Science@School Book 5E

Earth and beyond

Activity worksheets

Peter Riley

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 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

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.

2

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 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).

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			

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.

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 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.

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)

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 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.

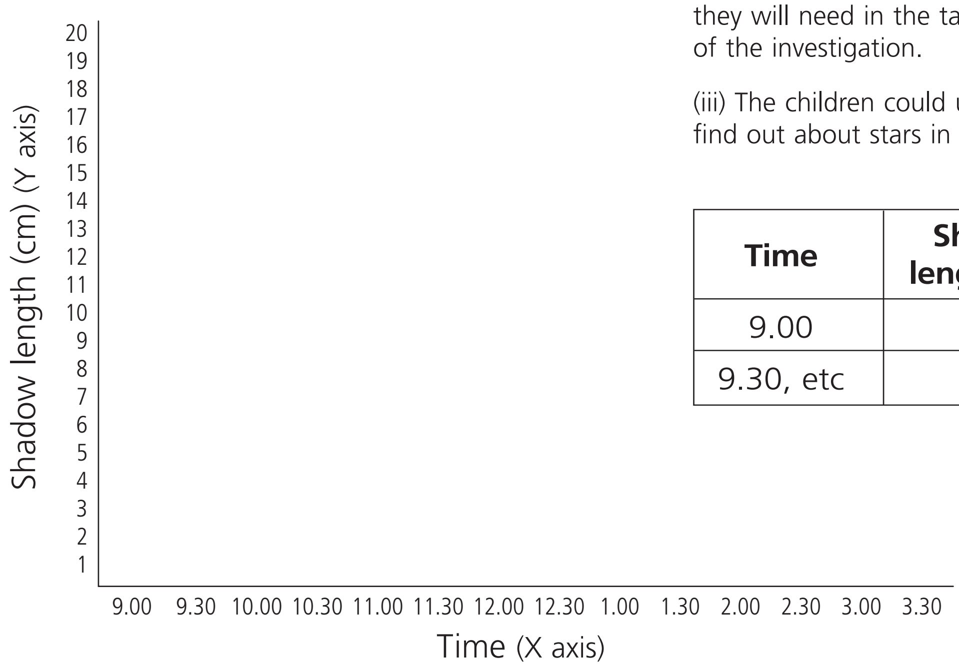
Using the sheet

(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

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 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.

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

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 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.

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.

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 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.