Where this unit fits in

This unit builds on:

- Ideas introduced in unit 5E Earth, Sun and Moon and unit 6F How we see things in the key stage 2 Scheme of Work.

The concepts in this unit are:

- the movement of the Earth causes the apparent daily and annual movement of the Sun and other stars
- the relative positions of the Earth, Sun and planets in the Solar System; phases of the Moon, eclipses, seasons
- planets and satellites are seen by reflected light and the Sun, as a star, emits light
- the Sun compared with other stars
- how the planets orbit the Sun and differences between them.

This unit leads onto:

- unit 9J Gravity and space. Reflection of light is covered in unit 8K Light.

Expectations from the QCA Scheme of Work

At the end of this unit …

... most pupils will …

... some pupils will not have made so much progress and will …

... some pupils will have progressed further and will …

in terms of scientific enquiry NC Programme of Study Sc1 1a, c; 2g, k, i, m, o

- describe and explain a phenomenon of the Solar System, e.g. solar eclipse
- describe ways in which evidence about the Solar System has been collected
- interpret patterns in data with respect to a model of the Solar System, e.g. the tilt of the Earth causing seasonal variation
- select information from secondary sources to present a report about a planet and evaluate the strength of evidence from data.

in terms of physical processes NC Programme of Study Sc4 4a, b, c, d

- relate eclipses, phases of the Moon and seasonal changes to a simple model of the Sun, Earth and Moon system
- describe the relative positions of the planets and their conditions compared to Earth
- state that the Sun is a star and that stars are light sources, while planets and other objects in the Solar System reflect light.

Suggested lesson allocation (see individual lesson planning guides)

Direct route

<table>
<thead>
<tr>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shedding light</td>
<td>All in a day</td>
<td>All in a year</td>
<td>Round the Sun</td>
<td>Making models: Think about scales and models</td>
</tr>
</tbody>
</table>

Extra lessons (not included in pupil book)

| L4 Investigate: Shall we tour the Solar System? |

Additional information

- Pupils may think very reflective surfaces are sources of light. Pupils may confuse the phases of the Moon with an eclipse of the Moon.
- Links with other areas of science and across the curriculum
  - Numeracy – data handling, Literacy – reading for information, extended writing [supported and unsupported]
  - Technology – space research, Citizenship – advantages and disadvantages of space travel.
- Health and safety (see activity notes to inform risk assessment)
  - In this unit, pupils study the Sun, which is a potentially hazardous activity and specific risk assessments must be made.

To make good progress, pupils starting this unit need to know:

- that the Sun, Earth and Moon are approximately spherical
- how the position of the Sun appears to change during the day and how shadows change as this happens
- how day and night are related to the spin of the Earth
- that the Earth orbits the Sun once each year, and that the Moon takes approximately 28 days to orbit the Earth.

➞ Transition quiz for unit L

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This worksheet may have been altered from the original on the CD-ROM.
**Learning outcomes**

**Most pupils will ...**
- distinguish between luminous and non-luminous objects
- state that the Sun is a star and that stars are light sources, while planets and other objects in the Solar System reflect light
- know that light travels in a straight line, at a speed of 300 000 000 m/s.

**Some pupils, making less progress will ...**
- distinguish between luminous and non-luminous objects
- recognise that the Sun is a star and that stars are light sources, while planets and the Moon reflect light
- know that light travels in a straight line, at a speed of 300 000 000 m/s.

**Some pupils, making more progress will ...**
- also explain why we can only see stars at night
- make comparisons between the Sun and other stars.

**Key words**
light source, luminous, galaxy, non-luminous, reflected, *red only*: luminosity

**Out-of-lesson learning**
Homework L1
Textbook L1 end-of-spread questions
Learning objectives

i. Day and night and the apparent movement of the Sun.
ii. The Moon orbits the Earth once every 28 days and the phases of the Moon.
iii. When the Earth blocks light from the Sun there is a lunar eclipse.
iv. When the Moon blocks light from the Sun there is a solar eclipse.

Scientific enquiry

v. Use models to explain night and day, Moon phases and eclipses. (Framework Y10 Sc1 7a, h)

Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Recap last lesson</th>
<th>Share learning objectives</th>
<th>Problem solving</th>
<th>Capture interest (1)</th>
<th>Capture interest (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminous and non-luminous objects.</td>
<td>• Know what causes night and day, the phases of the Moon and eclipses.</td>
<td>Pupils match cards relating the position of the Sun and Moon with different phenomena.</td>
<td>Show photos of day and night, eclipses, and phases of the Moon. Catalyst Interactive Presentations 1</td>
<td>Read out a description of what it is like during a solar eclipse.</td>
</tr>
</tbody>
</table>

Suggested alternative main activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objectives see above</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook L2</td>
<td>i, ii, iii and iv</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.</td>
<td>35 min</td>
<td>C H E S</td>
</tr>
<tr>
<td>Activity L2a</td>
<td>i and v</td>
<td><strong>Night and day</strong> Demo of how the Sun creates day and night using a globe or ball and a projector.</td>
<td>5 min</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Activity L2b</td>
<td>ii and v</td>
<td><strong>Phases of the Moon</strong> Demo of phases of the Moon using a half-black polystyrene sphere on a stick and a torch and spheres.</td>
<td>5 min</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Activity L2c</td>
<td>i and v</td>
<td><strong>Moon orbits and months</strong> Pupils take a detailed look at the phases of the Moon throughout the year from an animation with pupil sheet.</td>
<td>25 min</td>
<td>✓</td>
</tr>
<tr>
<td>Activity L2d</td>
<td>i and iv</td>
<td>Demo of how day and night work with a model using ICT simulation.</td>
<td>5 min</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Activity L2e</td>
<td>iii and v</td>
<td>Demo of how Moon phases work with a model using ICT simulation.</td>
<td>5 min</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Activity L2f</td>
<td>iii and v</td>
<td>Demo of how lunar and solar eclipses take place with a model using ICT simulation.</td>
<td>5 min</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Brainstorming</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils draw diagrams to show how lunar and solar eclipses occur.</td>
<td>Pupils choose words to describe how day/night, Moon phases and lunar and solar eclipses occur.</td>
<td>Pupils describe the apparent movement of the Sun and how shadows are caused.</td>
<td>Pupils put diagrams of the phases of the Moon in the right order.</td>
<td>Pupils suggest why, when a solar eclipse occurs, not everyone on Earth can see it.</td>
</tr>
</tbody>
</table>

Learning outcomes

Most pupils will ... Some pupils, making less progress will ... Some pupils, making more progress will ...

• explain how day and night happen • explain how day and night happen • develop mental links between models, animations and diagrams enabling them to explain how day and night, the phases of the Moon and eclipses occur.
• draw a diagram to show the positions of the Sun, Earth and Moon during a lunar and a solar eclipse. • develop their understanding of how day and night and eclipses occur through models, animations or diagrams.

Key words

phases of the Moon, orbit, lunar eclipse, solar eclipse, red only: axis, partial eclipse

Out-of-lesson learning

Homework L2

Textbook L2 end-of-spread questions

Activity L2c

Show video of 1999 solar eclipse in Cornwall; write a news report
**Learning objectives**

i. The Earth takes 365.25 days or a year to orbit the Sun.
ii. The Earth is slightly tilted at 23.5° from the vertical. This causes the seasons or changes in the climate.
iii. The stars we see in the night sky change with the seasons because we are facing a different way into space. *(red only)*

**Scientific enquiry**

iv. Present data as line graphs using spreadsheets and interpret this. *(Framework YT0 Sc1 f)*

v. Use a model to explain the seasons. *(Framework YT0 Sc1 7a, h)*

---

**Suggested alternative starter activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Recap last lesson</th>
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<th>Problem solving</th>
<th>Capture interest</th>
</tr>
</thead>
</table>
| Pupils decide where on Earth it will be day, night and an eclipse. | • Find out what causes the seasons.  
• Be able to use a model to show how the seasons occur. *(Sc1)* | | Show photos of sunny winter and summer days.  
*Catalyst Interactive Presentations 1*

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**Suggested alternative main activities**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective see above</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook L3</td>
<td>i, ii and iii</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.</td>
<td>35 min</td>
<td>R/G G R S</td>
</tr>
<tr>
<td>Activity L3a ICT</td>
<td>i, ii and iv</td>
<td>Seasonal temperatures Pupils use a spreadsheet to produce graphs based on temperature data.</td>
<td>25 min</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Activity L3b ICT</td>
<td>i, ii and v</td>
<td>All in a year Demo with infra red lamps inclined at different angles with temperature sensors in trays of sand.</td>
<td>20 min</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Activity L3c Practical</td>
<td>i, ii and v</td>
<td>Simulating the seasons Pupils simulate the seasons by looking at the relationship between the angle of the Sun and the amount of light that hits the surface.</td>
<td>25 min</td>
<td>✓</td>
</tr>
</tbody>
</table>

---

**Suggested alternative plenary activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils match descriptions with explanations.</td>
<td>Pupils share their responses to Activity L3a.</td>
<td>Groups of pupils compare and discuss their findings from Activity L3b.</td>
<td>Pupils write a short poem about the seasons using key words.</td>
<td>Pupils suggest how the seasons in Australia are different from ours in the UK.</td>
</tr>
</tbody>
</table>

---

**Learning outcomes**

**Most pupils will …**

• describe how the climate in the UK changes with the seasons  
• describe that the axis of spin of the Earth is at an angle to the Sun  
• use a model, diagram or data to explain why parts of the Earth experience different seasons due to their relative position to the Sun  
• explain why we see different stars in different seasons.

**Some pupils, making less progress will …**

• describe how the climate in the UK changes with the seasons  
• begin to understand that the axis of spin of the Earth is at an angle to the Sun.

**Some pupils, making more progress will …**

• explain why the climate at the Equator does not change much throughout the year and the meaning of the term equinox  
• interpret graphical data produced by datalogging and relate this to their knowledge of climate in different seasons.

---

**Key words**

leap year, seasons, northern hemisphere, *(red only)*: summer solstice, winter solstice, Equator, equinoxes

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**Out-of-lesson learning**

Homework L3  
Textbook L3 end-of-spread questions
Lesson planning guide

Round the Sun

Learning objectives
i. The Solar System includes the Sun, and nine planets along with their moons and other objects such as meteors, asteroids and comets.
ii. The planets orbit the Sun in a similar way to the Earth but differ from each other in many ways such as diameter, distance from the Sun, what they are made of and the conditions there.
iii. The planets in the Solar System have years of different lengths and this is related to their distance from the Sun.

Scientific enquiry
iv. Search for patterns from ICT data about the planets. (Framework YTO 7f)
v. Interpret data and draw conclusions. (Framework YTO 7f, g)

Suggested alternative starter activities (5-10 minutes)

Recap last lesson
Pupils match descriptions of seasonal features to their names.

Share learning objectives
- Find out about the planets.
- Be able to interpret line graphs. (Sc1)

Brainstorming
Build up a diagram of the Solar System as a whole-class activity.

Capture interest (1)
Guess the planet from the facts.

Capture interest (2)
Show video clips/animation of planets orbiting the Sun.
Catalyst Interactive Presentations 1

Suggested alternative main activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objectives</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook L4</td>
<td>i, ii and iii</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows.</td>
<td>35 min</td>
<td>R/G G R S</td>
</tr>
<tr>
<td>Activity L4a Paper</td>
<td>iii and iv</td>
<td>How long is a year? Pupils interpret a graph that shows that the planets of the Solar System have different year lengths according to their distances from the Sun.</td>
<td>15 min</td>
<td>✓</td>
</tr>
<tr>
<td>Activity L4b ICT</td>
<td>iii, iv and v</td>
<td>Investigating planets Pupils create and analyse data in spreadsheet form on the planets of the Solar System and consider relationships between the groups of data about planets.</td>
<td>20 min</td>
<td>✓</td>
</tr>
<tr>
<td>Activity L4c Catalyst Interactive Presentations 1</td>
<td>i and ii</td>
<td>Animation of planets going round the Sun.</td>
<td>5 min</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5-10 minutes)

Review learning
Pupils play ‘guess the planet’.

Sharing responses
Pupils share their responses to Activity L4a.

Group feedback
Pupils discuss their findings for Activity L4b.

Word game
Check progress by playing a true/false quiz on ideas covered so far.

Looking back
Pupils revise and consolidate knowledge from the unit.

Learning outcomes

Most pupils will...
- describe how the planets orbit the Sun in a similar way to the Earth
- understand how the planets differ from each other in many ways such as distance from the Sun what they are made of
- explain that the planets in the Solar System have years of different lengths and this is related to their distance from the Sun
- describe ways in which evidence about the Solar System has been collected.

Some pupils, making less progress will...
- state that the planets orbit the Sun in a similar way to the Earth
- describe how the planets differ from each other giving some examples, e.g., distance from the Sun or the conditions there
- explain why the planets nearer the Sun have a shorter year length
- describe one way in which evidence about the Solar System has been collected.

Some pupils, making more progress will...
- be able to search for patterns from ICT data about the planets.

Key words
Solar System, asteroids, red only: asteroid belt, comets, meteors, meteorite

Out-of-lesson learning
Homework L4
Textbook L4 end-of-spread questions
Visit a planetarium

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This worksheet may have been altered from the original on the CD-ROM.
Investigate: Shall we tour the Solar System?

Learning objectives
i Use the internet to learn about the Solar System.
ii Present information about research into the Solar System.

Scientific enquiry
iii Use data from secondary sources to answer questions about the Solar System. (Framework YTO Sc1 8d)
iv Evaluate the strength of evidence collected about the Solar System. (Framework YTO Sc1 7h)

Suggested alternative starter activities (5–10 minutes)

Setting the context
Set the scene for an investigation into what it would be like to tour the Solar System as a tourist.

Introduce the apparatus
Introduce web search techniques and how the information is to be presented at the end of the investigation.

Brainstorming
Decide what questions pupils need to find the answers to.

Investigation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity L4d ICT</td>
<td>i–iv</td>
<td>Shall we tour the Solar System? Pupils use the internet to obtain information and make a presentation about the planets and what a tour of them would be like. They prepare group PowerPoint presentations or leaflets.</td>
<td>40 min</td>
<td>✓</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5–10 minutes)

Review learning
Pupils look at each other’s presentations.

Group feedback
Pupils discuss how easy it was to find suitable and relevant information.

Analysing
Pupils discuss their findings and what a tour would be like.

Evaluating
Pupils discuss how good and reliable their information sources are.

Learning outcomes

Most pupils will …
• use appropriate reading strategies to find information from a range of secondary sources.
• present information about the planets in the Solar System given templates.
• evaluate why the Earth is the most suitable planet for life.

Some pupils, making less progress will …
• use appropriate reading strategies to find information from secondary sources.
• present information about one of the planets in the Solar System given a template to help them.

Some pupils, making more progress will …
• prepare presentations unsupported by templates.
• identify the main information to include given headings.

Out-of-lesson learning
The internet search may be continued in homework.
Visit a planetarium.
Making models – Think about scales and models

Learning objectives

i To review the concepts of scale and models in the context of the Solar System.

The structure of this lesson is based around the CASE approach. The starter activities give concrete preparation. The lesson then moves away from the concrete towards a challenging situation, where pupils need to think. The plenary activities give pupils time to discuss what they have learnt, to commit their understanding to paper and express their ideas verbally to the rest of the class.

Scientific enquiry

ii Evaluate various models representing the Solar System.

Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Bridging to the unit</th>
<th>Setting the context</th>
<th>Concrete preparation (1)</th>
<th>Concrete preparation (2)</th>
<th>Concrete preparation (3)</th>
</tr>
</thead>
</table>

Main activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Learning objective</th>
<th>Description</th>
<th>Approx. timing</th>
<th>Target group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbook L5</td>
<td>i and ii</td>
<td>Teacher-led explanation and questioning OR pupils work individually, in pairs or in small groups through the in-text questions and then onto the end-of-spread questions if time allows. A role play of the distance model described on L5 might help with modelling.</td>
<td>30 min</td>
<td>R/G G R S</td>
</tr>
</tbody>
</table>

Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Group feedback</th>
<th>Bridging to other topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in pairs, pupils discuss how a model helped them understand the Solar System.</td>
<td>Discuss the importance of evaluating a model.</td>
</tr>
</tbody>
</table>

Learning outcomes

Most pupils will … | Some pupils, making less progress will … | Some pupils, making more progress will …

- consolidate their perceptions of the concepts of scale and models
- critically evaluate models that have been suggested for the Solar System
- have the opportunity to resolve any cognitive conflict arising from thinking about relative sizes and distances in the Solar System.

- develop their perceptions of the concepts of scale and models
- critically evaluate a model that has been suggested for the Solar System
- have the opportunity resolve any cognitive conflict arising from thinking about relative sizes and distances in the Solar System.

- extend their perceptions of the concepts of scale and models
- critically evaluate models that have been suggested for the Solar System using a wider range of data.

Key words

evaluated, scale

Out-of-lesson learning

Textbook L5 end-of-spread questions

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This worksheet may have been altered from the original on the CD-ROM.
## Introduce the unit

- **Either** draw the outline of the unit map on the board then ask pupils to give you words to add, saying where to add them. Suggest some yourself when necessary to keep pupils on the right track.

- **Or** give out the unit map and ask pupils to work in groups deciding how to add the listed words to the diagram. Then go through it on the board as each group gives suggestions.

## Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about how we see the planets and stars. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

## Problem solving

- Show pupils pictures of various luminous and non-luminous objects. Ask pupils to say which objects give out light themselves and which don’t. This will help them recap what they learnt at KS2 and lead into the new KS3 terminology of luminous and non-luminous.

## Brainstorming

- Pupils answer the multiple-choice quiz questions by jotting down the letter for the answer.

- Go through each question and answer with the class, asking for a show of hands for each possible answer so you can see how much pupils know already.

## Capture interest

- Set up a helium neon laser so the beam strikes a screen. Show that the beam is a straight line. Powder or chalk in the beam will make it show up.

- **Follow laser safety rules:** A small helium neon laser is unlikely to cause damage, but take care not to place any reflecting objects (such as a ring) in the beam. If you want to show reflection, have a mirror mounted to direct the light safely away from pupils towards a non-reflecting surface and put this in the beam.

---

### Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Introduce the unit</th>
<th>Share learning objectives</th>
<th>Problem solving</th>
<th>Brainstorming</th>
<th>Capture interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit map for The Solar System and beyond.</td>
<td>● Find out how we see the planets and the stars. Show photos of luminous and non-luminous objects. <a href="#">Catalyst Interactive Presentations 1</a></td>
<td>Quiz on KS2 prior learning.</td>
<td>Demonstrate using a laser that light travels in straight lines.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Equipment**
- helium neon laser, screen, powder or chalk, (mirror)

**Answers**
- 1a, 2a, 3b, 4c, 5b, 6b, 7b
Copy the unit map and use these words to help you complete it. You may add words of your own too.

- asteroid
- axis
- comet
- day
- equator
- equinox
- galaxy
- leap year
- light source
- luminous
- lunar eclipse
- meteor
- meteorite
- Milky Way
- month
- non-luminous
- northern hemisphere
- orbit
- partial eclipse
- phases of the Moon
- reflected
- rotate/spin
- seasons
- solar eclipse
- southern hemisphere
- summer solstice
- total eclipse
- Universe
- winter solstice
- year
Brainstorming

1. The Earth and the Moon are:
   a. approximately spherical
   b. approximately circular
   c. approximately cylindrical

2. How long does it take for the Earth to orbit the Sun?
   a. $365\frac{1}{4}$ days
   b. about 28 days
   c. 24 hours

3. How long does it take for the Moon to orbit the Earth?
   a. $365\frac{1}{4}$ days
   b. about 28 days
   c. 24 hours

4. How long does it take for the Earth to spin on its axis?
   a. $365\frac{1}{4}$ days
   b. about 28 days
   c. 24 hours

5. During the day, the Sun appears to move across the sky because:
   a. the Sun goes around the Earth
   b. the Earth spins on its axis
   c. the Earth goes around the Sun

6. When is the Sun highest in the sky?
   a. spring
   b. summer
   c. winter

7. When is the Sun highest in the sky during the day?
   a. 3 pm
   b. noon
   c. 10 am
## Recap last lesson
- Pupils use the pupil sheet individually or in groups to check that they have understood the difference between light sources and objects that reflect light.
- Check that everyone agrees.

## Share learning objectives
- Ask pupils to write a list of FAQs they would put on a website telling people about what causes night and day, the phases of the Moon and eclipses. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

## Problem solving
- Give each group a set of cards made from the two pupil sheets. (You could use a different colour for each sheet, to make the matching easier.)
- Pupils work in groups to match the cards into pairs, one from sheet 1 with one from sheet 2. Check they have done this correctly and ask which one is the odd one out.

## Capture interest (1)
- Use the photos of day and night, eclipses and phases of the Moon as a basis for discussion of what pupils think causes them.

## Capture interest (2)
- Read out (or ask pupils to take it in turns to read out) the account of an eclipse from two pupils at Helston School in Cornwall.
- Ask pupils about their experiences of the 1999 solar eclipse in Britain.

---

### Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Recap last lesson</th>
<th>Share learning objectives</th>
<th>Problem solving</th>
<th>Capture interest (1)</th>
<th>Capture interest (2)</th>
</tr>
</thead>
</table>
| Luminous and non-luminous objects. | - Know what causes night and day, the phases of the Moon and eclipses.  
  - Be able to model how the Earth, Moon and Sun move. (Sci) | Pupils match cards relating the position of the Sun and Moon with different phenomena. | Show photos of day and night, eclipses, and phases of the Moon.  
  *Catalyst Interactive Presentations 1* | Read out a description of what it is like during a solar eclipse. |

---

**Pupil sheet**

**Teacher sheet**
Recap last lesson

Look at these pictures. List the luminous and non-luminous objects in the table below.

<table>
<thead>
<tr>
<th>Luminous objects</th>
<th>Non-luminous objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>light bulb</td>
<td></td>
</tr>
<tr>
<td>glow-worm</td>
<td></td>
</tr>
<tr>
<td>cat’s eyes</td>
<td></td>
</tr>
<tr>
<td>cats’ eyes</td>
<td></td>
</tr>
<tr>
<td>Moon</td>
<td></td>
</tr>
<tr>
<td>stars</td>
<td></td>
</tr>
<tr>
<td>lightning</td>
<td></td>
</tr>
<tr>
<td>mirror</td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td></td>
</tr>
<tr>
<td>Saturn</td>
<td></td>
</tr>
<tr>
<td>prism</td>
<td></td>
</tr>
<tr>
<td>fire</td>
<td></td>
</tr>
</tbody>
</table>
Problem solving

The Earth travels once around the Sun.

The Moon travels once around the Earth.

The Earth rotates once.

There is a shadow of the Moon on part of the Earth.

There is a shadow of the Earth on the Moon.
Problem solving

1 year (365 1/4 days)

1 month (28 days)

a solar eclipse

a lunar eclipse

1 day (24 hours)

1 week (7 days)

Monday  Tuesday
  Wednesday
  Thursday
  Friday
  Saturday

Sun Mon Tues Wed Thur Fri Sat
All in a day

Capture interest (2)

Teacher sheet

A report written by two students from Helston School in Cornwall

We found out about the total eclipse in school first. In earlier years we had learned about eclipses in science lessons and drawn diagrams of how it happened, but it did not mean much to us. Then our teachers told us there was to be a total eclipse in the UK in August 1999. Even better, our school had received a grant to try out some ideas to do with eclipses in Venezuela during February 1998. We were chosen to go as the pupils involved.

Eclipses happen because one object in our Solar System gets between the Sun and another object and casts a shadow on it. In a solar eclipse the shadow of the Moon passes across the Earth. If you are in the right place, the Moon fits exactly over the Sun and blocks all of its normal light.

The journey was very long and tiring. We flew for 10 hours. Then we travelled on to the island of Curacao. The island is 35 miles north of the coast, in the Caribbean Sea. There were many people going there, especially from the United States, so it was quite crowded.

You must be very careful when you look at an eclipse; you must never look directly at the Sun unless it is totally covered by the Moon. We took ‘mylar’ film glasses. Mylar is like mirror plastic sheet, but you can see through it faintly. These glasses worked but they were a little light and blew off in the wind. The new design of welders’ glasses we had were better. Also we used two sheets of card, one with a pinhole to project and see an image of the Sun.

At first you could see very little change, then we began to notice that the Sun’s disc had a nip out of it where the Moon was beginning to cover it. As time progressed the bite got bigger and the light began to darken slightly. It took about two hours for the Sun to become totally eclipsed. It was noticeably colder than it had been. One of our experiments was to log data of the temperature of the surroundings and brightness of the sunlight; this showed a drop in temperature of five or six degrees during the eclipse. It was a very strange, creepy feeling and people were unusually silent but excited.

The time went very quickly and soon the dark Moon shape had nearly covered the whole of the Sun.

Then the moment of totality arrived. First there was the bright ‘diamond ring’ effect as the last of the Sun’s surface shone brightly through one of the valleys on the Moon’s edge. Then there was a dramatic drop in light, and the sky became nearly as dark as night. We could see stars in the daytime and, most noticeably, several bright planets were clearly visible. People cheered and screamed and shouted. It was as if they were overcome by the spectacular nature of the event.

There was a tremendous glow round the edge of the Sun that you would not imagine existed. This is called the corona. It was the most beautiful blue colour and full of surprising movement of lines of light. The onlookers were shouting and crying, but at the same time very excited. It only lasts two minutes – I don’t think I drew breath in that time – I just looked and wondered and felt amazing. It was a highly emotional event and a fantastic experience.

Then it was gone; first another diamond ring signalling the end, then the light came back and darkness went. The wind down of the Sun’s disc uncovering and time to look at the results of the experiments we had set up.

All the photos and slides we have seen of the eclipse seem almost nothing compared to the real thing. The pictures cannot capture sparkle and the faint vivid colours. The emotion was unique. This was really the experience of a lifetime.

For Britain, the next total eclipse after 1999 is in 2090. We will be 107 years old then!

Source: ASE/PPARC ’99, Unit 6, Eclipse report
Recap last lesson

- Using the pupil sheet, pupils work individually or in groups to decide what it would be like at positions A, B and C on the diagram.
- Ask some groups to report their ideas. Check that everyone agrees.

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about the seasons. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Problem solving

- Pupils list the activities they can do after school in summer and winter. They write down reasons why the lists are different, and why some activities are more suited to summer than winter.
- Follow up with a class discussion of their ideas.

Capture interest

- Show the photos of sunny winter and summer days, and discuss them by comparing summer with winter in terms of how high the Sun is in the sky and what the temperature is.
- Ask pupils to suggest how we can explain the difference between the day length and position of the Sun in summer and winter.
Recap last lesson

For each of the positions A, B and C on the diagram, describe what it would be like if you were there.

- Could you see the Sun?
- Would it be dark or light?
All in a year

Problem solving

1. List some activities you can do after school in the summer.
2. List some activities you can do after school in the winter.
3. Write down some reasons why the lists are different. Why are some activities more suited to summer or winter?
Recap last lesson

- Pupils work through the matching exercise on the pupil sheet.
- Discuss the answers with the class.

Share learning objectives

- Ask pupils to write a list of FAQs they would put on a website telling people about our Solar System. Collect suggestions as a whole-class activity, steering pupils towards those related to the objectives. Conclude by highlighting the questions you want them to be able to answer at the end of the lesson.

Brainstorming

- With contributions from the whole class, build up a diagram with the words 'Our Solar System' in the middle of the board and all the planets radiating from it.
- Discuss whether to include the Sun and the Moon or to have the Moon as a branch from the Earth. Consider moons of other planets, comets, asteroids, etc.
- Include all pupil suggestions in the appropriate part of the diagram.

Capture interest (1)

- Give the pupils the names of the nine planets. Write them on the board or use the OHT.
- Then read out the descriptions of the planets and ask pupils to guess which planet is being described. You could add up the number of guesses for each planet. Their answers will be based on general knowledge. This is a fun quiz – if pupils don’t know, then reassure them that they will find out during the lesson.

Capture interest (2)

- Show the video clip/animation and discuss what pupils know already about the Solar System.
Recap last lesson

Look at the positions of the Sun in each of these diagrams. Match the descriptions on the left to the names or dates on the right.

**Description**
- longest day
- shortest day
- time when the Sun is highest in the sky
- season when shadows are shortest
- season when days are getting longer
- season when days are getting shorter
- season when Sun is lowest in the sky
- direction of sunrise
- direction of sunset

**Name**
- spring
- west
- noon
- 21 June (summer solstice)
- summer
- east
- winter
- 21 December (winter solstice)
- autumn
Capture interest (1)

**Teacher sheet**

1. Which planet:
   - has 18 moons
   - is over 300 times heavier than the Earth
   - has a red spot
   - is the biggest planet?

2. Which planet:
   - is the hottest
   - has an acid atmosphere
   - is covered in cloud
   - is named after a Roman goddess?

3. Which planet:
   - has a volume over 700 times bigger than the Earth
   - has a solid rocky core, but is mainly made of gas
   - would float in water
   - has rings which can be seen using a telescope?

4. Which planet:
   - is called the blue planet
   - has water on the surface in solid, liquid and gaseous forms
   - has one moon
   - is the only planet known to have carbon-based life-forms?

5. Which planet:
   - has white clouds of methane gas
   - has a deep blue atmosphere
   - has a great dark spot
   - had its existence predicted mathematically from the effect it had on the orbit of Uranus?

6. Which planet:
   - was photographed by *Mariner 10*
   - is a rocky, cratered planet
   - has a year 88 days long
   - is closest to the Sun?

7. Which planet:
   - is smaller than Earth
   - has two moons
   - is covered with red dust
   - has been thought to have life by authors and scientists?

8. Which planet:
   - was the first to be discovered with a telescope, in 1781
   - is a gas giant made mainly of hydrogen and helium
   - is tilted so its axis of spin is almost horizontal
   - has rings discovered by a spacecraft in 1977?

9. Which planet:
   - has a moon which is about half its size
   - is the smallest planet
   - has an orbit that is tilted compared to all the other planets
   - is farthest from the Sun?
L4  Round the Sun

Capture interest (1)

Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto

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This worksheet may have been altered from the original on the CD-ROM.
Investigate: Shall we tour the Solar System?

Setting the context
- Ask pupils to consider what it would be like to tour the Solar System as a tourist. Ask them to think about the things they would recommend for a tourist to take with them and what to wear.

Introduce the apparatus
- Demonstrate any web search techniques the group will need to use which they are not already familiar with.
- Explain that pupils will be working in groups to do research and present their findings as a poster. Ask them to think about what they will need for that.

Brainstorming
- Ask pupils to brainstorm ten questions they need to find the answers to (to help them describe what a tour of the Solar System would be like) and where they will look.

### Suggested alternative starter activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Setting the context</th>
<th>Introduce the apparatus</th>
<th>Brainstorming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the scene for an investigation into what it would be like to tour the Solar System as a tourist.</td>
<td>Introduce web search techniques and how the information is to be presented at the end of the investigation.</td>
<td>Decide what questions pupils need to find the answers to.</td>
</tr>
</tbody>
</table>
Making models – Think about

**Suggested alternative starter activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Bridging to the unit</th>
<th>Setting the context</th>
<th>Concrete preparation (1)</th>
<th>Concrete preparation (2)</th>
<th>Concrete preparation (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk about the arrangement of the Solar System.</td>
<td>Introduce the idea of pupils making their own model of the Solar System.</td>
<td>Solar System simulation using an orrery.</td>
<td>Show animation of the planets orbiting the Sun. <a href="#">Catalyst Interactive Presentations 1</a></td>
<td>Show photos of the Solar System model along the York–Selby cycle path.</td>
</tr>
</tbody>
</table>

**Bridging to the unit**

- Recap the arrangement of the Solar System (central Sun, orbiting planets, some with orbiting moons).

- Use the information on the teacher sheet to give examples of size in relation to Earth and the vast distances between planets in relation to the Earth’s distance to the Sun. Discuss how useful these comparisons with the Earth are.

**Setting the context**

- Show the pupils some diagrams of the Solar System, and discuss how a scale model would help them to understand it, rather than just the data.

**Concrete preparation (1)**

- Set up the orrery. Identify the planets and moons.

- Compare the sizes of the different bodies, and then the distances between planets and the Sun. Are they to scale? (No, because of huge variation.)

- Demonstrate that the purpose of the orrery is to show how the planets orbit the Sun. It is possible to move them at different speeds, to model the orbits.

**Concrete preparation (2)**

- Show the animation and identify each planet. Look at the sizes of the planets. Look at the distance from the Sun for each planet.

**Concrete preparation (3)**

- The York to Selby cycle path has a Solar System model along it, shown on their website.

- Look at the photographs of the model planets, and the map of the cycle path showing the locations of planets.

- Estimate how long it would take to walk/cycle/skateboard between some pairs of planets.

- To summarise: the Sun is situated just south of York, with Pluto just outside Riccall (a total of 6.4 miles away from the Sun). The scale of the model is 575 872 239 : 1, so a single stride takes a walker 500 000 km. (A cyclist would be travelling at 10 times the speed of light!) The planets are also scaled in size. All dimensions, real and in the model, are listed.

**Equipment**

- diagrams of the Solar System

- orrery/model of the Solar System

**Website**

- [Cycle the Solar System website](#)

  Click on Sustrans route for map.
Making models – Think about

Bridging to the unit

Teacher sheet

This table shows the diameters and distances from the Sun of the planets compared to the Earth.

- The Earth is 1 unit in diameter and 1 unit away from the Sun.
- All the planets with a number less than 1 for their size are smaller than the Earth.
- All the planets with a number less than 1 for the distance are closer to the Sun than Earth is.

<table>
<thead>
<tr>
<th>Body in the Solar System</th>
<th>Diameter (× Earth’s diameter)</th>
<th>Distance from Sun (× Earth’s distance from Sun)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>109</td>
<td>0</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td>Venus</td>
<td>0.95</td>
<td>0.72</td>
</tr>
<tr>
<td>Earth</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Moon</td>
<td>0.27</td>
<td>1</td>
</tr>
<tr>
<td>Mars</td>
<td>0.53</td>
<td>1.5</td>
</tr>
<tr>
<td>Jupiter</td>
<td>11</td>
<td>5.2</td>
</tr>
<tr>
<td>Saturn</td>
<td>9.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Uranus</td>
<td>3.7</td>
<td>19</td>
</tr>
<tr>
<td>Neptune</td>
<td>3.5</td>
<td>30</td>
</tr>
<tr>
<td>Pluto</td>
<td>0.47</td>
<td>39</td>
</tr>
</tbody>
</table>

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Running the activity

Core:
Pupils work in groups and read the passage on the Core sheet. Then they sort objects into luminous and non-luminous. They suggest how to correct a small child's misconception about sight. A group could come out and demonstrate how they would do this – especially if the room has a good blackout.

Help/Extension:
These pupils need access to the Core sheet for the diagram and passage. They answer their own questions.

Answers

Core:
1. Luminous – lighted candle, star and spark
   Non-luminous – Venus, teacher, comet, Earth
2. Luminous – e.g. lit torch, firework, flame, bonfire, Sun
   Non-luminous – e.g. mirror, window, pupil, house, tree
3. For example: go into a dark room with cousin and torch, torch out – can’t see anything. Switch on torch, see things (but not if light from torch does not fall on them).

Help:
1–3 As Core
4. Rays from bulb to toy car and from toy car to child’s eye. Rays should be straight, have arrows, and begin and end at objects – not in mid air.

Extension:
1–3 As Core
4. a. Rays from light to eye
   b. Rays from light to object, object to mirror, mirror to eye.
      Rays should be straight, have arrows, and begin and end at objects – not in mid air.
You are going to think about objects that are luminous and non-luminous, and how we see them.

1. In your groups, make sure you understand the meaning of these words:
   - luminous
   - non-luminous
   - reflect
   - reflection

2. In your group, read this text:

   When a light bulb is switched on it is luminous. This means it gives out light. We can see it in daylight and we can even see it the dark. A flower is non-luminous. We could not see the flower in the dark – we could only find it by touch or smell.

   In the picture, the light bulb is switched on. Light goes from the bulb in all directions. Some hits the flower and bounces off – it is reflected. Some of the reflected light from the flower enters the girl’s eye – so she sees the flower. We see non-luminous things because they reflect light into our eyes. A mirror reflects light from objects on its smooth surface and we see a reflection of the object.

   The Sun and other stars are luminous, but the Moon is non-luminous – we see it because it reflects the Sun’s light. Planets are non-luminous too.

1. Draw a table with two columns, headed luminous and non-luminous. Write the names of these objects in the correct columns:
   - lighted candle
   - Venus
   - chair
   - teacher
   - star
   - comet
   - Earth
   - spark

2. Think of two extra things to add to each column.

3. Imagine your little cousin believes that we see things because of rays that come out of our eyes. Suggest how you could prove to your cousin that light has to come from something luminous and into your eyes for you to see it. Include a drawing to show how the light would travel.
   (Hint – Imagine taking your cousin into somewhere really dark.)
You are going to think about objects that are luminous and non-luminous, and how we see them. First look at the diagram and read the text on the other sheet.

1. Write the names of these objects in the correct columns:

<table>
<thead>
<tr>
<th>Luminous</th>
<th>Non-luminous</th>
</tr>
</thead>
<tbody>
<tr>
<td>lighted candle</td>
<td></td>
</tr>
<tr>
<td>Venus</td>
<td>chair</td>
</tr>
<tr>
<td>cat’s eyes</td>
<td>teacher</td>
</tr>
<tr>
<td>star</td>
<td>Earth</td>
</tr>
<tr>
<td></td>
<td>spark</td>
</tr>
</tbody>
</table>

2. Think of one extra thing to add to each column.

3. Imagine your little cousin believes that we see things because of rays that come out of our eyes. Imagine it is night and the light is off, but you have a torch. How could you show your cousin that we really see things because light from them enters our eyes?

4. Draw arrows on the diagram to show how the child sees the car.
You are going to think about objects that are luminous and non-luminous, and how we see them.

First look at the diagram and read the text on the other sheet.

1. Draw a table with two columns, headed luminous and non-luminous. Write the names of these objects in the correct columns:

   - lighted candle
   - Venus
   - chair
   - teacher
   - star
   - comet
   - Earth
   - spark

2. Think of two extra things to add to each column.

3. Imagine your little cousin believes that we see things because of rays that come out of our eyes. Suggest how you could prove to your cousin that light has to come from something luminous and then enters your eyes for you to see. Include a diagram in your answer.

4. Draw a diagram like the one on the other sheet. On your diagram, draw rays of light to show:
   a. how the person sees the light
   b. how the person sees the reflection in the mirror.

   Draw the rays from the luminous bulb all the way to the person’s eye.
Running the activity
This is a quick demonstration of something that is probably familiar from Key Stage 2. It is best in a darkened room. Have the projector at the same height as the globe, set up to shine a bright beam of light towards the globe. As you turn the globe, point out the UK’s position on the Earth’s surface. Discuss when the UK experiences apparent sunrise and sunset. Discuss the answers to the questions on the activity sheets.

Expected outcomes
Pupils learn/consolidate the idea that day and night are caused by the Earth’s rotation every 24 hours, and revise some terminology.

Pitfalls
Make sure that the globe rotates so that the Sun rises in the East, (anticlockwise when viewed from above).

Answers
*Core/Help:*
1. Sun
2. Luminous
3. Opaque
4. Night
5. Axis
6. 24 hours
7. East, west
Night and day

Equipment
- a darkened room
- a slide projector
- a globe (or large suspended ball that can be spun)

For your information
Running the activity
This is a quick demonstration of something that is probably familiar from Key Stage 2. It is best in a darkened room. Have the projector at the same height as the globe, set up to shine a bright beam of light towards the globe. As you turn the globe, point out the UK’s position on the Earth’s surface. Discuss when the UK experiences apparent sunrise and sunset. Discuss the answers to the questions on the activity sheets.

Expected outcomes
Pupils learn/consolidate the idea that day and night are caused by the Earth’s rotation every 24 hours, and revise some terminology.

Pitfalls
Make sure that the globe rotates so that the Sun rises in the East, (anticlockwise when viewed from above).
You are going to explain why we have night and day.

Your teacher will shine the light (representing the Sun) and turn the globe (representing the Earth). This is a model of the Sun and the Earth.

1. In the Solar System, where does the light come from?
2. What word describes something that gives out light?
3. One side of the Earth is in shadow. Why is light unable to travel through the Earth?
4. When part of the Earth is in shadow, is it day or night there?
5. What do we call the imaginary line through the Earth from North to South?
6. How long does it take for the Earth to rotate once on its axis?
7. Where does the Sun appear to rise and then to set?
Night and day

You are going to explain why we have night and day.

Your teacher will shine the light (representing the Sun) and turn the globe (representing the Earth). This is a model of the Sun and the Earth.

Complete the sentences below using these words:

- 24 hours
- axis
- East
- luminous
- night
- opaque
- Sun
- West

1. In the Solar System, light comes from the .................................................. .
2. The word we use to describe something that gives out light is ................................. .
3. One side of the Earth is in shadow. Light cannot travel through the Earth because it is ................................. .
4. When we are in shadow it is ................................. .
5. The imaginary line through the Earth from North to South is called its ................................. .
6. The Earth rotates on its axis once every ................................. .
7. The Sun appears to rise in the ................................. and set in the ................................. .
Running the activity

This is a quick demonstration of something that is probably familiar from Key Stage 2. First have a white ball, half-coloured black and on a stick, and rotate it in front of the class so that they can see the appearance change.

The next part is best done in a darkened room. Have a projector or torch at the same height as another ball (the Moon), and set it up to shine a bright beam of light towards the ball. Move the projector or torch around the ball, so that the class’s view varies from full Moon to no Moon. Point out the crescent shapes.

Pitfalls

Of course it is the Moon that moves and not the Sun. If it is possible, you could set up a broad enough beam of light so that you can move the ‘Moon’ round the class – but this is difficult to arrange, and so you must explain why the demonstration is done this way.

You may wish to show the ‘Moon’ ball orbiting the ‘Earth’ globe, but if everything is in the same horizontal plane then there will be a solar eclipse moving round the Earth’s surface. Explain that this doesn’t usually happen because the light comes in at more of an angle.
Phases of the Moon

Equipment
- a darkened room
- a white ball, half painted black, on stick so that it can be held up and rotated
- a torch (easier to move than a slide projector)
- a suspended ball or one on clamped stick.

For your information

Running the activity
This is a quick demonstration of something that is probably familiar from Key Stage 2. First have a white ball, half-coloured black and on a stick, and rotate it in front of the class so that they can see the appearance change.

The next part is best done in a darkened room. Have a projector or torch at the same height as another ball (the Moon), and set it up to shine a bright beam of light towards the ball. Move the projector or torch around the ball, so that the class's view varies from full Moon to no Moon. Point out the crescent shapes.

Pitfalls
Of course it is the Moon that moves and not the Sun. If it is possible, you could set up a broad enough beam of light so that you can move the 'Moon' round the class – but this is difficult to arrange, and so you must explain why the demonstration is done this way.

You may wish to show the 'Moon' ball orbiting the 'Earth' globe, but if everything is in the same horizontal plane then there will be a solar eclipse moving round the Earth's surface. Explain that this doesn't usually happen because the light comes in at more of an angle.
Running the activity

Pupils work individually to complete the activity sheet using the resource sheet to help them. The activity should take about 15 minutes to complete.

To help some pupils visualise the arrangement of the Sun, Moon and Earth in 3D, balls/spheres of different sizes can be used to represent the Moon and Earth, and a lamp or ball for the Sun.

Some pupils may find the later questions hard to visualise and need some extra input.

Answers

1. 365.25 days
2. 27.32 days
3. 13 times
4. 12
5. The Moon has to travel more than one orbit to reach the new position for the full Moon, so the time between full Moons (a month) is greater than the time for the orbit – 13 orbits fit into a year, but there are only 12 months.
6. No Moon
7. Shorter
8. The Moon would have to travel less than one orbit to reach the new position for the full Moon.
Moon orbits and months

The Moon orbits the Earth, and the Earth orbits the Sun. In this activity you are going to study a diagram that shows these movements over one year, then answer the questions below.

1. Study the diagram on the Resource sheet.

   1. From your general knowledge, how long does it take the Earth to orbit the Sun?
   2. From the information on the Resource sheet, how long does it take the Moon to complete one orbit of the Earth?
   3. Use your answers to questions 1 and 2 to work out how many times the Moon orbits the Earth in one year.
   4. From the diagram, how many full moons are there in one year?
   5. Explain carefully why there is a difference between your answers to questions 3 and 4.

2. Look at the large diagram again. The positions of the Moon and the Earth halfway between full moons are shown in grey.

   6. What would the Moon look like from the Earth at these times?

3. Imagine that the Moon orbited the Earth in a clockwise direction (opposite to the direction shown), and the Earth still orbited the Sun in an anticlockwise direction (as shown). Assume that the time for the Moon to orbit the Earth is still 27.32 days, and that a year stays the same.

   7. Would a month (the time between full Moons) be:
      a. longer than the normal time taken for the Moon to orbit the Earth,
      or
      b. shorter than the normal time taken for the Moon to orbit the Earth?
   8. Explain your answer to question 7.
The diagram below shows both the Earth orbiting the Sun and the Moon orbiting the Earth. Use it to answer the questions on Activity sheet L2c.

The time it takes the Moon to orbit the Earth is 27 days, 7 hours, 43 minutes and 11.3 seconds, or approximately 27.32 days.

A full Moon happens when the side of the Moon facing the Earth is also facing the Sun. These are shown next to the names of the months.

The Moon has to go slightly more than one orbit each month to reach the position for the next full Moon. This is because the Earth has moved relative to the Sun.
Running the activity

This PC-based activity uses a Microsoft® Excel spreadsheet available on this CD-ROM. Pupils use a spreadsheet package to analyse the data (or they could draw the graphs manually). They can either word-process the answers to the questions or write them by hand on their printed graphs.

Pitfalls

It is advisable to check the pupils' work before allowing them to print, to ensure that they have the correct graphs.

Answers

Core:

1. A is London – warmer (summer) in July/Aug
2. B is Sydney – colder (winter) in July/Aug (or warmer in Jan/Feb)
3. The ‘tilt’ of the Earth means that in July/August sunlight is more concentrated in London and the day lasts longer (summer) compared with Sydney, and vice versa for Jan/Feb. (Note: beware the misapprehension that one part of Earth is closer to Sun at any time of year.)
4. London’s temperatures are always higher than the North Pole’s. Sunlight intensity at the North Pole is always less than in London, and during winter there is no sunshine at all for several months. (London has four seasons, the North Pole has two seasons.)
5. It would always be hot with little seasonal variation, as sunlight intensity would always be high.

Help:

1. a A; it is warmer (summer) in July /Aug
   b B; colder (winter) in July/Aug (or warmer in Jan/Feb)
2. A: spring Mar/Apr/May (yellow); summer Jun/July/Aug (green); autumn Sep/Oct/Nov (brown); winter Dec/Jan/Feb (red)
   B: spring Sep/Oct/Nov (yellow); summer Dec/Jan/Feb/Mar (green); autumn Apr/May (brown); winter Jun/July/Aug (red)
   (Allow for some variation.)
3. a ... of the tilt of the Earth
   b ... the Sun is high in the sky (the sunlight is more concentrated)
   c ... the Sun is low in the sky (the sunlight is more spread out)
Seasonal temperatures

You are going to use a spreadsheet to draw line graphs of the data in the table, and explain what the graphs show. The table on the right shows the average temperature in two cities for a year.

1. Produce a spreadsheet of this information. You will need the following columns:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Month</td>
<td>Average Temperature of City A</td>
<td>Average Temperature of City B</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Type in the data from the table on the right.
3. Use your spreadsheet to draw line graphs that show the temperatures of both cities through the year.

Considering the evidence

The data comes from two cities: London, UK and Sydney, Australia.

1. Is city A London or Sydney? Explain your answer.
2. Is city B London or Sydney? Explain your answer.
3. Explain the differences in the temperatures between London and Sydney at different times of the year.
4. Describe how the data from London would be different from that of the North Pole, and why.
5. The Sun passes directly over the equator twice a year, and all through the year it is always high in the sky. Knowing these facts, suggest what the climate would be like if you lived for a year on the equator. Explain your answer.
### Seasonal temperatures

You are going to use a spreadsheet to draw line graphs of the data in the table, and explain what the graphs show. The table on the right shows the average temperature in two cities for a year.

1. Produce a spreadsheet of this information. You will need the following columns:

<table>
<thead>
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<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Month</td>
<td>Average Temperature of City A</td>
<td>Average Temperature of City B</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Type in the data from the table.

3. Use your spreadsheet to draw line graphs that show the temperatures of both cities through the year.

The data comes from two cities: London, UK and Sydney, Australia. But which city is which?

1. Complete these sentences:
   a. I think London is city ............. . I think this because ....................................................................................

   b. I think Sydney is city ............. . I think this because ....................................................................................

2. On the temperature table above, show which months of the year match with the four seasons for the two cities.

   Colour the City A and City B columns:
   - yellow for spring
   - green for summer
   - brown for autumn
   - red for winter.

3. Complete these sentences:
   a. We get seasons on the Earth because ....................................................................................

   b. London is warmer in the summer because ....................................................................................

   c. London is colder in the winter because ....................................................................................

---

**Month** | **Temperature °C**
---|---
| **City A** | **City B** |
| Jan | 4 | 22 |
| Feb | 4.5 | 22 |
| Mar | 6.5 | 20.5 |
| Apr | 9.5 | 18 |
| May | 12.5 | 15 |
| June | 16 | 12.5 |
| July | 18 | 12 |
| Aug | 17 | 13 |
| Sep | 15 | 15 |
| Oct | 11 | 17.5 |
| Nov | 7.5 | 19.5 |
| Dec | 5.5 | 21 |
Running the activity

In preparation, it may be helpful to supplement the first diagram on the pupil sheet with a demonstration using a globe and a torch. You could also shine a projector beam perpendicular to a sheet of paper and at an angle of 45° and measure the illuminated area. Show pupils the set up and ask them to make a prediction before carrying out the demonstration. Then they answer the questions on the sheet.

Expected outcomes

The demonstration should show that the temperature rise from lamp A is greater than from B because it is directly facing the soil.

Pitfalls

Use dry soil with low humus content to avoid a smell during the heating. Clean, dry dark sand is a good alternative. If the lamps are large, two trays will be needed to avoid overlap.

Safety notes

This activity is a teacher demonstration only. The infrared heating lamps will get very hot very quickly and should not be touched whilst in use. The infrared radiation will burn skin, melt plastic, and char paper close to the lamp. Allow the lamps sufficient time to cool down after switching off before moving them.

Answers

Core: Pupils’ answers will vary.

Help: Missing words are as follows:

1. A, more
2. Graph A
3. Yes (assuming Q1 is correct)
4. Lamp A
All in a year

<table>
<thead>
<tr>
<th>Type</th>
<th>Purpose</th>
<th>Differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>Pupils observe a model of the position of the Sun in the sky in winter and summer and its heating effect on the Earth.</td>
<td>Core, Help</td>
</tr>
</tbody>
</table>

**Equipment**
- a computer and interface
- two temperature sensors
- datalogging software
- a printer (optional)
- two infrared lamps
- two lamp holders
- two clamps
- two plastic trays, such as standard laboratory storage trays
- soil
- heat-resistant material to act as a shield between the lamps

**For your information**

**Running the activity**
In preparation, it may be helpful to supplement the first diagram on the pupil sheet with a demonstration using a globe and a torch. You could also shine a projector beam perpendicular to a sheet of paper and at an angle of 45° and measure the illuminated area. Show pupils the set up and ask them to make a prediction before carrying out the demonstration. Then they answer the questions on the sheet.

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The demonstration should show that the temperature rise from lamp A is greater than from B because it is directly facing the soil.

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Use dry soil with low humus content to avoid a smell during the heating. Clean, dry dark sand is a good alternative. If the lamps are large, two trays will be needed to avoid overlap.

**Safety notes**
This activity is a teacher demonstration only. The infrared heating lamps will get very hot very quickly and should not be touched whilst in use. The infrared radiation will burn skin, melt plastic, and char paper close to the lamp. Allow the lamps sufficient time to cool down after switching off before moving them.
The weather in Britain is usually hot in the summer and cold in the winter. Your teacher will demonstrate how the angle of the Sun in relation to the Earth causes this difference in temperature.

1. Your teacher will use a temperature sensor to show how the position of the Sun causes the seasons. The lamps tilted at different angles represent the Sun in the summer and winter. They give out heat energy. The soil represents the Earth. Your teacher will shine the lamps on the soil for 20 minutes. The temperature sensors will record the temperatures.

2. Predict which lamp, A or B, will heat up the soil more. Explain your prediction.

3. Look at the graphs from the computer.

4. Was your prediction correct?

5. Explain why you would feel warmer standing outside on a sunny day in June than you would in December. Use the tilt of the Earth in your answer.
All in a year

The weather in Britain is usually hot in the summer and cold in the winter. Your teacher will demonstrate how the angle of the Sun in relation to the Earth causes this difference in temperature.

1. Your teacher will use a temperature sensor to show how the position of the Sun causes the seasons. The lamps tilted at different angles represent the Sun in the summer and winter. They give out heat energy. The soil represents the Earth. Your teacher will shine the lamps on the soil for 20 minutes. The temperature sensors will record the temperatures.

2. Look at the graphs from the computer.

3. Compare the two graphs. Which shows a higher temperature? ............

4. Does this match your prediction? ............

5. Which lamp represents summer? ............

I predict lamp ............ will heat up the soil more because more/less energy will reach the soil.
Running the activity

It would be best to start with a demonstration, with a globe and torch, showing how the tilt of the Earth causes the light to be spread over different areas as the Earth rotates round the Sun. Then pupils can work through the activity as described on the sheet.

Pupils see that a more obtuse angle causes the light to be spread over a larger area, and relate this to temperature variation with the seasons. Pupils could draw a graph with a curve of best fit to show a relationship between angle and area of illumination.

Pitfalls

Pupils must keep the height of the light source constant as they adjust the angle. This is a hard investigation to understand conceptually. Pupils may need help with the ideas in question 7.

Safety

A ray box will become very hot; pupils should be warned to leave it to cool down before dismantling the apparatus.

The retort stand and ray box may be top-heavy; it can either be G-cramped to the bench, or blocks/books can be put on the base of the retort stand to restore stability.

Answers

1. No
2. No
3. December had the largest area (but the light was the most diffuse).
4. January had a large area of diffuse light, while June had a small area of bright light.
5. In June the Sun is more directly overhead than in January, when the northern hemisphere of the Earth is tilted away from the Sun.
6. Not as angled, with more of the cards the same angle.
7. a June
   b December
8. Suggestions could include: test the light intensity and link this to the area that is lit.
Simulating the seasons

Equipment
For the demonstration:
- a torch
- a retort stand and clamp
- a globe, preferably on axis.

For each group:
- a retort stand, boss, clamp and ray box or torch
- clamps or weights to make clamped light source stable
- graph paper, and sticky tape to fix in place on bench
- power supply if required for light source
- 12 card triangles, labelled with each month, with angles as listed on the right.

For your information
Running the activity
It would be best to start with a demonstration, with a globe and torch, showing how the tilt of the Earth causes the light to be spread over different areas as the Earth rotates round the Sun. Then pupils can work through the activity as described on the sheet.

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<thead>
<tr>
<th>Type</th>
<th>Purpose</th>
<th>Differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical</td>
<td>Pupils learn how light hitting a surface at a more obtuse angle will cause the energy to be more dilute.</td>
<td>Extension</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>Angle of card</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>20°</td>
</tr>
<tr>
<td>February</td>
<td>30°</td>
</tr>
<tr>
<td>March</td>
<td>40°</td>
</tr>
<tr>
<td>April</td>
<td>50°</td>
</tr>
<tr>
<td>May</td>
<td>60°</td>
</tr>
<tr>
<td>June</td>
<td>70°</td>
</tr>
<tr>
<td>July</td>
<td>60°</td>
</tr>
<tr>
<td>August</td>
<td>50°</td>
</tr>
<tr>
<td>September</td>
<td>40°</td>
</tr>
<tr>
<td>October</td>
<td>30°</td>
</tr>
<tr>
<td>November</td>
<td>20°</td>
</tr>
<tr>
<td>December</td>
<td>15°</td>
</tr>
</tbody>
</table>
Simulating the seasons

The seasons are caused by the tilt of the Earth. You are going to investigate how changing the angle of the light falling on a surface affects how much energy reaches the surface.

 Obtaining evidence

1. Set up the ray box as shown in the diagram. Angle it using the first angle card (January). Each card shows the angle at which the light rays should shine.
2. Switch on the ray box and fix a large piece of graph paper on the table where the light is shining. You must not move the paper.
3. Measure the area of light that hits the graph paper. The best way is to see how many square centimetres are lit up – count the squares.
4. Record your results in a table.
5. Repeat for each angle card.

 Considering the evidence

1. Does changing the angle of the ray box affect the brightness of the lamp?
2. Does changing the angle of the ray box affect the total amount of energy being given out?
3. Which month had the greatest area of light?
4. What were the differences between the results for January and June?
5. Explain the differences you found in question 4. You must refer to the tilt of the Earth.
6. How would the set of the angle cards be different for the equator?
7. The amount of energy each square on the graph paper receives is the total amount of energy divided by the number of squares. In which month does each square receive:
   a. the most energy
   b. the least energy?

Evaluating

8. How would you improve the experiment if you were to do it again?
How long is a year?

Running the activity
Pupils study the graph on the sheet and answer the questions relating to it. For question 3 pupils will need to refer to other planet data.

Other relevant material
Skill sheet 6: Interpreting graphs

Pitfalls
The questions are not comprehension-style questions and so require extra thought and analysis by pupils. They also require some basic mathematical skills to complete.

Answers
1. The year gets longer the further the planet is from the Sun.
2. A (i.e. 1 Earth year)
3. In order of distance from the Sun: B = Mars, C = Jupiter, D = Saturn, E = Uranus, F = Neptune, G = Pluto
4. Mercury and Venus; because they are closer to the Sun than Earth they will take less than 1 Earth year to orbit the Sun, so will not fit on the scale of this graph.
5. About 1750 million km
6. 3 Jupiter years old
How long is a year?

The Earth takes a year to orbit the Sun. You are going to use a graph to find out about the length of a year on other planets.

1. From the graph, what can you say about the length of a planet’s year, if the planet is a long way from the Sun?
2. Which of the crosses, A–G, represents the Earth?
3. Which planets are represented by the other crosses?
4. Some planets are missing. Why do you think this is?
5. The asteroid Chiron has a year of about 40 Earth years. Estimate how far Chiron must be from the Sun.
6. Ras is 90 Earth years old. If he had lived all his life on Mars he would be only 45 Mars years old. How old, in Jupiter years, would he be if he had lived on Jupiter?
Running the activity

The data for this activity is provided in a table on the sheet, but also as a spreadsheet on the CD-ROM.

Pupils answer questions on the sheet using the data provided, which should take 20–30 minutes. This work can also be extended by allowing the pupils to graph some of the data to study the relationships. The pupils could make a database of the data provided. A whole-class discussion of the answers would be beneficial to ensure pupils have understood all the limitations and relationships in the data and their scientific significance.

The activities rely on pupils being happy looking for relationships between variables. The teacher may like to run through the first few questions to ensure the pupils understand what is required to answer the questions.

Other relevant material

Skill sheet 6: Interpreting graphs

Answers

1. Pluto
2. Pluto – furthest from the Sun
3. Venus – close to the Sun and has atmosphere to keep in heat
4. Generally, the further from the Sun the colder the planet/the nearer the Sun the hotter the planet.
5. No (Pupils should realise that sometimes there is no relationship.)
6. Yes – the further a planet is from the Sun, the longer it takes to orbit the Sun.
7. Neptune has a greater surface gravity, so an object’s weight would be greater on Neptune than on Mercury.
8. No, there is not a direct relationship. However, larger planets do tend to have more moons than smaller planets.
Investigating planets

Over the centuries we have compiled a great amount of data about the different planets of the Solar System. This has allowed us to understand why the planets move and look the way they do. The table below shows some of this data. It is also available as a spreadsheet. You are going to group and sort the information then answer the questions below.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Mercury</th>
<th>Venus</th>
<th>Earth</th>
<th>Mars</th>
<th>Jupiter</th>
<th>Saturn</th>
<th>Uranus</th>
<th>Neptune</th>
<th>Pluto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (km)</td>
<td>5000</td>
<td>12000</td>
<td>12800</td>
<td>7000</td>
<td>140000</td>
<td>120000</td>
<td>52000</td>
<td>50000</td>
<td>3000</td>
</tr>
<tr>
<td>Approx. distance from the Sun (million km)</td>
<td>60</td>
<td>110</td>
<td>150</td>
<td>230</td>
<td>780</td>
<td>1400</td>
<td>2900</td>
<td>4500</td>
<td>6000</td>
</tr>
<tr>
<td>Surface gravity (N/kg)</td>
<td>4</td>
<td>9</td>
<td>10</td>
<td>4</td>
<td>26</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Number of moons</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>16</td>
<td>20+</td>
<td>15+</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Mass if Earth = 1</td>
<td>0.1</td>
<td>0.8</td>
<td>1</td>
<td>0.1</td>
<td>320</td>
<td>95</td>
<td>15</td>
<td>17</td>
<td>0.0002</td>
</tr>
<tr>
<td>Average temperature (°C)</td>
<td>427</td>
<td>480</td>
<td>22</td>
<td>-23</td>
<td>-150</td>
<td>-180</td>
<td>-210</td>
<td>-220</td>
<td>-230</td>
</tr>
<tr>
<td>Time to orbit the Sun (Earth years)</td>
<td>0.2</td>
<td>0.6</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>30</td>
<td>84</td>
<td>160</td>
<td>248</td>
</tr>
</tbody>
</table>

1. Which planet is furthest from the Sun?
2. Which is the coldest planet? Explain.
3. Which is the hottest planet? Explain.
4. What is the general relationship between temperature and distance from the Sun?
5. Is there a relationship between the distance a planet is from the Sun and its surface gravity?
6. Is there a relationship between distance from the Sun and the time it takes a planet to orbit the Sun? Discuss your answer.
7. Weight is a force put on an object’s mass by gravity. Discuss the differences in your weight on Mercury and Neptune.
8. Is there a relationship between the number of moons a planet has and its diameter?
Investigate: Shall we tour the Solar System?

<table>
<thead>
<tr>
<th>Type</th>
<th>Purpose</th>
<th>Differentiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>Pupils find out about the different planets and appreciate that only the Earth has the conditions for life in the form we know it. Pupils develop their information and retrieval skills.</td>
<td>Core, Help</td>
</tr>
</tbody>
</table>

Running the activity

This activity could spread over two or three lessons and a homework. Decide what resources will be available for research. Check if all pupils can use the internet. Decide if the class should move to the school library. Divide the class into ability-matched groups if appropriate. Set them a clear time limit for gathering information. Decide whether the output is to be in the form of a slide show or a leaflet, and if the latter, whether it is to be word-processed or not. Decide how the results of the pupils’ work will be displayed to the rest of the class.

Help: All pupils use the Core sheet, but some pupils will need help in extracting information and there so there is a Help sheet for recording facts.

Other relevant materials

Skill sheet 4: Web searches
Skill sheet 19: Writing frame: Research

Pitfalls

An overabundance of information could cause pupils to lose sight of their aim in the activity.
Investigate: Shall we tour the Solar System?

You are going to use books and the internet to research the different planets, and then produce a leaflet or a slide presentation to describe a ‘holiday of a life-time’ tour around the Solar System.

Obtaining evidence

1. Find out as much as you can about all the different planets. Your teacher will tell you how much time you have to do this. You may find it best to save what you find out in Word computer files. Make sure you give everything you save a title so you know what you have.

Try to find out the answers to these questions for each planet.

- How big is the planet?
- How strong is gravity?
- What is the surface like?
- How long is a day?
- What is the atmosphere made of?
- What temperature is it on the planet?
- How long is a year?
- How bright will the Sun look?

Presenting the evidence

2. Decide whether you are going to print a leaflet or make a slide show. Your aim is to advertise a ‘holiday of a lifetime – touring the Solar System’. Include information and pictures about all the places the tour will visit.

Don’t forget to include some advice on what to wear and what your tourists should take with them.

3. Now put together your leaflet or slide show and check it through.
# Investigate: Shall we tour the Solar System?

Use this table to help you record what you find out.

<table>
<thead>
<tr>
<th>Planet name</th>
<th>How far from Sun?</th>
<th>Day</th>
<th>Year</th>
<th>Temperature</th>
<th>Atmosphere</th>
<th>Surface</th>
<th>Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Review learning

- First, pupils compare and contrast the properties of luminous and non-luminous objects.

- Then, pupils work in pairs to produce a ‘golden rule’ for other pupils to use, to distinguish between luminous and non-luminous objects.

- Ask pupils to share their ideas so one ‘golden rule’ is agreed by the class.

Sharing responses

- Carry out a class scan and identify pupils to describe the evidence they would use to persuade their little cousin that light really does enter their eyes (question 3, Activity L1a).

- Summarise the ideas on the board. Highlight those ideas which provide clear evidence that light really does enter the eyes. Identify the science vocabulary used.

Group feedback

- Read out the statements on the Teacher sheet and ask pupils to decide if the statements are true or false.

Word game

- Pupils play Taboo using cards cut out from the Pupil sheet.

- Give one pupil a card with a mystery word on it. The pupil offers clues to the class to allow them to identify the mystery word, but is not allowed to use the given ‘taboo’ words in their clues.

- You can adjust the level of challenge by banning the use of just the first, or first and second words in the taboo list, and then increase the number later.

Looking ahead

- Set the question on the right for individuals to consider and suggest answers to.

- Pupils then share responses with each other. Make it clear they may not know the answer and need to suggest their ideas and predictions.

- Suggestions can be summarised and recorded in pupils’ books to reconsider after further lessons.

Question
Stars are burning balls of gas, so why can’t they be seen during the day?
Group feedback

Read out the statements below and ask pupils to answer true or false.

1. Light travels in straight lines. [True]
2. Light travels at 300 million metres per second. [True]
3. The Moon is a source of light. [False]
4. Light travels outwards from the source of the light. [True]
5. Darkness is the absence of light. [True]
6. Light can travel round corners. [False]
7. Light cannot pass through opaque objects. [True]
8. Light can be made to change direction by reflecting it off surfaces. [True]
9. A mirror cannot reflect light. [False]
### Word game: Taboo

#### Luminous
- light bulb
- Sun
- non-luminous

#### Non-luminous
- luminous
- planets
- Moon

#### Star
- Sun
- luminous
- source

#### Galaxy
- Milky Way
- chocolate
- collection

#### Light
- faster than sound
- luminous
- non-luminous
**Review learning**

- Individually, pupils draw diagrams to show how a lunar and a solar eclipse occur.
- Then they join up with a partner and discuss and check their drawings.

**Sharing responses**

- Write the words (see right) on the board.
- Pupils work in pairs, listing those words that relate to three scenarios:
  (a) day and night
  (b) phases of the Moon
  (c) eclipses.
- Ask pairs in turn to read out their lists of words chosen for a scenario.
- Summarise suggestions on the board and ask other pairs if they agree.
- Go over the key scientific language they need to include to describe each scenario.

**Group feedback**

- Discuss how we normally think about the Sun moving from left to right across the page, as if we face the Sun (south) and watch it rise in the east on our left hand and set in the west on our right hand.
- Then suggest to pupils there are other positions to view the Sun from and ask them for suggestions (e.g. facing north, from space).
- Hand out the Pupil sheet and let pupils work in groups to answer the questions.
- Follow up with a class discussion.

**Brainstorming**

- Pupils put the artwork on the Pupil sheet in the right order to show the phases of the Moon.

**Looking ahead**

- Set the question on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear they may not know the answer and need to suggest their ideas and predictions.
- Suggestions can be summarised and recorded in pupils’ books to reconsider after further lessons.

---

**Words**

- northern hemisphere
- southern hemisphere
- east
- west
- lunar
- solar
- luminous
- opaque
- shadow

---

**Question**

When a solar eclipse occurs not everyone on Earth can see it. Why is this?
Group feedback

When you look at the Sun, you can imagine it rising in the east on your left and setting in the west on your right. That is because you are facing south.

Now imagine you are standing with the Sun behind you, looking at a telegraph pole. The diagram shows this.

The telegraph pole will cast different shadows, depending on the time of day. The diagrams A to D show four different shadows you could see when standing with your back to the Sun.

Q1 Think about where the Sun is. Mark ‘east’ and ‘west’ on the diagrams A to D below.

Q2 For each of the diagrams A to D, write down what time of day it is. Choose from this list.

- early morning
- just before midday
- midday
- just after midday
- mid-afternoon
- late evening
All in a day

Brainstorming

Put the phases of the Moon in the correct order 1 to 8. Start with the new Moon and end with the full Moon.
**Review learning**

- In pairs or individually, pupils match the description of a phenomenon to an appropriate explanation.

**Sharing responses**

- Ask pupils to suggest a pattern for the data across a year in city A and city B (Activity L3a).
- Ask pupils if they can make a connection between the data and what season it is.
- Ask pupils to suggest what evidence they have to support the statement: 'The temperature is always lower in city B when it is high in city A'.
- Discuss whether there is sufficient information to make the statement a generalisation. If not, what additional data would they need to collect to make a generalisation?

**Group feedback**

- Ask each group to present a verbal description of what the data shows (Activity L3b).
- Ask them whether their predictions matched the results, or were there some surprises?

**Word game**

- Ask pupils to write a short poem about the seasons using the key words (see right).

**Looking ahead**

- Set the question on the right for individuals to consider and suggest answers to.
- Pupils then share responses with each other. Make it clear they may not know the answer and need to suggest their ideas and predictions.
- Suggestions can be summarised and recorded in pupils’ books to reconsider after further lessons.

---

**Suggested alternative plenary activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking ahead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils match descriptions with explanations.</td>
<td>Pupils share their responses to Activity L3a.</td>
<td>Groups of pupils compare and discuss their findings from Activity L3b.</td>
<td>Pupils write a short poem about the seasons using key words.</td>
<td>Pupils suggest how the seasons in Australia are different from ours in the UK.</td>
</tr>
</tbody>
</table>

---

**Key words**

- summer
- orbit
- warm
- winter
- tilted
- cold

**Question**

How are the seasons in Australia different from those in the UK?
### All in a year

Review learning
Match each description to the most appropriate explanation.

<table>
<thead>
<tr>
<th>Description</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The temperature in the UK varies throughout the year as the Earth rotates around the Sun.</td>
<td>The southern hemisphere is tilted away from the Sun when the northern hemisphere is tilted towards the Sun.</td>
</tr>
<tr>
<td>Australians can expect high temperatures at Christmas.</td>
<td>The northern hemisphere is tilted towards the Sun in summer.</td>
</tr>
<tr>
<td>The UK can expect high temperatures in July and August.</td>
<td>The southern hemisphere is tilted towards the Sun in December.</td>
</tr>
<tr>
<td>It is generally hottest at the equator.</td>
<td>The Earth is tilted.</td>
</tr>
<tr>
<td>It is summer in the northern hemisphere when it is winter in the southern hemisphere.</td>
<td>The Sun’s rays make a smaller angle at the surface of the Earth at the equator.</td>
</tr>
</tbody>
</table>
**Round the Sun**

### Suggested alternative plenary activities (5–10 minutes)

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Sharing responses</th>
<th>Group feedback</th>
<th>Word game</th>
<th>Looking back</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils play ‘guess the planet’.</td>
<td>Pupils share their responses to Activity L4a.</td>
<td>Pupils discuss their findings for Activity L4b.</td>
<td>Check progress by playing a true/false quiz on ideas covered so far.</td>
<td>Pupils revise and consolidate knowledge from the unit.</td>
</tr>
</tbody>
</table>

### Review learning

- Give one pupil the name of a planet on a piece of paper, so the other can’t see. You may also provide them with data for that planet.
- The pupil responds to questions from other pupils, but can answer only ‘yes’ or ‘no’.
- The class has to see how many questions it takes for them to identify the planet.

### Sharing responses

- Ask pupils to identify the planets in Activity L4a on an OHT copy of the graph, and say what information they used to identify the planets.
- Ask pupils to say what the relationship is between the distance of a planet from the Sun and the length of a planet’s year.
- Ask pupils what calculation they carried out to estimate Ras’s age on Jupiter.

### Group feedback

- Ask different groups to say if they found a relationship for a particular set of data (Activity L4b).
- Summarise all the ideas on the relationships on the board. Mention that there isn’t always a relationship between two sets of data.

### Word game

- Read out the statements on the Teacher sheet and let pupils work in pairs or alone to decide if the statements are true or false.

### Looking back

- Pupils revise and consolidate knowledge from the unit. They can use the Unit map, Pupil check list, or the Test yourself questions.
Word game

Read out the statements below and ask pupils to answer true or false.

1. At night, the Moon blocks out the Sun.    [False]
2. The Sun orbits the Earth once every 24 hours to give us day and night.  [False]
3. The Earth spins on its axis once every 24 hours to give us day and night. [True]
4. The Earth appears flat to us even though it is actually spherical.    [True]
5. The planets move around the Sun because of the Sun’s magnetism.   [False]
6. Even though the Earth is spherical we do not fall off it because of the force of gravity. [True]
7. The Earth spins once every day around an imaginary line drawn from the north pole to the south pole.   [True]
8. We can see objects in the sky because they give out light or light is reflected, and the light enters our eyes.   [True]
9. There is nothing further away from the Earth than the Solar System.   [False]
10. It is daylight for longer in summer because the Sun appears to move more slowly through the sky in summer. [False]
11. Eclipses only occur when the Sun, Earth and Moon are in line. [True]
12. All the planets orbit the Sun.   [True]
Investigate: Shall we tour the Solar System?

**Suggested alternative plenary activities (5–10 minutes)**

<table>
<thead>
<tr>
<th>Review learning</th>
<th>Group feedback</th>
<th>Analysing</th>
<th>Evaluating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupils look at each other’s presentations.</td>
<td>Pupils discuss how easy it was to find suitable and relevant information.</td>
<td>Pupils discuss their findings and what a tour would be like.</td>
<td>Pupils discuss how good and reliable their information sources are.</td>
</tr>
</tbody>
</table>

**Review learning**

- In groups, pupils look at each other’s presentations and identify where they have used facts, scientific vocabulary, a description and an explanation relating to this topic.

**Group feedback**

- In groups, pupils identify one useful search question they used.
- They identify what was difficult to research and what advice they would give to another group next year tackling the same research.

**Analysing**

- Pupils compare data from the different planets and describe what a tour to particular planets would be like.
- Ask pupils to say what they recommended tourists to take with them and wear, and why.

**Evaluating**

- Pupils suggest which data they think is reliable and which is unreliable or based on guess-work.
- Pupils identify any examples of conflicting data or information they came across and what strategies they used to decide which data was the more likely to be accurate. Ask if they found a third source to compare with.
Making models – Think about

Group feedback

- Each pair of pupils takes two of the models and compares them by identifying what is the same about each model and what is different.
- Ask if one of the models is a better model, and if so which one and what are their reasons for thinking this.
- What can each model predict for them?

Bridging to other topics

- Make it explicit that it is important to evaluate each aspect of any model.
- Ask pupils to make a list of points to keep in mind when evaluating a model.
- Ask pupils to comment on any other models they have used already and how well they worked.

Models
7A A model that cells make up all living things
7J A model of electricity
7G The particles model about how matter behaves
1 Match the words to the descriptions.

These objects do not make their own light. We see them because they reflect light. The Moon and planets are this.

These objects are sources of light. They make their own light. Stars are this.

A very large group of stars in the Universe. Most of the stars we see belong to ours, which is called the Milky Way.

This travels in straight lines. Its speed is 300 000 000 m/s.

This is our closest star. It is a light source.

Light that has bounced off an object is ....

2 Look at these objects.

- Moon
- mug of tea
- Saturn
- torch
- tree
- stars
- bonfire
- fireworks
- cat

a Which are luminous objects? Colour them in yellow.

b Which are non-luminous objects? Shade them in grey.
1. Here is a diagram of the Sun and the Earth.

a. Use some of these words to label the diagram.

- Earth
- north pole
- east
- Sun
- west
- south pole

b. Shade in grey the side of the Earth where it will be night.

c. Colour in yellow the side of the Earth where it will be day.

2. a. How long does it take the Earth to turn around once?
   - 24 minutes
   - 24 hours
   - 24 days

b. How long does it take the Moon to orbit the Earth?
   - 28 minutes
   - 28 hours
   - 28 days
3 Reemal’s window faces south. He has drawn the view from his window. He has marked where the Sun is in the evening.

a Draw on the picture where the Sun will be at dawn. Label this Sun *dawn*.

b Draw on the picture where the Sun will be at midday. Label this Sun *midday*.
All in a year

1a Use some of these words to label the diagram.

- axis
- summer
- orbit
- winter
- spin
- Earth
- Sun

---

b Write true or false for each sentence.

In summer, the north pole is tilted away from the Sun. .........................
In summer, the north pole is tilted towards the Sun. .........................
In winter, the north pole is tilted away from the Sun. .........................
2 Use these words to fill in the gaps.

- short, summer, long, spring, days, winter, year, seasons, autumn, cold, axis, hot

a Summer days are .......... and .......... .

b Winter days are .......... and .......... .

c It takes the Earth 365 .......... or one .......... to orbit the Sun once.

d In Britain we have four .......... . They are called .......... , .......... , .......... and .......... .

e We get seasons because the Earth’s .......... is tilted.

3 Complete these sentences about summer.

a In summer the days are long / short and the nights are long / short.

b The longest day is 21 June / December and the Sun is highest / lowest in the sky.

c In winter the days are long / short and the nights are long / short.

d The shortest day is 21 June / December and the Sun is highest / lowest in the sky.
1 Match the words to the descriptions.

- **Sun**: The Sun is one of these. They are luminous objects.
- **Orbit**: The path an object takes around the Sun or a planet.
- **Asteroids**: This is at the centre of the Solar System.
- **Moons**: Large lumps of rock orbiting the Sun between Mars and Jupiter.
- **Planets**: These travel in orbits around the planets.
- **Stars**: The Earth is one. Nine of them go round the Sun.

2 Here is sentence to help you remember the planets in the right order. The first planet is closest to the Sun.

My Very Easy Method Just Shows Up Nine Planets

Write down the planets in the right order.

- **M**
- **V**
- **E**
- **M**
- **J**
- **S**
- **U**
- **N**
- **P**

© Harcourt Education Ltd 2003 Catalyst 1
This worksheet may have been altered from the original on the CD-ROM.
Look at this diagram of the Solar System. It shows the time each planet takes to orbit the Sun once.

- **a** Which planet is closest to the Sun? ......................................
- **b** Which planet is third furthest from the Sun? ......................................
- **c** Which planet takes the longest to orbit the Sun once? ......................................
  Is this planet the closest or furthest from the Sun? ......................................
- **d** Which planet is found between Jupiter and Uranus? ......................................
  How many years does it take to orbit the Sun? ......................................
4 Here is a list of planets with their temperatures. Use this information to help you answer the questions.

**a** Write down the two warmest planets.

..............................................................

..............................................................

Are they near to or far from the Sun? .................

**b** Write down the two coldest planets.

..............................................................

..............................................................

Are they near to or far from the Sun? .................

**c** The surface of the Sun has a temperature of 5500 °C.
Is this hotter than or colder than the planets? .................

<table>
<thead>
<tr>
<th>Planet</th>
<th>Temperature in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>427</td>
</tr>
<tr>
<td>Venus</td>
<td>480</td>
</tr>
<tr>
<td>Earth</td>
<td>22</td>
</tr>
<tr>
<td>Mars</td>
<td>–23</td>
</tr>
<tr>
<td>Jupiter</td>
<td>–150</td>
</tr>
<tr>
<td>Saturn</td>
<td>–180</td>
</tr>
<tr>
<td>Uranus</td>
<td>–214</td>
</tr>
<tr>
<td>Neptune</td>
<td>–220</td>
</tr>
<tr>
<td>Pluto</td>
<td>–230</td>
</tr>
</tbody>
</table>
Making models

1 This table contains information about the sizes of the planets in the Solar System.

a Which planet is the biggest?
......................................

b Which planet is the smallest?
......................................

c Which planet is bigger than the Earth but smaller than Uranus? ..............................

d Which planet is bigger than Pluto but smaller than Venus? ..............................

<table>
<thead>
<tr>
<th>Planet</th>
<th>Diameter to nearest 1000 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>5000</td>
</tr>
<tr>
<td>Venus</td>
<td>12 000</td>
</tr>
<tr>
<td>Earth</td>
<td>13 000</td>
</tr>
<tr>
<td>Mars</td>
<td>7000</td>
</tr>
<tr>
<td>Jupiter</td>
<td>143 000</td>
</tr>
<tr>
<td>Saturn</td>
<td>121 000</td>
</tr>
<tr>
<td>Uranus</td>
<td>51 000</td>
</tr>
<tr>
<td>Neptune</td>
<td>50 000</td>
</tr>
<tr>
<td>Pluto</td>
<td>2000</td>
</tr>
</tbody>
</table>

2 These different sized circles are the planets. They are in order of size. Write the name of the planet in each box.

Use the table to help you!
L1 Shedding light
1 light – This travels in straight lines. Its speed is 300 000 000 m/s.
luminous – These objects are sources of light. They make their own light. Stars are this.
non-luminous – These objects do not make their own light. We see them because they reflect light. The Moon and planets are this.
reflected – Light that has bounced off an object is ...
Sun – This is our closest star. It is a light source.
galaxy – A very large group of stars in the Universe. Most of the stars which we see belong to ours, which is called the Milky Way.
2 a Coloured yellow – torch, stars, bonfire, fireworks.
b Coloured grey – Moon, mug of tea, Saturn, tree, cat.

L2 All in a day
1 a Clockwise from top right – north pole, Earth, south pole, Sun.
b Right side of the Earth (to right of dotted line) shaded grey.
c Left side of the Earth coloured yellow.
2 a 24 hours b 28 days
3 a Dawn Sun drawn low in the sky on the left of the picture.
b Midday Sun drawn high in the sky in the middle of the picture.

L3 All in a year
1 a Clockwise from top right – axis, summer, winter, Earth, Sun.
b false, true, true
2 a long and hot
b short and cold
c days, year
d seasons, spring, summer, autumn, winter
e axis
3 a In summer the days are long and the nights are short.
b The longest day is 21 June and the Sun is highest in the sky.
c In winter the days are short and the nights are long.
d The shortest day is 21 December and the Sun is lowest in the sky.

L4 Round the Sun
1 Sun – This is at the centre of the Solar System.
moons – These travel in orbits around the planets.
planet – The Earth is one. Nine of them go round the Sun.
stars – The Sun is one of these. They are luminous objects.
orbit – The path an object takes around the Sun or a planet.
asteroids – Large lumps of rock orbiting the Sun between Mars and Jupiter.
2 Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto
3 a Mercury b Earth
c Pluto, furthest d Saturn, 29 years
4 a Mercury, Venus, near to
b Neptune, Pluto, far from
c hotter

L5 Making models
1 a Jupiter b Pluto
c Neptune d Mercury or Mars
2 From left to right – Pluto, Mercury, Mars, Venus, Earth, Neptune, Uranus, Saturn, Jupiter
HELP

1 Here are the names of six objects.

- the Moon
- Alpha Centauri (a star)
- a bedside lamp
- a mirror
- this homework
- the Sun

Copy and complete the sentences below, using the names of the objects. You must use all the names.

a Some objects are non-luminous. Examples are ...
They are non-luminous because ...

b Other objects are luminous. Examples are ...
They are luminous because ...

2 When the Moon is in the sky at night it shines. Write a sentence explaining why the Moon appears to shine at night.

3 Which of the following statements are true? Write true or false.

a Light does not have to travel in a straight line.
b The speed of light is about 300 000 000 m/s.
c The Sun is the nearest star to Earth.
d Venus is a luminous planet and we see it because light from the Sun reflects off its surface.

CORE

4 The table shows how the colour of a star is related to its temperature.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Temperature in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>red</td>
<td>3000</td>
</tr>
<tr>
<td>orange</td>
<td>4000</td>
</tr>
<tr>
<td>yellow</td>
<td>6000</td>
</tr>
<tr>
<td>white</td>
<td>10 000</td>
</tr>
<tr>
<td>blue-white</td>
<td>20 000</td>
</tr>
</tbody>
</table>

a What is the most likely temperature of the Sun?
b An astronomer thinks she has found a new star. Its temperature seems to be about 12 000 °C. What colour is it?
c Another star is orange. What is its temperature?
5 Alpha Centauri is the next nearest star, after our Sun, but it looks no bigger than the other stars we can see. Explain why it does not look as large as the Sun.

6 The Earth gets enough light from the Sun to keep the planet warm and for plants to photosynthesise. Can plants photosynthesise on Pluto? Give reasons for your answer.

EXTENSION

7 Saskia thinks that we cannot see stars in the sky during the day, even if it is not cloudy, because they are only there at night. Write down what you would say to Saskia to help her understand what really happens.

8 Venus is 42 million kilometres from the Earth. Mars is 78 million kilometres from the Earth. Venus is less than twice the size of Mars but is very much more than twice the brightness. It is often the brightest object in the night sky, even when the Moon is shining. Venus is covered with white clouds but Mars is not.

a Suggest two reasons why Venus should be so bright.

b Indicate which reason is likely to be the more important and say why.
All in a day

HELP

1 Look at this diagram of the Earth.

a Copy and complete the table.

<table>
<thead>
<tr>
<th>Country</th>
<th>Day or night?</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>night</td>
</tr>
<tr>
<td>Sahara Desert</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td></td>
</tr>
</tbody>
</table>

b John wants to telephone his sister, who lives in Australia. Why would it not be a good idea to ring at lunchtime to wish her a happy birthday?
CORE
2 The diagram shows a photographic image taken by a camera that has been focussed on some stars.

The dot in the centre is the Pole Star. The curves are other stars.

a For how many hours was the camera shutter open?

b Why does the Pole Star appear as a spot, when the other three stars show a track? (Hint: think about the name of the Pole Star!)

3 The diagram below shows one of the two types of eclipse that can be seen from the Earth.

![Eclipse Diagram]

a Which type of eclipse does the diagram show?

b What is the other type of eclipse that sometimes happens?

c In a total eclipse of the Sun, the shadow of the Moon does not cover the whole of the Earth. Explain why not.

EXTENSION
4 Draw a fully labelled diagram to show how the Sun, Earth and Moon can align to give a solar eclipse.

5 The Moon orbits the Earth once every 28 days. It also spins once on its axis during this time. Explain why, when we look at the Moon, we always see the same side.
HELP

1 Copy and complete these sentences using the words below.

- northern hemisphere
- seasons
- 365\(\frac{1}{4}\)
- 366
- 365

a There are ................. days in a normal year.
b There are ................. days in a leap year.
c The Earth orbits the Sun once every ................. days.
d The tilt of the Earth is the reason why we get .................
e The top half of the Earth is called the .................

2 Sarah was born on 29 February 1992. In which year was the next 29 February?

3 Copy the diagram below. The Sun is shown where you would see it in the sky at midday on 21 June.

   ![Diagram of the Sun and Earth]

   View of Sun looking to the south

   EAST

   WEST

   a On your diagram, mark an X where you would see the Sun at midday on 21 December.
   b Mark a Y where you would see the Sun at sunrise on 21 June.
4 Look at the diagram. Use A, B, C or D to answer the questions.

a In which position will the UK have the longest day?

b In which position is it coldest in the UK?

c In two positions the lengths of day and night are equal. One is in spring and the other is in autumn. Which position is in spring?

5 Look at the diagram above again.

a How long will it take for the Earth to move from position D to position C? Explain how you worked out your answer.

b What would happen to the daytime temperature in the UK as the Earth moved from position B to position A?

c Copy and complete this table.

<table>
<thead>
<tr>
<th>Position of the Earth</th>
<th>Time of year in the UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>21 September</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>21 March</td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
</tbody>
</table>
EXTENSION

6 The graph shows the amount of daylight hours per 24-hour cycle, as recorded by a light sensor at the top of Nelson’s Column in London.

![Graph showing daylight hours per 24-hour cycle]

- **a** In which month is point A likely to have been recorded?
- **b** In which month is point C likely to have been recorded?
- **c** Hammerfest is a town in the far north of Norway.
  - i How would the graph be different at point B, if the sensor had been in Hammerfest instead of London?
  - ii How would the graph at point C be different in Hammerfest?
  - iii Explain why the Hammerfest graphs would be different from the graph shown.

7 The constellation known as Cygnus is sometimes called the ‘Summer Cross’. Why do you think it has this name?
Round the Sun

This table gives data about some of the planets. You will need this information to answer questions 1, 2 and 3.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Distance from Sun in millions of kilometres</th>
<th>Time to orbit the Sun in Earth Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>Mercury</td>
<td>60</td>
<td>0.25</td>
</tr>
<tr>
<td>Mars</td>
<td>230</td>
<td>1.9</td>
</tr>
<tr>
<td>Pluto</td>
<td>5900</td>
<td>248</td>
</tr>
<tr>
<td>Jupiter</td>
<td>780</td>
<td>12</td>
</tr>
<tr>
<td>Saturn</td>
<td>1400</td>
<td>29</td>
</tr>
</tbody>
</table>

HELP

1 Copy and complete these sentences.
   a The planet furthest from the Sun is ...................................... .
   b The planet nearest to the Sun is ...................................... .
   c Mars is colder than Earth because ...
   d Saturn takes longer to orbit the Sun than Mars because ...
   e Mercury takes the least time to orbit the Sun because ...

CORE

2 a Use the data in the table to plot a line graph of the distance from the Sun (horizontal) against the time to orbit the Sun (vertical) for the planets Mercury, Earth, Mars and Jupiter. Do not include Saturn or Pluto on your graph.
   b If Venus has an orbit time of 0.6 Earth years, approximately how far is it from the Sun?
   c Imagine that astronomers have discovered a new planet, between Mars and Jupiter, which is 500 million kilometres from the Sun. Use your graph to estimate how long it would take for the new planet to orbit the Sun once.
EXTENSION

3 The diagram shows the relative positions of the Earth, Mercury and Mars around the Sun, on 1 July. Copy the diagram and use the table of data on Sheet 1.

   a i Mark an X on the diagram where the Earth would be six months later.
   ii Mark a Y on the diagram where Mercury would be six months later.
   iii Mark a Z on the diagram where Mars would be six months later.

   b Explain why, six months after the starting point, it would no longer be possible to see Mercury in the night sky.

   c Explain why, six months after the starting point, Mars could still be seen from Earth but in a different part of the night sky.

4 a The table shows the length of time between each appearance of some comets that can sometimes be seen fairly easily from the Earth.

<table>
<thead>
<tr>
<th>Comet</th>
<th>Time between appearances (years)</th>
<th>Last appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halley</td>
<td>76</td>
<td>1986</td>
</tr>
<tr>
<td>Hale-Bopp</td>
<td>4000</td>
<td>1997</td>
</tr>
<tr>
<td>Kahoutek</td>
<td>6</td>
<td>1997</td>
</tr>
<tr>
<td>Hyakutake</td>
<td>65 000</td>
<td>1997</td>
</tr>
<tr>
<td>Temple-Tuttle</td>
<td>33</td>
<td>1998</td>
</tr>
</tbody>
</table>

   i What is a comet?
   ii Which of the comets listed has the largest orbit and how do you know?
   iii When will Halley’s comet next be easily visible from the Earth?
   iv Which of the comets will be the next one to come close to the Earth?

   b Most meteorites that fall towards the Earth burn up in the atmosphere. They are often called ‘shooting stars’. The Moon’s surface is covered with craters caused by meteorites regularly hitting its surface. What does that tell you about the Moon?
### HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Underscores show answers; other text copied by pupils. Some objects are non-luminous. Examples are the Moon, a mirror, this homework. They are non-luminous because they do not give out light / only reflect light. Some objects are luminous. Examples are Alpha Centauri (a star), a bedside lamp, the Sun. They are luminous because they give out light.</td>
<td>3 1 3 1</td>
</tr>
<tr>
<td>1 b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The Moon shines at night because it reflects light from the Sun.</td>
<td>1</td>
</tr>
<tr>
<td>3 a</td>
<td>False</td>
<td>1</td>
</tr>
<tr>
<td>3 b</td>
<td>True</td>
<td>1</td>
</tr>
<tr>
<td>3 c</td>
<td>True</td>
<td>1</td>
</tr>
<tr>
<td>3 d</td>
<td>False</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total for Help</td>
<td>14</td>
</tr>
</tbody>
</table>

### CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 a</td>
<td>6000 °C</td>
<td>1</td>
</tr>
<tr>
<td>4 b</td>
<td>White</td>
<td>1</td>
</tr>
<tr>
<td>4 c</td>
<td>4000 °C. <em>Pupils must give the unit of temperature at least once to get full marks.</em></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>It is a lot further away and more distant objects appear smaller. <em>Accept equivalent answers.</em></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Plants could not photosynthesise on Pluto because its great distance from the Sun means that very little light will reach it. <em>Accept equivalent answers.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total for Core</td>
<td>7</td>
</tr>
</tbody>
</table>

### EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td><em>Pupils must get across the idea that</em> • the stars are really still there • but light from the Sun is too bright for them to be seen.</td>
<td>1 1</td>
</tr>
<tr>
<td>8 a</td>
<td>Venus is larger than Mars. Venus is more reflective than Mars.</td>
<td>1</td>
</tr>
<tr>
<td>8 b</td>
<td><em>Accept any sensibly argued suggestion.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total for Extension</td>
<td>5</td>
</tr>
</tbody>
</table>
### HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Underscores show answers; other text in table copied by pupils.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UK – night</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sahara Desert – <strong>night</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>China – <strong>day</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Australia – <strong>day</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sri Lanka – <strong>day</strong></td>
<td>1</td>
</tr>
<tr>
<td>1b</td>
<td>It would be the middle of the night in Australia.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total for Help</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

### CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>6 hours</td>
<td>1</td>
</tr>
<tr>
<td>2b</td>
<td>The Pole Star is directly above the axis / North Pole or</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>The Pole Star is on the same axis as the Earth.</td>
<td></td>
</tr>
<tr>
<td>3a</td>
<td>Lunar eclipse</td>
<td>1</td>
</tr>
<tr>
<td>3b</td>
<td>Solar eclipse</td>
<td>1</td>
</tr>
<tr>
<td>3c</td>
<td>The Moon is quite a small object in space</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>so it casts only a small shadow.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Accept equivalent answers.</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total for Core</strong></td>
<td><strong>6</strong></td>
</tr>
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### EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><img src="image" alt="Diagram of solar eclipse" />s</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Award one mark for Sun, Moon and Earth in correct alignment;</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>one mark for light from the Sun in straight lines;</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>one mark for correct labelling.</em></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>The Moon spins at the same time as it orbits the Earth so the two movements are co-ordinated.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><em>Accept equivalent answers. Award one mark for the right reason, and one mark for coherence and quality of communication.</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total for Extension</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>
### HELP

1. **Underscores show answers; other text copied by pupils.**

   **a** There are 365 days in a normal year. 1
   **b** There are 366 days in a leap year. 1
   **c** The Earth orbits the Sun once every 365\(\frac{1}{2}\) days. 1
   **d** The tilt of the Earth is the reason we get seasons. 1
   **e** The top half of the Earth is called the northern hemisphere. 1

2. 1996 1

3. **On the pupil’s diagram:**
   - X should be directly below the drawn Sun. 1
   - Y should be on the eastern side and lower than the drawn Sun. 1

**Total for Help 8**

### CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 <strong>a</strong></td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td><strong>b</strong></td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td><strong>c</strong></td>
<td>C</td>
<td>1</td>
</tr>
</tbody>
</table>

| 5 **a** | 3 months / about 91 days / 13 weeks A quarter of one year | 1 |
|  **b** | It would get colder. | 1 |
|  **c** | Underscores show answers; other text in table copied by pupils. | 1 |
|        | A – 21 September | 1 |
|        | B – 21 June | 1 |
|        | C – 21 March | 1 |
|        | D – 21 December | 1 |

**Total for Core 8**

### EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 <strong>a</strong></td>
<td>March</td>
<td>1</td>
</tr>
<tr>
<td><strong>b</strong></td>
<td>December</td>
<td>1</td>
</tr>
<tr>
<td><strong>c i</strong></td>
<td>The line/curve would be higher up at B / more daylight hours.</td>
<td>1</td>
</tr>
<tr>
<td><strong>ii</strong></td>
<td>The line would be lower down at C / fewer daylight hours.</td>
<td>1</td>
</tr>
<tr>
<td><strong>iii</strong></td>
<td>Norway is further from the equator, so more affected by the Earth’s tilt.</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>These stars can only be seen in the summer.</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total for Extension 7**
HELP

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Underscores show answers; other text copied by pupils.</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>The planet furthest from the Sun is Pluto.</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>The planet nearest to the Sun is Mercury.</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Mars is colder than Earth because it is further away from the Sun.</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>Saturn takes longer to orbit the Sun than Mars because it is further away from the Sun.</td>
<td>1</td>
</tr>
<tr>
<td>e</td>
<td>Mercury takes the least time to orbit the Sun because it is closest to the Sun.</td>
<td>1</td>
</tr>
</tbody>
</table>

Total for Help 5

CORE

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 a</td>
<td>Pupils draw a graph using the given data. Award marks for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● correctly labelled scales</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>● accurate plots</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>● appropriate line</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>Approx. 110 million km</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Accept values between 100 and 120 million km.</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Approx. 6½ years</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Accept values between 6 and 7 years.</td>
<td></td>
</tr>
</tbody>
</table>

Total for Core 5

EXTENSION

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 a</td>
<td>Award one mark for each correctly positioned point X, Y, Z.</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Mercury would be on the other side of the Sun.</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Mars would be on the same side of the Sun, but at a different angle from the Earth.</td>
<td>1</td>
</tr>
<tr>
<td>4 a i</td>
<td>A cloud of gas with an ice and dust core/centre.</td>
<td>1</td>
</tr>
<tr>
<td>ii</td>
<td>Hyakutake</td>
<td>1</td>
</tr>
<tr>
<td>iii</td>
<td>2062</td>
<td>1</td>
</tr>
<tr>
<td>iv</td>
<td>Kahoutek</td>
<td>1</td>
</tr>
<tr>
<td>b</td>
<td>There is no atmosphere on the Moon.</td>
<td>1</td>
</tr>
</tbody>
</table>

Total for Extension 12
1 Professor Upthrust the intrepid space traveller is writing home. Unfortunately he was not concentrating when he wrote his last postcard.

Can you help him by underlining the incorrect parts on his card?

---

Dear Mum,

Having a great time. This last trip has been my best yet. I have travelled past the 10 planets in our solar system, Mercury, Venus, Earth, Moon, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. The planets are all larger than the Sun. The Sun orbits around the planets. I have seen the Earth spinning on its axis as it orbits around the Moon, every 24 hours. It orbits so quickly we can only see one side of the Moon at any time. It is nearly night now as the Sun is moving behind the Moon - I will write again soon.

Wish you were here, your loving son

Ivan

Mrs Upthrust
24 Photon Alley
Matterville
PH7 SICS

There are at least seven incorrect words or phrases. Can you find them all?
1. The picture shows our solar system. It is made up of planets orbiting the Sun.

**a** The names of the planets have been mixed up. Rearrange the letters to correctly name each planet. Write the correct names on the diagram.

**b** Which planet is closest to the Sun?  

**c** Which planet is furthest away from the Sun?  

**d** Which planet would you expect to be the warmest?  

**e** Which planet would you expect to be the coldest?
2 The Sun is massive compared to the planets. It holds the planets in their orbits due to its gravitational pull on them.

Complete these sentences using the words below.

axis  
gravity   
face  
orbits

The Earth .................................. the Sun. It is held in its orbit by the force of ................................ acting on it. As the Earth moves around the Sun it also spins on its .............................. . The Moon .................................. the Earth. It also turns on an axis. We only see one .............................. of the Moon as it moves around the Earth.

3 Cross out the incorrect numbers/words.

a The Earth spins round once on its axis every 12/24/365 hours.

b At the same time it orbits the Sun/Moon/Universe.

c It takes the Earth 24/1/365 days to make one orbit around the Sun.

d As the Earth spins we see the morning Sun rise in the East/West/South.

e The Sun sets in the West/East/South.

4 Below is a picture of the Earth and the Sun (not to scale). Shade in night time on the diagram.
The Solar System and beyond

1a Underline the name of the object at the centre of the Solar System.

A asteroid  B Earth  C Pluto  D Sun

b Which object or objects listed above are luminous?

........................................................................................................................................................

2 Day and night on Earth is caused by which of the following? Circle the correct letter.

A the rotation of the Earth about its axis
B the movement of the Earth in orbit around the Sun
C the movement of the Moon around the Earth

3 How long does it take for one complete orbit of the Sun by the Earth? Circle the correct letter.

A 24 hours  B 28 days  C 365½ days  D 48 hours

4 Complete these sentences by crossing out the wrong words.

a The seasons are caused by the tilt of the Moon’s/Sun’s/Earth’s axis, combined with its movement around the planets/Moon/Sun.

b When the northern hemisphere is tilted towards the Sun, it is summer/winter there and summer/winter in the southern hemisphere.

c The closer/further away a part of the Earth is tilted towards the Sun, the hotter the temperature will be on that part of the Earth’s surface and the longer/shorter the amount of daylight.

5 Complete the sentences using dates from this list.

25 April  21 June  21 July  21 September  21 December  25 December

a The Sun is highest in the sky on ......................... . This is the longest day.

b The Sun is lowest in the sky on ......................... . This is the shortest day.
6 These pictures of the phases of the Moon are in the wrong order. Write numbers in the boxes to put them in order. Start with the New Moon.

7 Complete these sentences by writing solar or lunar.

   a A ................................ eclipse is when the Earth moves between the Moon and the Sun.

   b A ................................ eclipse is when the Moon passes exactly between the Earth and the Sun, creating a shadow on the surface of the Earth.

8 Put the planets into the correct order.

   closest to Sun ......................................
   ......................................
   ......................................
   ......................................
   ......................................
   ......................................
   ......................................
   ......................................
   ......................................
   furthest from Sun ......................................
9 Complete the sentences using these words.

**a** The Earth takes ...................................... days to orbit the Sun. This is called one Earth ...................................... .

**b** Mercury takes 88 Earth days to orbit the ...................................... .

This is because it is .................................................. the Sun than Earth.

**c** ...................................... takes 248 Earth years to orbit the Sun.

This is because it is .............................................................. the Sun than Earth.

10 Underline the correct ending for this sentence.

Stars cannot be seen clearly during the day because ...

A ... stars do not shine as brightly during the day as they do at night.

B ... the asteroid belt blocks the light from the stars.

C ... the light from the Sun is so bright that we can’t see the faint light from stars further away.

11 Planet X is a red, rocky planet with an atmosphere of carbon dioxide, and an average temperature of −23 °C.

Planet Y is a rocky planet, average temperature 22 °C, with water and an atmosphere of mostly nitrogen and oxygen.

Planet Z has many moons. It is made mainly of liquids and gases, and has an average temperature of −150 °C.

**a** Which planet is most likely to have living organisms? ............

**b** From the information, which planet is furthest from the Sun? ............
The Solar System and beyond

1 a Underline the name of the object at the centre of the Solar System.
   A asteroid   B Earth   C Pluto   D Sun

b Which object or objects listed above are luminous?
   Sun

2 Day and night on Earth is caused by which of the following? Circle the correct letter.
   A the rotation of the Earth about its axis
   B the movement of the Earth in orbit around the Sun
   C the movement of the Moon around the Earth

3 How long does it take for one complete orbit of the Sun by the Earth? Circle the correct letter.
   A 24 hours   B 28 days   C 365 1/4 days   D 48 hours

4 Complete these sentences by crossing out the wrong words.
   a The seasons are caused by the tilt of the Moon's/Sun's/Earth's axis, combined with its movement around the planets/Moon/Sun.
   b When the northern hemisphere is tilted towards the Sun, it is summer/winter there and summer/winter in the southern hemisphere.
   c The closer/further away a part of the Earth is tilted towards the Sun, the hotter the temperature will be on that part of the Earth's surface and the longer/shorter the amount of daylight.

5 Complete the sentences using dates from this list.
   25 April   21 June   21 July   21 September   21 December   25 December

   a The Sun is highest in the sky on 21 June. This is the longest day.
   b The Sun is lowest in the sky on 21 December. This is the shortest day.
6 These pictures of the phases of the Moon are in the wrong order. Write numbers in the boxes to put them in order. Start with the New Moon.

7 Complete these sentences by writing solar or lunar.
   a A ................................ eclipse is when the Earth moves between the Moon and the Sun.
   b A ................................ eclipse is when the Moon passes exactly between the Earth and the Sun, creating a shadow on the surface of the Earth.

8 Put the planets into the correct order.

   closest to Sun

   .................................................................
   Mercury
   .................................................................
   Venus
   .................................................................
   Earth
   .................................................................
   Mars
   .................................................................
   Jupiter
   .................................................................
   Saturn
   .................................................................
   Uranus
   .................................................................
   Neptune
   .................................................................
   Pluto

   furthest from Sun

   .................................................................
   Uranus
   .................................................................
   Pluto
   .................................................................
   Mercury
   .................................................................
   Venus
   .................................................................
   Earth
   .................................................................
   Neptune
   .................................................................
   Jupiter
The Solar System and beyond (continued)

9 Complete the sentences using these words.

a The Earth takes \(365\frac{1}{2}\) days to orbit the Sun. This is called one Earth \(\text{year}\).

b Mercury takes 88 Earth days to orbit the \(\text{Sun}\). This is because it is \(\text{closer to}\) the Sun than Earth.

c \(\text{Pluto}\) takes 248 Earth years to orbit the Sun. This is because it is \(\text{further from}\) the Sun than Earth.

10 Underline the correct ending for this sentence.
Stars cannot be seen clearly during the day because ...

A ... stars do not shine as brightly during the day as they do at night.

B ... the asteroid belt blocks the light from the stars.

C ... the light from the Sun is so bright that we can’t see the faint light from stars further away.

11 Planet \(\text{X}\) is a red, rocky planet with an atmosphere of carbon dioxide, and an average temperature of \(-23\) °C.

Planet \(\text{Y}\) is a rocky planet, average temperature \(22\) °C, with water and an atmosphere of mostly nitrogen and oxygen.

Planet \(\text{Z}\) has many moons. It is made mainly of liquids and gases, and has an average temperature of \(-150\) °C.

a Which planet is most likely to have living organisms? \(\text{Y}\).

b From the information, which planet is furthest from the Sun? \(\text{Z}\).
1 a Name two reflectors of light in the Solar System.  
2 marks

b Explain why the Sun is not a reflector of light.  
1 mark

c Do the stars reflect light or give out light?  
1 mark

2 One of the main things needed on a planet for life to exist is water.  
Write down two other things needed for life from this list.  
2 marks

- sugar
- carbon
- ozone
- fossil fuels
- energy from the Sun

3 Ethan discovered some interesting information about the nine  
planets in the Solar System and recorded the results in this table.

<table>
<thead>
<tr>
<th>Name of planet</th>
<th>Distance from the Sun (in km)</th>
<th>Length of year (in Earth days or years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>58 000 000</td>
<td>88 days</td>
</tr>
<tr>
<td>Venus</td>
<td>108 000 000</td>
<td>224.7 days</td>
</tr>
<tr>
<td>Earth</td>
<td>150 000 000</td>
<td>365.3 days</td>
</tr>
<tr>
<td>Mars</td>
<td>228 000 000</td>
<td>687 days</td>
</tr>
<tr>
<td>Jupiter</td>
<td>780 000 000</td>
<td>11.9 years</td>
</tr>
<tr>
<td>Saturn</td>
<td>1 427 000 000</td>
<td>29.5 years</td>
</tr>
<tr>
<td>Uranus</td>
<td>2 871 000 000</td>
<td>84 years</td>
</tr>
<tr>
<td>Neptune</td>
<td>4 504 000 000</td>
<td>165 years</td>
</tr>
<tr>
<td>Pluto</td>
<td>5 900 000 000</td>
<td>248 years</td>
</tr>
</tbody>
</table>

a Which planet is closest to the Sun?  
1 mark

b Which planet is the furthest from the Sun?  
1 mark

c Which planet has a year which is approximately twice the length of an Earth year?  
1 mark
4 Ethan and Poppy were discussing the different planets in the Solar System. Ethan thought it would be a great idea to live on a planet close to the Sun, like Mercury, as it would always be hot even during the winter months. Poppy didn’t agree with this idea – she thought it would be a better idea to live on a planet further away from the Sun, like Pluto.

   a Name one disadvantage to Ethan’s idea about living on Mercury. 1 mark
   b Explain why Poppy’s choice of Pluto would also not be a good idea. 1 mark

5 These pictures of the phases of the Moon are in the wrong order. On the right are days in the lunar cycle. Write the correct day for each picture.

   2 marks

   ![Moon phases](day 7)  ![Moon phases](day 0)  ![Moon phases](day 21)  ![Moon phases](day 14)

6 Look at the diagram showing a model of how the Sun, Earth and Moon move in relation to each other.

   ![Diagram](Sun)  ![Diagram](Moon)  ![Diagram](Earth)

   a How long does it take for the Earth to spin round once on its axis? 1 mark
   b How long does it take for the Earth to orbit the Sun? 1 mark
   c The Moon has a cycle which is 28 days long. Why is this? 1 mark
   d A solar eclipse is when a shadow falls on the Earth because the light from the Sun is blocked. What blocks the light from the Sun? 1 mark
7 The diagram shows how the tilt of the Earth on its axis causes the seasons we get in the UK.

a Is it summer or winter at A?  
1 mark

b What two conditions change between summer and winter in the UK?  
2 marks

8 Jo made this graph from data collected by a datalogging weather station. The graph shows the time of sunrise and sunset from 26 July to 15 September.

a What pattern can Jo see from the graph?  
1 mark

b What causes this change in day length?  
1 mark

c What graph pattern would you expect in the spring, from February to April?  

Jo has to do a presentation about the planets in the Solar System. She wants to be sure that her data is reliable. How could she do this?  
1 mark

Jo finds a photo that shows star trails. The photo was taken using a time exposure of several minutes.

e Why are these trails not visible during the day?  
1 mark
1 Ethan and Poppy were discussing the different planets in the Solar System. Ethan thought it would be a great idea to live on a planet close to the Sun, like Mercury, as it would always be hot even during the winter months. Poppy didn’t agree with this idea – she thought it would be a better idea to live on a planet further away from the Sun, like Pluto.

a Name one disadvantage to Ethan’s idea about living on Mercury.  

b Explain why Poppy’s choice of Pluto would also not be a good idea.

2 These pictures of the phases of the Moon are in the wrong order. On the right are days in the lunar cycle. Write the correct day for each picture.

![Moon phases diagram]

2 marks

<table>
<thead>
<tr>
<th>Day</th>
<th>Moon Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Full moon</td>
</tr>
<tr>
<td>7</td>
<td>Waxing half</td>
</tr>
<tr>
<td>14</td>
<td>Waning half</td>
</tr>
<tr>
<td>21</td>
<td>New moon</td>
</tr>
</tbody>
</table>

3 Look at the diagram showing a model of how the Sun, Earth and Moon move in relation to each other.

![Diagram of solar system]

a How long does it take for the Earth to spin round once on its axis?  

b How long does it take for the Earth to orbit the Sun?  

c The Moon has a cycle which is 28 days long. Why is this?
The Solar System and beyond (continued)

...continued

d A solar eclipse is when a shadow falls on the Earth because the light from the Sun is blocked. What blocks the light from the Sun? 1 mark

e A lunar eclipse is when a shadow falls on the Moon so we don’t see the Sun’s rays reflected off the Moon. What blocks the light from the Sun? 1 mark

4 a The Sun is one of many stars in the Universe. Stars are luminous objects. Explain what luminous means. 1 mark

b The stars have fixed positions in the sky. But from the Earth they appear to move across the sky at night. Why is this? 1 mark

c When we look at the stars at night, some stars are brighter than others. Give two reasons why this might be. 2 marks

5 The diagram shows how the tilt of the Earth on its axis causes the seasons we get in the UK.

a Is it summer or winter at A? 1 mark

b What two conditions change between summer and winter in the UK? 2 marks

6 Ethan discovered some interesting information about the nine planets in the Solar System. He recorded his results in the table on the next sheet.

a Which planet has a year approximately twice the length of an Earth year? 1 mark

b How does the distance of a planet from the Sun affect the length of the planet’s year? 1 mark

c Explain your answer to b. 1 mark

d In one year on Earth, how many times will Mercury have orbited the Sun? 1 mark
The Solar System and beyond (continued)

<table>
<thead>
<tr>
<th>Name of planet</th>
<th>Distance from the Sun (in km)</th>
<th>Length of year (in Earth days or years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>58 000 000</td>
<td>88 days</td>
</tr>
<tr>
<td>Venus</td>
<td>108 000 000</td>
<td>224.7 days</td>
</tr>
<tr>
<td>Earth</td>
<td>150 000 000</td>
<td>365.3 days</td>
</tr>
<tr>
<td>Mars</td>
<td>228 000 000</td>
<td>687 days</td>
</tr>
<tr>
<td>Jupiter</td>
<td>780 000 000</td>
<td>11.9 years</td>
</tr>
<tr>
<td>Saturn</td>
<td>1 427 000 000</td>
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</tr>
<tr>
<td>Uranus</td>
<td>2 871 000 000</td>
<td>84 years</td>
</tr>
<tr>
<td>Neptune</td>
<td>4 504 000 000</td>
<td>165 years</td>
</tr>
<tr>
<td>Pluto</td>
<td>5 900 000 000</td>
<td>248 years</td>
</tr>
</tbody>
</table>

7 a Jo has to do a presentation about the planets in the Solar System. She wants to be sure her data is reliable. How could she do this?  

b Jo finds a photo that shows star trails. It looks as though the stars are moving. The photo was taken using a time exposure of several minutes. What causes the star trails on the photo?  

c Why are these star trails not visible on photos taken during the day?  

The Sun appears high in the sky in summer, but much nearer the horizon in winter. Below are two star maps showing positions of constellations in December and January.

d What causes the constellation called Orion to appear higher in the sky in January?  

e Orion cannot be seen from London during the summer months. Why is this?
# End of unit test
## mark scheme

## The Solar System and beyond

### Green (NC Tier 2–5)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>Two from: any of the planets, moon, asteroids</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>b</td>
<td>It produces its own light.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>Give out light</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Carbon, energy from the Sun</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3 a</td>
<td>Mercury</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Pluto</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>Mars</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>4 a</td>
<td>Mercury is too close to the Sun, so the surface temperature of Mercury is too hot for any life to survive.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Pluto is so far from the Sun that very little sunlight reaches it; it is too cold for life to survive.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Day 7, Day 21</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Day 14, Day 0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>6 a</td>
<td>24 hours</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>365 ½ days</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>c</td>
<td>Because it takes the Moon 28 days to orbit the Earth</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>d</td>
<td>The Moon</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>7 a</td>
<td>Summer</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>b</td>
<td>The number of daylight hours; temperature</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>8 a</td>
<td>Days are getting shorter/sunrise is getting later and sunset is getting earlier</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>Change in the position of the Earth in its orbit around the Sun</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>c</td>
<td>The lines getting further apart/days getting longer/sunrise getting earlier/sunset getting later</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>d</td>
<td>Check the data is the same in different sources.</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>e</td>
<td>The Sun is too bright.</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

### Scores in the range of:
- **4–7**: NC Level 2
- **8–13**: NC Level 3
- **14–17**: NC Level 4
- **18–25**: NC Level 5
### The Solar System and beyond

#### Red (NC Tier 3–6)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Mark</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Mercury is too close to the Sun, so the surface temperature of Mercury is too hot for any life to survive.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1b</td>
<td>Pluto is so far from the Sun that very little sunlight will reach it/it is too cold for life to survive.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Day 7, Day 21 Day 14, Day 0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3a</td>
<td>24 hours</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3b</td>
<td>365 1/2 days</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3c</td>
<td>Because it takes the Moon 28 days to orbit the Earth</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3d</td>
<td>The Moon</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3e</td>
<td>The Earth</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>4a</td>
<td>Generates its own light/a light source</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>4b</td>
<td>Because the Earth is spinning on its axis</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4c</td>
<td>They are closer; they are bigger</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>5a</td>
<td>Summer</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>5b</td>
<td>The number of daylight hours; temperature</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>6a</td>
<td>Mars</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>6b</td>
<td>Generally, the further the planet from the Sun the longer the length of the year.</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>6c</td>
<td>Because the orbit gets bigger and so it takes longer for the planet to orbit the Sun</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>6d</td>
<td>Approximately 4 times</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>7a</td>
<td>Check data is the same in different sources</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>7b</td>
<td>In the time the film is exposed the Earth has spun a distance on its axis, so the stars appear to have moved.</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>7c</td>
<td>The Sun is too bright.</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>7d</td>
<td>The tilting of the Earth on its axis</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>7e</td>
<td>The Earth is tilted away from Orion/Orion is below the horizon.</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

#### Scores in the range of:

<table>
<thead>
<tr>
<th>NC Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>
# The Solar System and beyond

## Pupil check list

<table>
<thead>
<tr>
<th>Learning outcomes</th>
<th>I can do this very well</th>
<th>I can do this quite well</th>
<th>I need to do more work on this</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can recognise and name examples of luminous and non-luminous objects.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use my ideas about how light travels and is reflected to explain how we see the planets and stars.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe how night and day occur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can sequence the phases of the Moon and describe how these occur.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use my ideas about the movement of the Earth, Sun and Moon to describe how solar and lunar eclipses take place.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use my ideas about the tilt of the Earth to explain why we have seasons.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe the relationship between temperature at the surface of the Earth and the tilt of the Earth.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe the relationship between day length and season.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe what the Solar System consists of and how planets differ from each other.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe the relationship between year length and distance from the Sun.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can structure questions to carry out a search of secondary resources to collect information about the planets.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use a model of the Solar System to understand how things are positioned and move in it.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can describe how the model is useful and what limitations it has.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word</td>
<td>Definitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>asteroid belt R</td>
<td>Something that gives out light energy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>asteroids</td>
<td>Objects that give out light are luminous.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>axis</td>
<td>A collection of millions of stars held together by gravitational pull.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>comet R</td>
<td>An object that does not give out light is non-luminous.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equator R</td>
<td>When light bounces off a surface, it is reflected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>equinox R</td>
<td>A measure of the light energy given out by bodies such as stars. R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>evaluate</td>
<td>An imaginary line through the Earth that runs from the North Pole to the South Pole.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>galaxy</td>
<td>The path a body takes around the object it is travelling round, such as the Moon’s orbit around the Earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>leap year</td>
<td>The different shapes of the Moon we see as the Moon orbits the Earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>light source</td>
<td>An eclipse that occurs when the shadow of the Earth moves across the Moon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>luminosity R</td>
<td>An eclipse that occurs when the Moon blocks the Sun’s light from reaching the Earth. A shadow passes across the Earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>luminous</td>
<td>An eclipse viewed from a place where the shadow is complete. R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lunar eclipse</td>
<td>An eclipse viewed from a place where the shadow is not complete. R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>meteor R</td>
<td>The time taken for the Earth to orbit the Sun.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>meteorite R</td>
<td>Times of different climate during the year. In the UK we have four seasons – spring, summer, autumn and winter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-luminous</td>
<td>The top half of the Earth, above the Equator.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>northern hemisphere</td>
<td>A year that has 366 days, that occurs every four years.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>orbit</td>
<td>The longest day, on 21 June in the UK. R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>partial eclipse R</td>
<td>The shortest day, on 21 December in the UK. R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>phases of the Moon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reflected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seasons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>solar eclipse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>summer solstice R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total eclipse R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>winter solstice R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Definitions

- **An imaginary line that goes around the middle of the Earth, midway between the North Pole and the South Pole. (G)**

- **A day of the year when day and night are the same length. There is one equinox in the spring and another in the autumn. (G)**

- **The Sun and the objects orbiting it, including Earth and the other planets.**

- **Rocky objects in space. In our Solar System most of the asteroids are found in the asteroid belt.**

- **A small object in the Solar System made of ice, dust and gas, that travels around the Sun. (G)**

- **A very small piece of debris from a comet. (G)**

- **A solid mass of rock or metal from space that lands on Earth. (A small meteor.) (G)**

- **A zone between Mars and Jupiter where most of the asteroids in our Solar System are. (G)**

- **To judge how good a model or experiment is, finding its good points and bad points.**

- **A scale drawing or model shows something bigger or smaller than it really is.**
The Solar System and beyond

asteroid belt R
asteroids
axis
comet R
Equator R
equinox R
evaluate
galaxy
leap year
light source

luminosity R
luminous
lunar eclipse
meteor R
meteorite R
non-luminous
northern hemisphere
orbit
partial eclipse R
phases of the Moon

reflected
scale
seasons
solar eclipse
Solar System
summer solstice R
total eclipse R
winter solstice R
year
L1 Shedding light

Green

a It gives out light.

b The Sun is the source of light and energy for everyone on Earth.

c The Sun is a huge ball of very hot gas.

1a false

b false
c false
d true

2 The Milky Way

3 The Sun is 150 million km from Earth. Alpha Centauri is 40 000 billion km from Earth, so it takes light from Alpha Centauri much longer to reach the Earth than it does from the Sun.

Red

a They give out light.

b 26 858 or 27 000 times further.

1a 18 000 000 000 metres or 18 000 000 km or 18 million km or \(1.8 \times 10^7\) km.

b 1 080 000 000 000 metres or 1 080 000 000 km or 1.08 \(\times 10^9\) km.

c 25 920 000 000 km or 25 920 million km or 2.59 \(\times 10^{10}\) km.

d 9 331 200 000 000 metres or 9 331 200 000 km or 9.331 200 million km or 9.3 \(\times 10^{12}\) km.

2 a 8 minutes = \(8 \times 60\) seconds = 480 s. The speed of light is 300 000 000 m/s, so the Sun is 300 000 000 \(\times 480 = 144 000 000 000\) metres or 144 000 000 km or 1.44 \(\times 10^8\) km from Earth.

b The Sun is very much closer to Earth. It gives us much more light than the other stars. If the Sun were as far away as Alpha Centauri then we would always have a night sky.

3 The Pole star appears bright because it is relatively near to us.

4 Light from the Sun is reflected off the planets and comets and then reflected to Earth.

5 The planets are very much closer to the Earth. They shine by reflected light from the Sun and appear much brighter than stars because they are so close.

L2 All in a day

Green

a Night

b Spinning of Earth on its axis.

c No, the Sun doesn’t move. When the Sun shines on the spinning Earth, only the side of the Earth facing the Sun gets light. The other half of the Earth is in darkness.

d 28 days.

e In a lunar eclipse the light from the Sun is blocked by the Earth and puts the Moon into shadow. In a solar eclipse the light from the Sun is blocked by the Moon and the Earth is in shadow.

1 The Earth spins on its axis once every 24 hours. When the Sun shines on the Earth, on the side facing the Sun is day time. On the side not facing the Sun it is night time.

2 The day would be longer than 24 hours.

3 a, b Individual answers.

Red

a The Earth is actually spinning on its axis. This makes it look as though the Sun is moving across the sky.

b The spinning of the Earth on its axis makes it appear that the stars are moving across the sky.

1 The day would be longer than 24 hours.

2 a, b Individual answers.

3 In a lunar eclipse the shadow cast by the Earth is very large compared with the size of the Moon, so it takes a long time for the Moon to move out of this big shadow. In a solar eclipse, the shadow cast by the Moon on the Earth is much smaller. This is because the Moon is much smaller than the Earth and the Moon is much closer to the Earth than is the Sun. So the shadow of the Moon passes across the Sun relatively quickly. These are best understood by referring to the eclipse diagrams.

4 Go off in a space ship around the Moon; make the Earth spin more slowly or more quickly; make the Moon rotate more slowly or more quickly.

L3 All in a year

Green

a The UK gets warm in the summer and cold in the winter.

b The tilt of the Earth’s axis gives us the seasons.

c We have warm summer days in the UK when Earth is tilted towards the Sun.

d Summer

1 The Earth’s axis is slightly tilted. This tilt of the Earth causes the seasons and day length. In the UK it is summer when the northern hemisphere is tilted towards the Sun. We have the longest day on 21 June and the shortest day on 21 December.

2 The Earth is tilted away from the Sun on the shortest day.

3 Individual answers.
Red

a In summer the days are long and the nights are short. In the winter the nights are long and the days are short.
b The higher in the sky the Sun is, the longer we have daylight and warmer the UK becomes. When the Sun is low in the sky its rays are spread over a larger area so it warms up less.
c The lengths of day and night are equal.

1 Winter: cold, long nights, short days, little plant growth, etc.
Summer: warm, long daylight hours, short nights, much green plant growth, etc.

2 a Diagram showing short shadow from tree with Sun high in the sky.
b Diagram showing long shadow from tree with Sun low in the sky.

3 a Cold and short daylight hours.
b Warm and long daylight hours.

4 a The climate would be less warm/colder.
b The Sun would not be so high in the sky.

L4 Round the Sun

Green

a Mercury
b Pluto
c Small lumps of rock.
d All the other planets are too cold, too hot or have poisonous atmospheres for life as we know it.
e Pluto was discovered from a photograph taken through a telescope.

1 Individual answers.

2 Earth – only planet that we know has life;
   Jupiter – planet with a Great Red Spot;
   Mercury – planet closest to the Sun;
   Neptune – giant planet with bluish gas around it;
   Venus – hottest planet;
   Saturn – planet with beautiful rings around it;
   Pluto – planet furthest from the Sun;
   Uranus – planet with 15 moons and rings around it;
   Mars – the red planet.

Red

a The Solar System is made up of the Sun and nine planets, including Earth. ‘Sol’ is Latin for Sun, so the name Solar System is a good one.
b All the other planets are too cold, too hot or have poisonous atmospheres for life as we know it.
c Pluto is the planet furthest from Earth and is the smallest planet.

1 Individual answers.

2 Venus, Earth, Mars, Jupiter, Saturn, Uranus.

3 Mercury, Venus, Earth, Mars and Pluto are made of rocky material. The other planets are made of liquids and gases.

4 \((248 \times 365) \div 88 \times 1029\) times.

5 There would be less light, plants would not grow as well, it would be colder, the year would be longer.

6 a The further away from the Sun, the colder the planet.
b The amount of light and heat reaching a planet becomes less the further away it is from the Sun.

7 Taking photographs through light telescopes and using radio telescopes to detect radio waves coming from distant stars. Pictures can also be made from the radio waves received.

L5 Making models

Green

a A rugby ball is not spherical.
b Jupiter – basketball; Saturn – football; Uranus – netball; Neptune – volleyball; Earth – cricket ball; Venus – tennis ball; Mars – squash ball; Mercury – golf ball; Pluto – table tennis ball.
c The beach ball is much bigger than any of the other balls, just as the Sun is much bigger than any planet. Earth and Venus are almost the same size and the cricket ball and the tennis ball are almost the same size.

d Individual answers.

e i Saturn would be 121 mm,
   ii Mars would be 7 mm,
   iii The Sun would be 1392 mm.

f The sizes of the planets are more accurate and in scale with their real size relationships.

1 Appropriate scale drawing with Earth shown as a circle of 13 mm and the Moon a circle of 3.5 mm diameter.

Red

a The rugby ball is not spherical.
b Jupiter – basketball; Saturn – football; Uranus – netball; Neptune – volleyball; Earth – cricket ball; Venus – tennis ball; Mars – squash ball; Mercury – golf ball; Pluto – table tennis ball.
c All the balls are spherical, as the planets are. The sizes of the balls are similar in scale to the sizes of the planets to each other.

d Individual answers.

e Sun – 1392 mm; Mercury – 5 mm; Venus – 12 mm; Earth – 13 mm; Mars – 7 mm; Jupiter – 143 mm; Saturn – 121 mm; Uranus – 51 mm; Neptune – 50 mm.

f Label the Sun at the beginning of the string. Then put labels for each of the planets as follows:
   Mercury 58 mm from the beginning of the string, Venus 108 mm, Earth 150 mm, Mars 228 mm, Jupiter 780 mm, Saturn 1427 mm, Uranus 2871 mm, Neptune 4504 mm and Pluto 5900 mm.
The string model shows how close together the inner planets are and the big gaps between the outer planets. The distances are to scale. The distances are sometimes shorter and sometimes longer. This could be improved by putting two labels for each planet, one for the shortest distance and another for the longest.

Mercury 5800 mm from the Sun, Venus 10 800 mm, Earth 15 000 mm, Mars 22 800 mm, Jupiter 78 000 mm, Saturn 142 700 mm, Uranus 287 100 mm, Neptune 450 400 mm and Pluto 590 000 mm.

No. Any scale that would usefully show the relative sizes of the planets would be too large to use for distances. For example the scale used in the previous question would need to have a field as large as six football fields end to end to show the relatives distances of the planets from the Sun. If you used a scale which could usefully show the distances of planets to the Sun and to each other within the classroom, then the sizes of the planets on this scale would be too small to see.

The model is useful in that it shows the correct order of the planets from the Sun. It also gives an indication of the relative sizes of the planets and an idea of the distances from the Sun. It does not, however, show these sizes or distances to a single scale.

Accurate copy of diagram.

Each line represents the distance of a planet from the Sun. The bottom horizontal line should be labelled ‘Earth’. The three vertical lines at the end represent, in order from left to right, the closest distance of the Earth to the Sun, the average distance of the Earth to the Sun and the furthest distance of the Earth to the Sun. Similarly, with each of the other vertical lines, they represent closest, average and furthest distances of those planets from the Sun and should be so labelled. The three other long straight lines angled to the Earth line, represent the tilts of the orbits of Mars (2°), Venus (3°) and Mercury (7°) and should be so labelled.

The model is useful in showing both the tilts of the orbits of these planets relative to Earth and their relative variations of closest and further distances from the Sun. It does not, however, give a correct idea of the scale of these closest/furthest variations compared to the actual distances of these planets from the Sun.