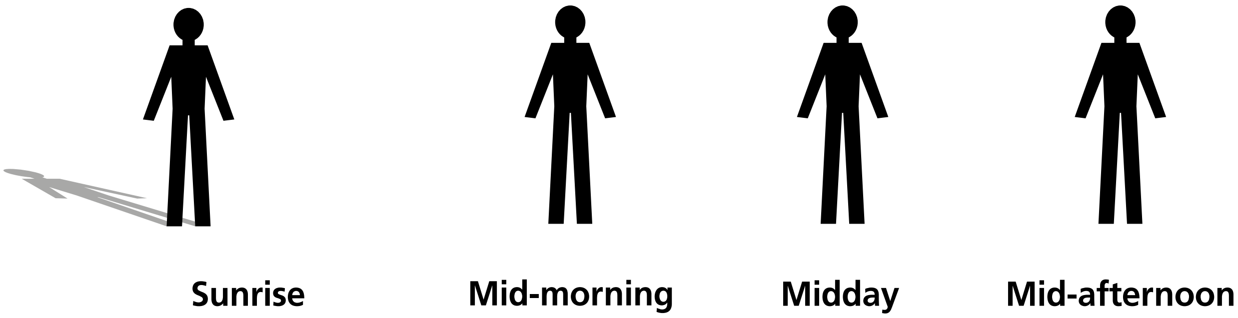
6

Name: .... Form: ....

See **pages 14 and 15** of *Earth and beyond*

Shadows and eclipses

When sunlight is blocked, it casts a shadow. This is true for both small objects like a tree and for large ones like the Moon.



Q1. Draw how the shadow appears at mid-morning, midday and mid-afternoon.

Q2. Why is a shadow cast when sunlight strikes an object?

✎...

✎...

Q3. If the Sun is shining in the east, in which direction does the shadow of an object lie?

✎...

Q4. When you look at the shadow of an object at two different times, and you find that the shadow is getting longer, is it morning or afternoon?

✎...

Q5. When does an eclipse take place?

✎...

✎...

Q6. What is the difference between a total eclipse and a partial eclipse?

✎...

✎...

Teacher's sheet: comprehension

See **pages 14 and 15** of *Earth and beyond*

Answers

1. **Mid-morning: Shorter than at sunrise but pointing in the same direction. Midday: Shorter than mid-morning and pointing vertically. Mid-afternoon: The same length as mid-morning but pointing in the opposite direction.**

2. **Light travels in straight lines and cannot bend around the object. The rays of light are stopped by the object, so on the other side there is no light, only darkness, and this makes a shadow.**

3. **West.**

4. **Afternoon.**

5. **When the Earth, Moon and Sun are in line.**

6. **In a total eclipse, the Moon blocks out all light coming from the Sun and the ground below it is in darkness. In a partial eclipse, only part of the Sun is covered and the ground below is in some shade.**

Complementary work

(a) Set up a large ball as the Sun. Have one of the children walk round the ball holding a globe. Make sure the tilt of the Earth always points in the same direction. Now ask the child to use a smaller ball, such as a tennis ball, as the Moon, and move it in orbit round the Sun. If possible, let the child try to perform the orbit of the Earth and the Moon at the same time. Note that the Moon comes between the Sun and Earth every month, but as the Moon's orbit is at a slight angle to the Earth's, they rarely line up directly with the Sun. When they do, an eclipse occurs.

(b) Set up a globe, tennis ball and lamp to show how an eclipse takes place and a shadow is cast on the globe.

Teaching notes

It may have been two years since the children studied light so it may be helpful to run through the idea that objects may be opaque or transparent, and that opaque objects cast shadows because light cannot pass through them. They will have studied shadows before and some time can be spent asking the children what they know about shadows, then relating it to the text on page 14.

Having consolidated earlier work on shadows, the children can then move on to consider how an eclipse of the Sun occurs. The children should realise that not everywhere on Earth is in the Moon's shadow when an eclipse occurs.

6

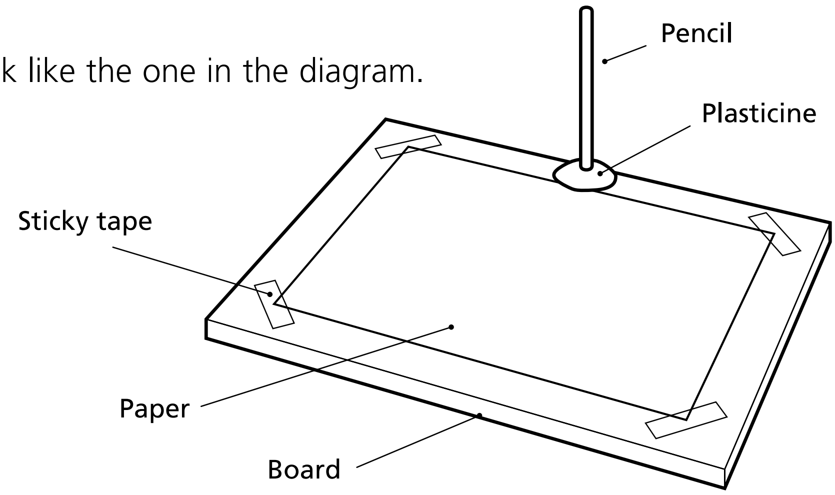
Name: .... Form: ....

Based on **pages 14 and 15** of *Earth and beyond*

Shadow clock

Try this…

1. Set up a simple shadow clock like the one in the diagram.



2. Put the shadow clock on a table near a sunny window or set it up in a sunny part of the playground or sports field.

3. Use a compass to find the direction of north, east and west and mark the directions in the corners of the paper.

4. Start as early in the day as you can. Mark the length and direction of the shadow every half hour and record the time. If there is no shadow at certain times just make a note. You will need your notes later.

5. On the back of this sheet, or on a separate piece of paper, make a table of the shadow length throughout the day. Include times when no shadow was present.

6. Make a bar graph of the results in the table.

Looking at the results.

7. How did the direction of the shadow change during the day?

✎..

8. How did the length of the shadow change during the day?

✎..

9. If there are any gaps in the graph, try to predict what the shadow length should have been. Draw in the prediction bars with P written on them.

6

Teacher's sheet: activity

Based on **pages 14 and 15** of *Earth and beyond*

Introducing the activity

(a) In the previous activity the children saw how observations may be linked together to discover patterns.

(b) We see shadows whenever we look out on a sunny day, but rarely consider how they change over time. Only by studying the shadow of an object at regular intervals can a pattern be seen in the way it changes.

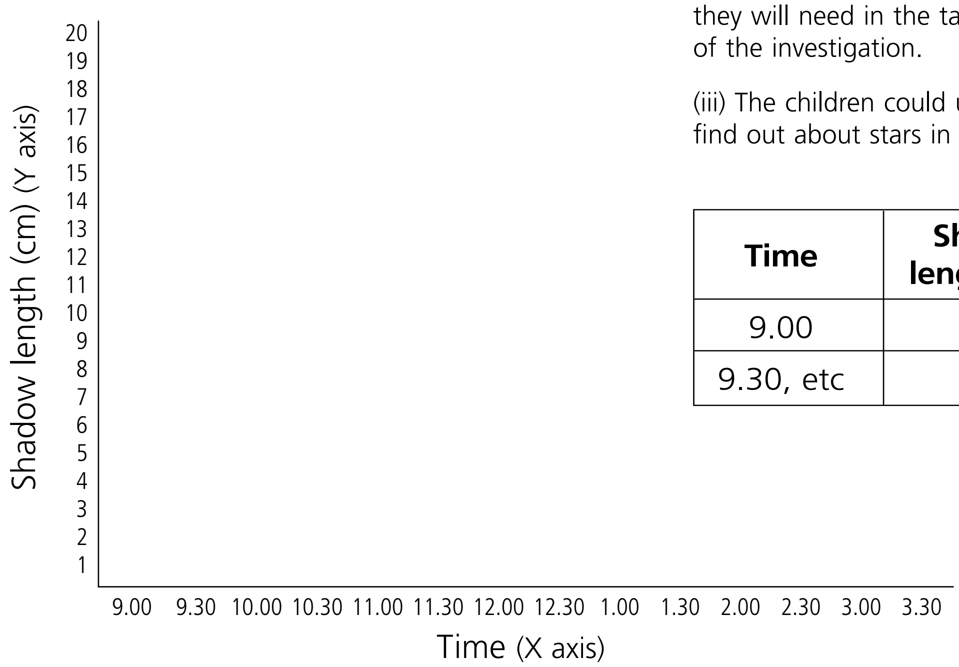
Using the sheet

(c) Give the children the sheet, let them write their names and form on it, then go through tasks 1 to 5 with them (see note (i)).

(d) Let the children make a table (see note (ii)).

(e) Let the children carry out the investigation (see note (iii)).

(f) The children can then make a bar graph of their results. Time runs along the X axis and shadow length runs up the Y axis (see example below).



Completing the activity

(g) The children complete tasks 7 to 9.

(h) The children may assess the accuracy of each other's predictions.

(i) Ask the children to look at the directions of the shadows and describe how they changed during the day.

Conclusion

During the day, shadows shorten until midday, then they lengthen again. They point west in the morning, north at midday and east in the afternoon.

Teaching notes

(i) It may be helpful to go through the sheet the day before the planned investigation so that every one is familiar with what to do and where the individual shadow clocks will be placed. Although the children will have studied shadows before, they are now making a more detailed study and more sophisticated presentation of their results.

(ii) The table should have three columns with the headings 'Time', 'Shadow length (cm)' and 'Shadow direction' (see example below). The children should be able to decide how many lines they will need in the table to match the duration of the investigation.

(iii) The children could use secondary sources to find out about stars in readiness for Unit 7.

Time	Shadow length (cm)	Shadow direction
9.00		
9.30, etc		

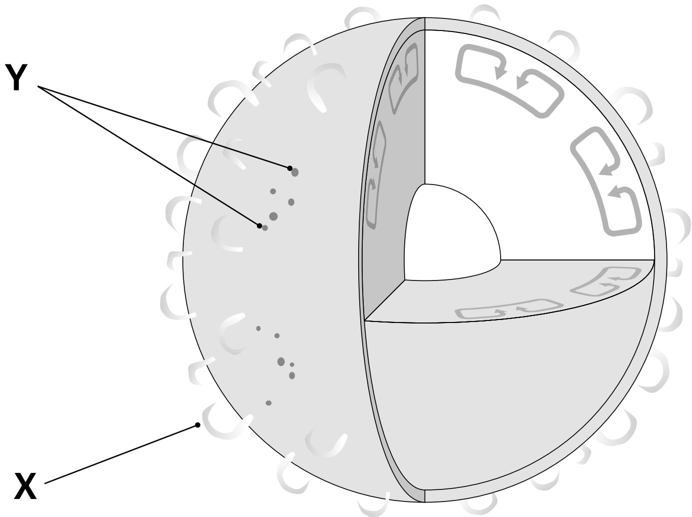
7

Name: .... Form: ....

See **pages 16 and 17** of *Earth and beyond*

The Sun

The Sun is a star. Its burning gases produce sunlight.



Q1. What is the temperature at the centre of the Sun?

✎..

Q2. What are the parts of the Sun labelled X and Y?

X ✎.. Y ✎..

Q3. Why doesn't the Sun twinkle like the other stars?

✎..

Q4. What does sunlight provide for life on Earth?

✎..

Q5. How does the Sun stop the Earth from flying away into space?

✎..

✎..

Q6. What is the temperature difference between the core and the surface of the Sun?

✎..

7 Teacher’s sheet: comprehension

See **pages 16 and 17** of *Earth and beyond*

Answers

1. **The temperature of the core, or centre, of the Sun is 15 million°C.**
2. **X is a solar flare, Y are sunspots.**
3. **Because it is so much closer to us than any other stars.**
4. **Energy.**
5. **The Sun’s pulling force, or gravity, pulls on the Earth. It makes the Earth go round the Sun.**
6. **14,994,000°C.**

Complementary work

(a) The children can use secondary sources to find out about the ‘life cycle of a star’. They could try and find out what will happen to the Sun.

(b) The children can find out about constellations and perhaps look out for them when they are doing their homework on phases of the Moon (see Activity plan 4).

Teaching notes

Children tend to think that the Sun is not a star and is somehow different. The Sun is in fact a yellow dwarf star, of which there are billions in the Universe. The only unusual thing about the Sun is that it is so close to us.

In Unit 1, the origin of the Sun and the Solar System was discussed. You could remind the children of that discussion and extend it by saying that stars occur together in huge groups called galaxies. Our galaxy is called the Milky Way galaxy, because of its appearance in the sky, and there are 500,000 million stars in it. There are thought to be over 100,000 million galaxies in the Universe.

Also in Unit 1, the children learned about the distances between the planets and that they could be measured in millions of kilometres. The distance between stars is so great that this unit of measurement is rarely used and the unit called the light-year is used instead. This is the distance a beam of light travels in one year. One light-year equals 9.5 million million kilometres. To help the children use time as a measurement of distance, you may want to tell them that the Sun is eight light-minutes from the Earth. The next nearest star is just over four light-years away and many stars in the night sky are over a hundred light-years away.

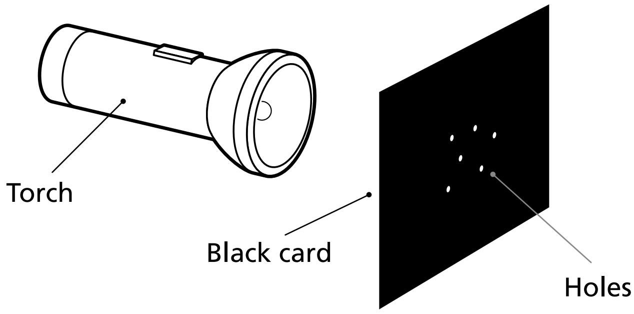
We group stars into constellations. This is not a natural grouping, but is based on what people thought the stars represented in the night sky. The stars in a constellation may be great distances from each other. For example, in the Plough, or Great Bear constellation, one star is 68 light-years away from the next star in the constellation while another is 210 light-years away.

7

Name: .... Form: ....

Based on **pages 16 and 17** of *Earth and beyond*

Star brightness



Try this…

1. Take a piece of black card and put some pin holes in it.

2. Put the card in front of a torch in a dark room and look at the light shining though the holes. The holes appear like stars.

3. Walk carefully backwards until you can no longer see the individual 'stars'. Measure the distance between you and the card.

4. Now make the holes 2 millimetres (mm) across. Predict how far back you would have to go before you could no longer see them, then walk backwards to find out the answer.

5. Repeat task 4 with holes 3mm across.

6. Repeat task 4 with holes 4mm across.

7. Repeat task 4 with holes 5mm across.

8. Use this table for your results.

Hole size (mm)	Prediction (m)	Actual distance (m)
Pin prick		
2		
3		
4		
5		

Looking at the results.

9. How good were your predictions?

✎...

10. What is the relationship between the brightness of a star and the distance at which it is visible?

✎...

✎...

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Earth and beyond*

Introducing the activity

(a) Ask the children about any observations on stars that they have made and note any comments about brightness. Ask the children how the brightness of a star affects its visibility.

(b) Challenge the children to devise a test without using real stars (see note (i)).

(c) Remind the children about how they have been using a prediction in their investigations. In this one they have four predictions to make in turn so they can see if their prediction skills improve during the investigation (see note (ii)).

Using the sheet

(d) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 8.

(e) Let the children perform tasks 1 to 8.

Completing the lesson

(f) Go through tasks 9 and 10.

(g) Let the children use secondary sources to find information about constellations such as the Plough, Orion and Cassiopeia. Look for sources which give an indication of the brightness of the stars in the constellation. Let the children make constellations on black card and test them by predicting which stars will be visible from the greatest distance (see note (iii)).

Conclusion

The brightness of the star affects the distance at which it is visible. A bright star is visible for a greater distance than a dim star.

Teaching notes

(i) Encourage original ideas and suggestions. Keep a note of these for later and let the children develop them. The emphasis is on developing ways of testing ideas about the Universe without actually using the Universe. Eventually, steer the class towards the activity on the sheet.

(ii) Children sometimes lack confidence in making predictions, especially when having to cope with a seemingly complex investigation. Here the investigation is fairly simple, so after finding the distance needed for the first holes they made, they have a starting point for making their predictions. By the end of the investigation they should understand the use of prediction to determine where they stand to test the distance at which a 'star' can be seen.

(iii) If an astronomy night could be organised, the children could look for the constellations in the night sky. They could identify many constellations and perhaps make a set of constellation recognition cards for the school.

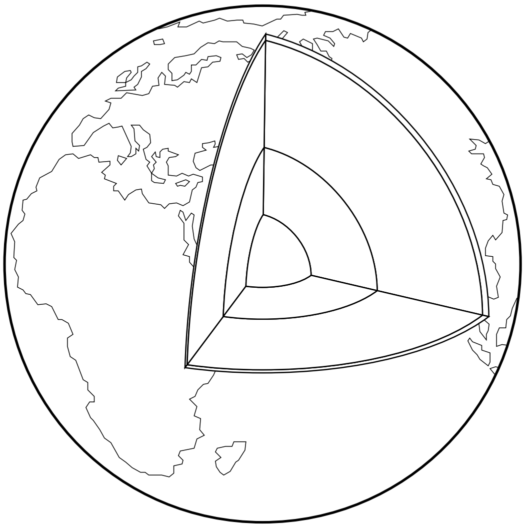
8

Name: .... Form: ....

See **pages 18 and 19** of *Earth and beyond*

The rocky planets

The Earth is one of five planets in our Solar System that are made of solid rock. The Moon is also rocky and bigger than the smallest planet.



Q1. On the diagram put (a) an X where there is a huge amount of liquid iron, (b) a Y where there is cold hard rock, (c) a Z where there is hot liquid rock.

Q2. What is the name of the region inside the Earth where hot liquid rock is found?

✎..

Q3. How does the air affect the temperature of the Earth?

✎...

Q4. (a) Which planet is second from the Sun? (b) How long is a day there? (i) 43 Earth days, (ii) 143 Earth days, (iii) 243 Earth days?

(a) ✎... (b) ✎.....................................

Q5. Which rocky planet is smaller than our Moon?

✎..

Q6. Describe the surface of Mars.

✎...

✎...

Teacher's sheet: comprehension

See **pages 18 and 19** of *Earth and beyond*

Answers

1. **X is at the core, Y is at the surface, Z is the mantle.**
2. **The mantle.**
3. **It makes the Earth warmer than it would otherwise be.**
4. **(a) Venus, (b) (iii) 243.**
5. **Pluto.**
6. **It has a dry rock surface covered with orange sand that is swirled about in the wind. There are great valleys, plains and giant mountains. There are ice caps.**

Complementary work

(a) The children can look in the weather and sky section of a broadsheet Sunday newspaper to find the planets that are present in the sky for the coming week, and look for them when they are doing their homework on phases of the Moon.

Teaching notes

Planets are not luminous and shine by reflected sunlight just like the Moon. They can be distinguished from stars by the way their light passes through the atmosphere. Planets are much nearer to the Earth than the stars and so their reflected light is much stronger than starlight. The movement of the gases and the particles in the atmosphere make rays of weak light bend in a wavy motion, but strong light is unaffected. The weak light from a star, when viewed from Earth, appears to twinkle because its rays have been bent to and fro by the atmosphere. The stronger light from a planet shines straight through the atmosphere, so the planet shines with a steady light.

The easiest planets to see are Venus and Mars, because they are close, and Jupiter, because it is very large and nearer to us than the other large planets. Saturn may also be seen but Uranus is much dimmer and very difficult to see. A telescope is needed to see Neptune and Pluto. Mercury is very close to the Sun and can sometimes be seen briefly above the horizon just before sunrise or just after sunset. Mars can be distinguished from the other planets by its orange-red light, due to the colour of the rocks on its surface.

8

Name: .... Form: ....

Based on **pages 18 and 19** of *Earth and beyond*

The sizes of the planets

Try this…

1. Make a scale model of the planets in the Solar System by comparing each planet with the size of the Earth. Using this scale, if Earth = 1, a planet about half the size of the Earth is O.5 and a planet ten times the size of the Earth is 10. When you make your model, if you choose the size of the Earth to be 2cm, then a planet half its size will be 1cm and a planet ten times its size will be 20cm across.

The table below shows how the size of the planets compares to Earth when the scale of the Earth = 1. Chose a different size scale for your Earth. Enter it in the table. Work out the sizes of the other models and enter them in the table.

Planet Size	Size compared to Earth	Size of model (cm)
Mercury	0.4	
Venus	1	
Earth	1	
Mars	0.5	
Jupiter	11	
Saturn	10	
Uranus	4	
Neptune	4	
Pluto	0.2	

2. Make a paper disc for each planet and use the pictures in your book to help you colour it in.

3. Arrange the planets in order.

4. Look for a pattern in the sizes of the planet and describe what you see.

✎...

✎...

✎...

5. The Sun is 109 times the size of the Earth. How can you make a model of it to complete your Solar System? (use the back of this sheet if you need more space)

✎...

8

Teacher's sheet: activity

Based on **pages 18 and 19** of *Earth and beyond*

Introducing the activity

(a) You may remind the children about the scale model of the Solar System they made in Activity 1. Tell them that using the same method to make planet models will require a large amount of paper. For example, if one centimetre was used to represent 1,000 kilometres, then the size of the Earth would be 12.7 centimetres across, which is acceptable, but the size of Jupiter would be 143 centimetres across, which would need a large amount of paper. To solve this problem we compare all the other planets to the size of the Earth.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1.

(c) Let the children try task 1 and check their work.

(d) Let the children try tasks 2 to 5 (see note (i)).

Completing the lesson

(e) Let the children display their Solar Systems and compare their ideas about a pattern in the sizes of the planets (see note (ii)).

(f) See if any model has a scale which could be used to make a Sun or part of the Sun (see note (iii)).

(g) You may like to use the largest scale model to repeat activity 1 in front of the whole class (see note (iv)) as a revision exercise.

Conclusion

As you move away from the Sun, the planets at first increase in size, then starting with Jupiter, they decrease in size. Mars is unusual as it is smaller than the Earth yet farther from the Sun than the Earth.

Teaching notes

(i) Some children may like to put rings around Saturn. The diameter of the rings is two and a half times the diameter of the planet.

(ii) Children may see a general pattern, in that the size of the planets increases, then decreases, as you move away from the Sun and that Mars is an exception in this general trend. In reality, as the swirling disc of dust and gases formed the Solar System, the heavier rocky material settled closer to the Sun and the gases settled around rocks further out to make the gas giants. Pluto is unusual in that it is a rocky planet which appears in the wrong place. It may once have been a large asteroid that changed its orbit.

(iii) You may like to mark out just part of the curve of the Sun, to scale, on paper, colour it yellow and compare it with the planets.

(iv) Note that the scale of sizes of the planets is not the same scale as the distances between them. They are shown just to help the children visualize the Solar System.

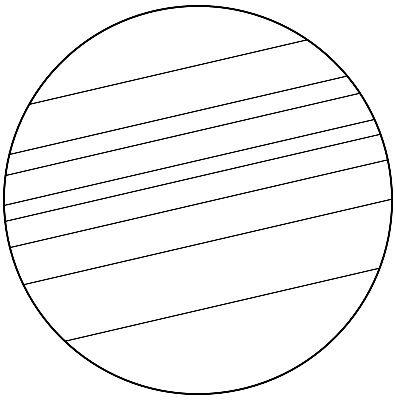
9

Name: .... Form: ....

See **pages 20 and 21** of *Earth and beyond*

The giant gas planets

The outer planets are huge compared to the Earth, and made mainly of gas. Jupiter is almost big enough to be a sun.



Q1. The diagram shows Jupiter. In the space next to it draw Saturn and Neptune to the same scale.

Q2. There is a planet that is found between Saturn and Neptune. What is it?

✎..

Q3. Which planet has the Great Red Spot?

✎..

Q4. What is the Great Red Spot?

✎..

Q5. Which planet in the Solar System has the most moons?

✎..

Q6. What do you find at the centre of gas giant planets?

✎..

Teacher's sheet: comprehension

See **pages 20 and 21** of *Earth and beyond*

Answers

1. **Saturn is a little smaller than Jupiter and has a ring system. Neptune is a little less than half the diameter of Saturn.**
2. **Uranus.**
3. **Jupiter.**
4. **A storm that is bigger than the Earth.**
5. **Saturn.**
6. **Rocky cores.**

Complementary work

(a) The children could use secondary sources to find out more about the moons of each of the gas giants. Some are quite small and occasionally new ones are identified.

(b) Newspaper articles could be collected about the discovery of new solar systems around other stars. These discoveries are made by watching for stars that wobble. Their movement is due to the gravity of large planets, like our gas giants, pulling on the star as they go round it.

Teaching notes

As our Solar System formed, some of the lighter materials (gases) were flung out from the centre and settled on large lumps of rock. Each lump of rock became the rocky core of a gas giant. Jupiter has a gas mixture similar to the Sun's mixture of hydrogen and helium. The heat and light that is produced in the Sun is a result of tremendous pressure inside the Sun, due to its own gravity. This squashes the hydrogen so much that it turns into helium. This is a nuclear reaction not unlike some that are used on Earth to generate energy. On Jupiter there is just not enough gas or gravity to get the reaction going.

Saturn has an atmosphere of hydrogen and helium. It also has clouds of ammonia.

Uranus and Neptune are blue, but this colour is not due to water, it is due to methane – the same gas used in cookers.

Although Jupiter has the greatest storm in the Solar System, Neptune has the strongest winds – they travel at over 2200 kilometres per hour.

The gas giants have many moons. The four largest moons of Jupiter can be seen through binoculars.

One of Jupiter's moons, Europa, is covered in ice which is thought to have an ocean of water beneath it. Volcanoes on the ocean floor may provide energy for living things just as they do in the oceans on Earth. Space probes are being designed to investigate Europa further.

Name: .... **Form:** ....

Based on **pages 20 and 21** of *Earth and beyond*

A closer look at the planets

Try this…

1. Venus spins in the opposite direction to the Earth. Use a globe and torch as the Sun and Earth, to remind you about how day and night occur. Then use the globe and torch as Venus and the Sun and explain how day and night would be different on Venus.

✎...

✎...

2. Uranus is unusual in that it spins on its side. Like the Earth, it always keeps its pole pointing in the same direction as it moves round the Sun. Draw a picture of Uranus in orbit round the Sun. Use the picture on page 9 of your book to help you.

3. Find out how long it takes Uranus to make its orbit on page 21 of your book. Work out how long each season lasts and write it on your picture.

4. How would summer and winter on Uranus be different from summer and winter on Earth?

✎...

✎...

Teacher's sheet: activity

Based on **pages 20 and 21** of *Earth and beyond*

Introducing the activity

(a) Begin by saying that the conditions on other planets are far different from the conditions here, not only in terms of temperature and length of year, but sometimes in the way a planet moves. For example, Venus spins in the opposite direction to the Earth and Uranus spins on its side. These two facts give us clues to how conditions on these planets are different from on Earth.

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through task 1.

(c) Let the children complete task 1.

(d) Go through tasks 2 to 4 (see note (i)).

(e) Let the children try tasks 2 to 4.

Completing the lesson

(f) Let the children compare their answers. You may like the children to speculate on how the shadows cast by a sundial on Venus would be different from those on Earth (see note (i)). They could think about how life on Venus or Uranus would be different from Earth. If they could live on Uranus they would take a whole human lifetime to travel one orbit (see note (ii)).

Conclusion

On Venus the Sun rises in the west and sets in the east. The stars and planets move in the opposite direction across the sky.

Uranus takes 84 years to orbit the Sun, so each season lasts 21 years.

In summer on Uranus, the Sun would not set for 21 years and in winter it wouldn't rise for 21 years.

Teaching notes

(i) In fact, Venus is covered with thick cloud. Although light gets through, it is reflected off the clouds, so you cannot see shadows or use a sundial. The clouds hold so much heat, that it is 480°C on the planet's surface so you could not survive to read the sundial anyway. Another condition on the planet that would ensure you did not survive is the pressure of the air, which is 90 times our air pressure. Also, the air on Venus contains large amounts of carbon dioxide gas which would suffocate you and it rains corrosive sulphuric acid which would dissolve you.

(ii) It is important to establish that these are science facts even though they seem like science fiction. You may challenge the children to look for more unusual facts about the Solar System and space which seem like science fiction. It may be worth mentioning that it is these unusual facts that have stimulated some people to take up a career in science to find out more.

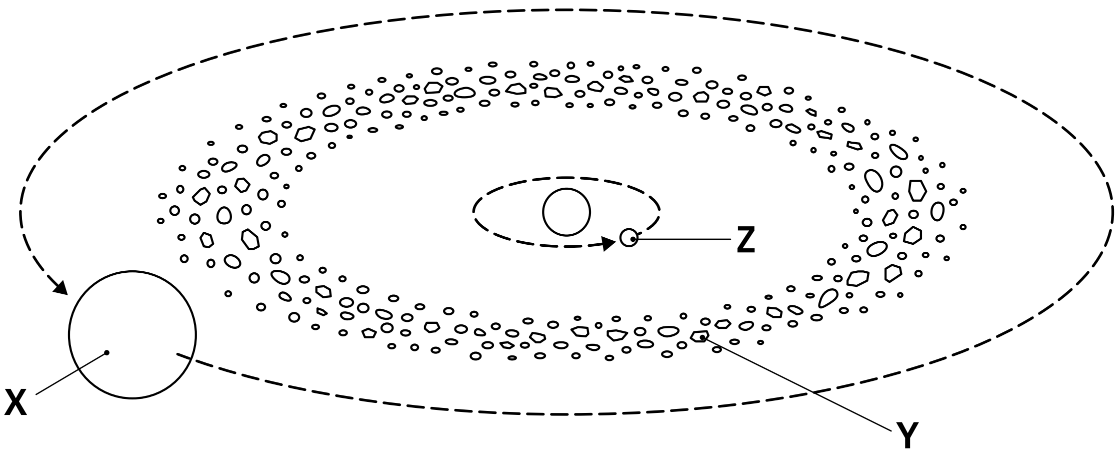
10

Name: .... Form: ....

See **pages 22 and 23** of *Earth and beyond*

Comets and asteroids

The Solar System contains a large number of small pieces of rock and ice. These are called asteroids, meteoroids and comets.



Q1. Name the objects labelled X, Y and Z in the diagram.

X ✎................................ Y ✎................................ Z ✎................................

Q2. What are small rocky bodies that are scattered through space?

✎...

Q3. What are made of rock and ice and are a few kilometres across?

✎...

Q4. What is a shooting star?

✎...

✎...

Q5. What forms a crater when it hits the Earth?

✎..

Q6. How is a comet's orbit different from a planet's orbit?

✎...

✎...

Teacher's sheet: comprehension

See **pages 22 and 23** of *Earth and beyond*

Answers

1. **X is Jupiter, Y is an asteroid, Z is Mars.**
2. **Meteoroids.**
3. **Comets.**
4. **It is a piece of rock about a few centimetres across that burns up in the night sky and makes a faint flash of light.**
5. **A large meteoroid.**
6. **It is very elongated (elliptical). In one part of its orbit it comes very close to the Sun. In another part of its orbit it is a great distance from the Sun.**

Complementary work

(a) The children can do research, using secondary sources, to find about recent comets.

(b) They can find out about Comet Shoemaker-Levy 9, which hit Jupiter in 1993.

Teaching notes

In Unit 9 it was mentioned that Jupiter has failed to be a star, but even so, its massive gravitational pull affects other parts of the Solar System. When the rocky fragments were joining together to make planets, Jupiter's gravity prevented many of these fragments from joining and they instead formed a huge ring, sometimes called the asteroid belt. There are other, smaller rings of asteroids too. Scientists have speculated on the size of the planet the asteroids would have made if Jupiter had not prevented them from forming a planet. The size of this planet would be only one thirty-third the size of the Moon.

It is believed that the Solar System is surrounded by a huge ring of icy rocks. It is called the Oort cloud after the astronomer who suggested its presence. It is thought that this is where the comets come from. As the Solar System moves through space some of these icy rocks become displaced and are pulled in around the Sun to become comets.

Dust and gas are released into space as a comet forms a tail. When the Earth passes though the path of a comet the dust that remains strikes the atmosphere and forms shooting stars. The Earth passes through these paths regularly and at the same time every year. The meteor showers that are produced can be spectacular. In the autumn, the meteor showers called Orinids (15th to 25th October), the Leonids (15th to 17th November) and the Geminids (9th to 13th December) can be seen. In the spring there are the Lyrids (19th to 22nd April) and the Aquarids (May 1st to 13th).

10

Name: .... **Form:** ....

Based on **pages 22 and 23** of *Earth and beyond*

Making craters

Try this…

1. Put a box or plastic bowl of dry sand on the floor. This represents the surface of the Moon.

2. Make a collection of objects to drop into the sand. Each one represents a meteoroid.

3. Think about the width of the crater that each object will make. Arrange the objects in order starting with the one that you think will make the smallest crater. Write down the order of objects from smallest crater to largest crater.

✎...

4. Drop each object from the same height above the sand. Measure the width of the crater each object makes.

5. Arrange the crater widths in order of size starting with the narrowest.

6. Compare your arrangement of the objects with the arrangement of crater widths. How closely do they match?

✎...

7. Think about the depth of the crater that each object will make. Arrange the objects in order starting with the one that you think will make the shallowest crater. Write down the order of objects from shallowest crater to deepest crater.

✎...

8. Drop each object from the same height above the sand. Measure the depth of the crater each object makes.

9. Arrange the crater depths in order of size starting with the shallowest.

10. Compare your arrangement of the objects with the arrangement of crater depths. How closely do they match?

✎...

11. If you dropped the objects from a greater height, what changes would you expect to see in the craters they made?

✎...

10 Teacher's sheet: activity

Based on **pages 22 and 23** of *Earth and beyond*

Introducing the activity

(a) You may begin by saying that large numbers of rocky fragments in space hit the Earth's atmosphere every day but most burn up as they fall through the air (see note (i)). Very occasionally a large meteoroid crashes into the Earth. When it does, it leaves a crater (see note (ii)). Most craters on the Earth have been worn down by the weather but on the Moon, where there is no atmosphere, weathering does not take place and craters can be seen that were formed millions of years ago (see note (iii)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through tasks 1 to 3.

(c) Let the children try tasks 1 to 3

(d) Go through tasks 4 to 6.

(e) Let the children try tasks 4 to 6.

(f) Go through tasks 7 to 10.

(g) Let the children try tasks 7 to 10.

(h) Let the children try task 11.

Completing the lesson

(i) Let the children report on their findings and compare results. Let them share ideas about task 11.

Conclusion

Large objects make wider craters than small objects. Heavy objects make deeper craters than light objects. Some small objects may make deeper craters than some large objects. When an object is dropped from a greater height, the depth of the crater increases but the width of the crater stays the same (unless the widest part of the object did not make the crater in the first trial).

Teaching notes

(i) It has been estimated that 75 million meteors enter the atmosphere every day. Nearly all burn up due to the heat of friction as they rush through the air. Perhaps 500 reach the Earth's surface and of these, most fall in the sea. Usually those that land on Earth are very small and are not noticed.

Since meteors are mostly iron, they very quickly rust away and disintegrate in the presence of water. The largest number of meteors is found in one of the driest places on Earth – Antarctica.

(ii) The frequency of crater formation may be once in hundreds of thousands or millions of years. A large comet that exploded a few hundred feet from the surface is thought to have caused huge forest devastation in Russia in the early twentieth century and occasionally news items feature closely passing asteroids.

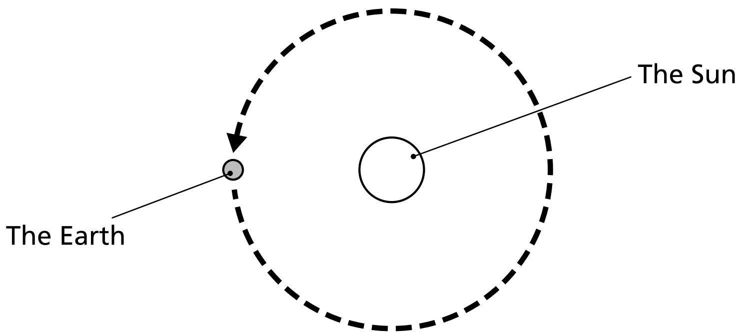
A group of astronomers, called Earthwatch, keeps a watch on the skies for asteroids that could collide with the Earth.

(iii) Not all craters on the Moon formed from asteroid impacts. Some are formed by extinct volcanoes.

QUESTIONS

Name: .... **Form:** ....

Q1. Here is the path that the Earth takes around the Sun.



(i) What is the name of the path? ✎.......................................

(ii) How long does it take the Earth to go round the Sun once? ✎............................

Q2. Here is a view of the Earth as seen looking down from the North Pole.

(i) Draw an arrow to show which way the Earth spins.

(ii) Is this direction clockwise or anticlockwise? ✎.......................................

(iii) How long does it take for the Earth to spin around once? ✎............................

QUESTIONS

Name: .... Form: ....

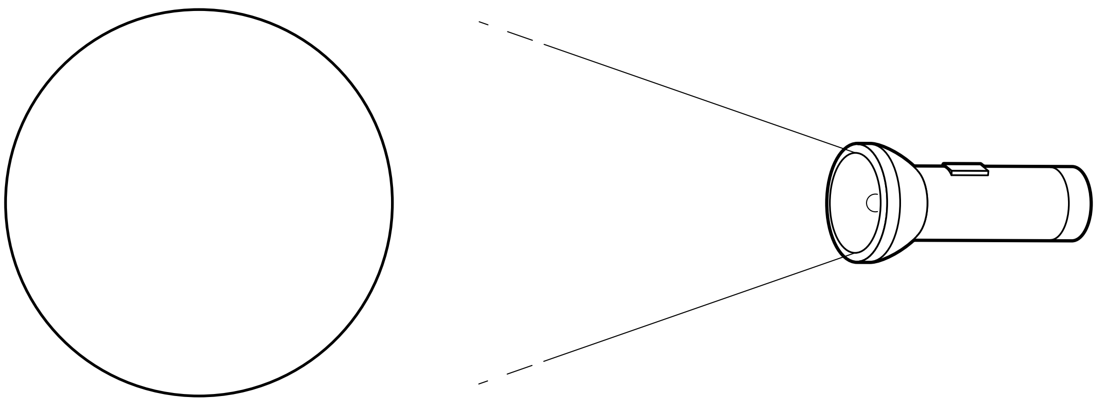
Q3. The Earth is a rocky planet.

Name two other rocky planets in the Solar System.

(i) ✎.......................................

(ii) ✎.......................................

Q4. This globe is being lit by a torch from one side. The torch is supposed to be the Sun.



(i) Shade in the part of the globe that is in the dark.

(ii) Write a D on the globe where it is daytime.

(iii) Write an N on the globe where it is night-time.

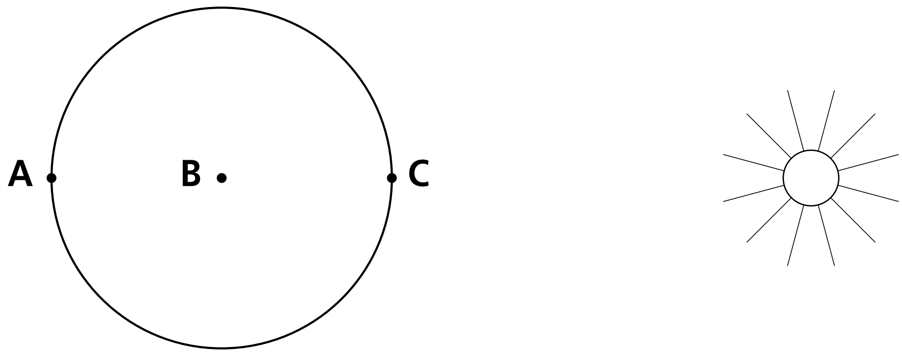
Q5. What is the name of the nearest star to the Earth?

✎...

QUESTIONS

Name: .... **Form:** ....

Q6. Here are three positions on the Earth.



Here are some words that describe the times of day.

midnight **midday** **morning** **afternoon** **sunset** **sunrise**

(i) Which word best describes the time at A? ✎.......................................

(ii) Which word best describes the time at B? ✎.......................................

(iii) Which word best describes the time at C? ✎.......................................

(iv) When the Earth turns one quarter of the way around, what time of day will it be at B?

✎.......................................

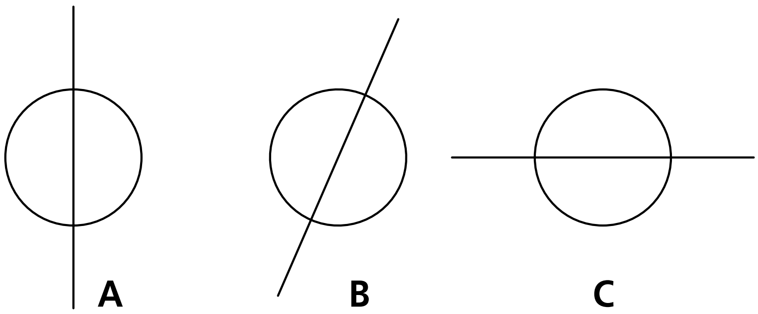
(v) When the Earth turns one quarter of the way around, what time of day will it be at C?

✎.......................................

QUESTIONS

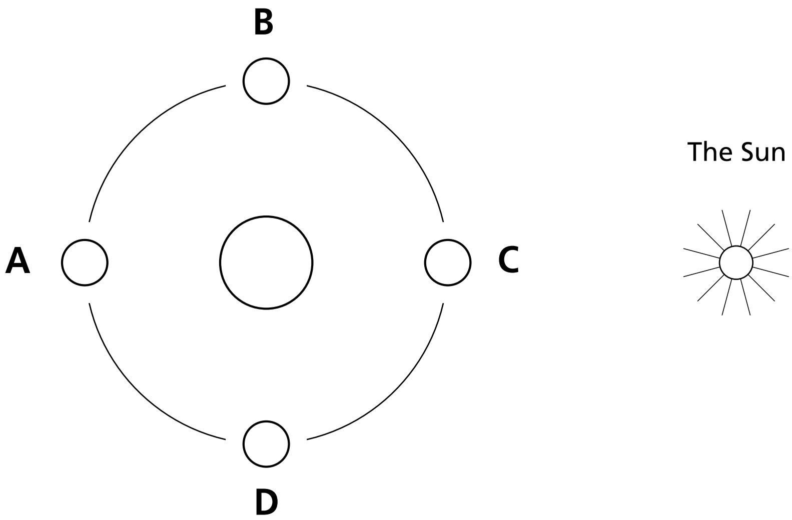
Name: .... **Form:** ....

Q7. Which picture shows the position of the Earth as it moves through space?



Tick one box: A ☐ B ☐ C ☐

Q8. Here is a picture showing four positions of the Moon around the Earth.



(i) Draw in the arrowheads to show how the Moon moves round the Earth.

(ii) When the Moon is Full which position is it in?

Tick one box: A ☐ B ☐ C ☐ D ☐

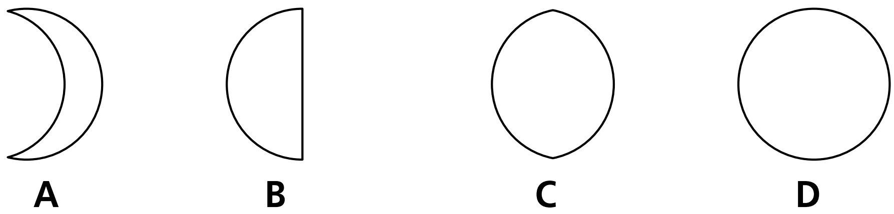
(iii) When the Moon is New which position is it in?

Tick one box: A ☐ B ☐ C ☐ D ☐

QUESTIONS

Name: .... **Form:** ....

Q9. Here are some shapes of the Moon that we see in the sky.



(i) Which one is a Crescent Moon?

Tick one box: A ☐ B ☐ C ☐ D ☐

(ii) Which one is a Gibbous Moon?

Tick one box: A ☐ B ☐ C ☐ D ☐

(iii) Which one is a Full Moon?

Tick one box: A ☐ B ☐ C ☐ D ☐

(iv) Which one shows the real shape of the Moon?

Tick one box: A ☐ B ☐ C ☐ D ☐

Q10. Where does moonlight really come from?

✎..

Q11. Name two planets that have a large number of moons.

✎... ✎..

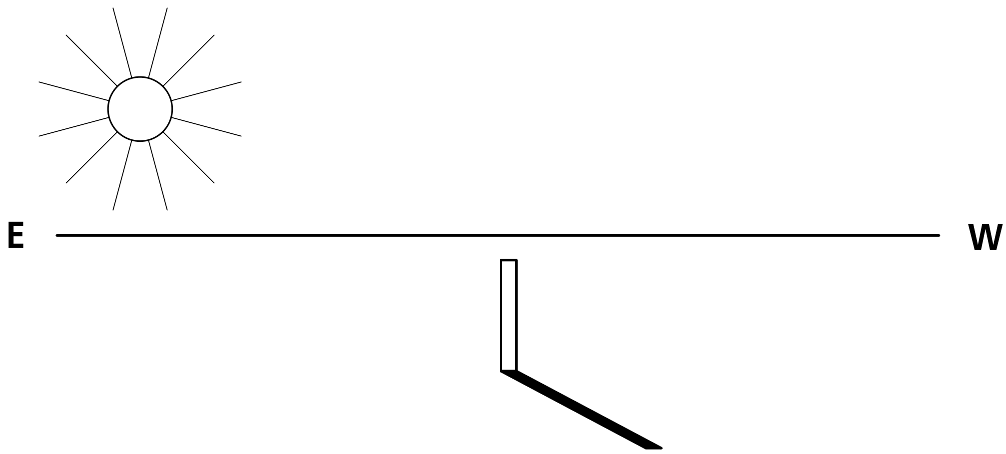
QUESTIONS

Name: .... **Form:** ....

Q12. What makes the Sun appear to move across the sky?

✎..

Q13. Look at the shadow that has been cast by the stick



(i) Draw in the shadow you would expect to see when the Sun is at midday.

(ii) How will the shadow change in the afternoon?

✎..

Q14. Arrange the Sun, Moon and Earth in order of size starting with the smallest.

✎..

What happens when an eclipse takes place?

✎..

✎..

ANSWERS

1. (i) Orbit. *1 mark*
(ii) A year. *1 mark*

2. (i) The arrows should be anticlockwise. *1 mark*
(ii) Anticlockwise. *1 mark*
(iii) 24 hours or one day. *1 mark*

3. Any two from Mercury, Venus, Mars or Pluto. *2 marks*

4. (i) The left hand side of the globe should be shaded. *1 mark*
(ii) D should be in the unshaded part. *1 mark*
(iii) N should be in the shaded part. *1 mark*

5. The Sun. *1 mark*

6. (i) Midnight. *1 mark*
(ii) Sunrise. *1 mark*
(iii) Midday. *1 mark*
(iv) Midday. *1 mark*
(v) Sunset. *1 mark*

7. B. *1 mark*

8. (i) The arrows should show anticlockwise motion. *1 mark*
(ii) A. *1 mark*
(iii) C. *1 mark*

9. (i) A. *1 mark*
(ii) C. *1 mark*
(iii) D. *1 mark*
(iv) D. *1 mark*

10. The Sun. *1 mark*

11. Any two from Jupiter, Saturn, Uranus, or Neptune. *2 marks*

12. The spin of the Earth. *1 mark*

13. (i) The shadow should be a short vertical line straight down from the bottom of the stick. *2 marks*
(ii) It will point towards the east and increase in length. *2 marks*

14. Moon, Earth, Sun. *1 mark*

15. The Moon comes between the Earth and the Sun and casts a shadow on the Earth. *2 marks*

Total marks: 35