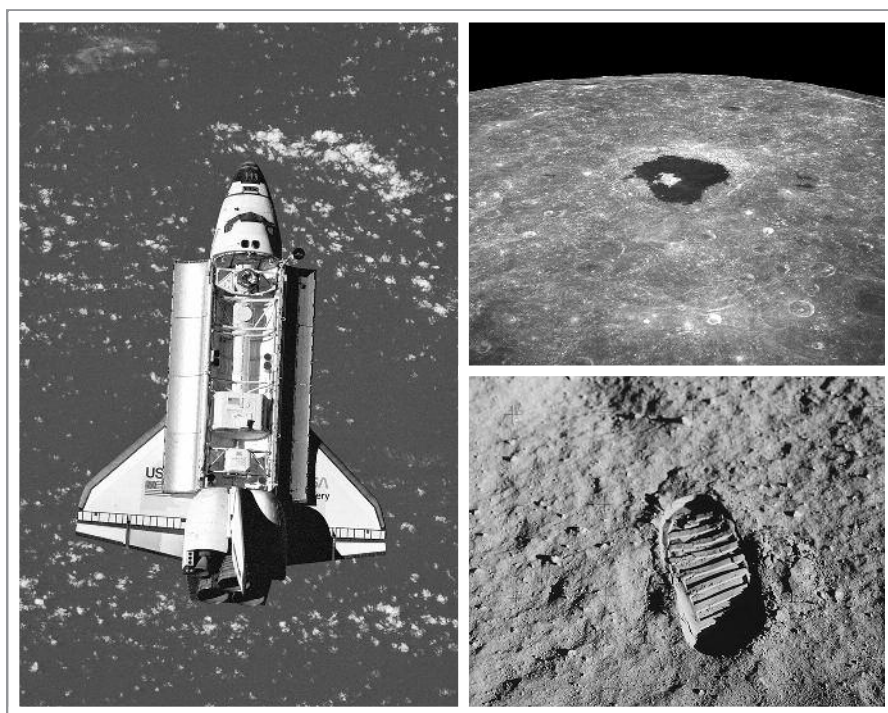


Scientific Enquiry Materials

KS2

SPACE EXPLORATION



Images downloaded from www.nasa.gov

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Contents

Observing the sky at night	4
Space ideas	6
Space equipment	8
Moon watch	10
Moon data	12
Moon's surface	14
Apollo Moon landings	16
Investigating Mars	18
Astronauts on Mars?	20
Surviving on Mars	22

Levels 2–5**Resources**

- ▶ Enquiry Sheet – Observing the sky at night
- ▶ Internet access
- ▶ photograph of the sky at night (available on the CD-ROM or the Internet sites, below)
- ▶ hubblesite.org
- ▶ hubble.nasa.gov



ensure pupils have
parents' / carers'
permission

Links to skills in the Science PoS

Pupils are invited to make careful observations and comparisons, communicating their work clearly by speech, writing and drawings.

Observing the sky at night**Overview**

This activity requires pupils to observe the sky at night, to describe their observations by drawings and writing and to share their observations with their peers. Pupils are also invited to compare their own drawings with photographs taken using the Hubble telescope.

Activity

Explain to the pupils that this activity involves them observing the sky at night. Ask them to carry out this activity at home on a clear night and to use the Enquiry Sheet to describe in drawings and writing their observations of what they can see in the sky at night.

Ask pupils to tell each other about the things they have observed and recorded.

They could discuss differences between skies in rural and town areas.

Their interpretations could be shared in pairs and then with the class.

Invite the pupils to look at photographs of the sky at night taken using the Hubble telescope. Ask them to compare their drawing of the sky at night with the Hubble telescope photographs.

Suggested questions

How many stars would you estimate you saw in the night sky?

How do your observations compare with the photograph from Hubble?

Can you explain the difference?

Why do you think some stars are brighter than others?

Supplementary activities

Pupils could research famous astronomers.

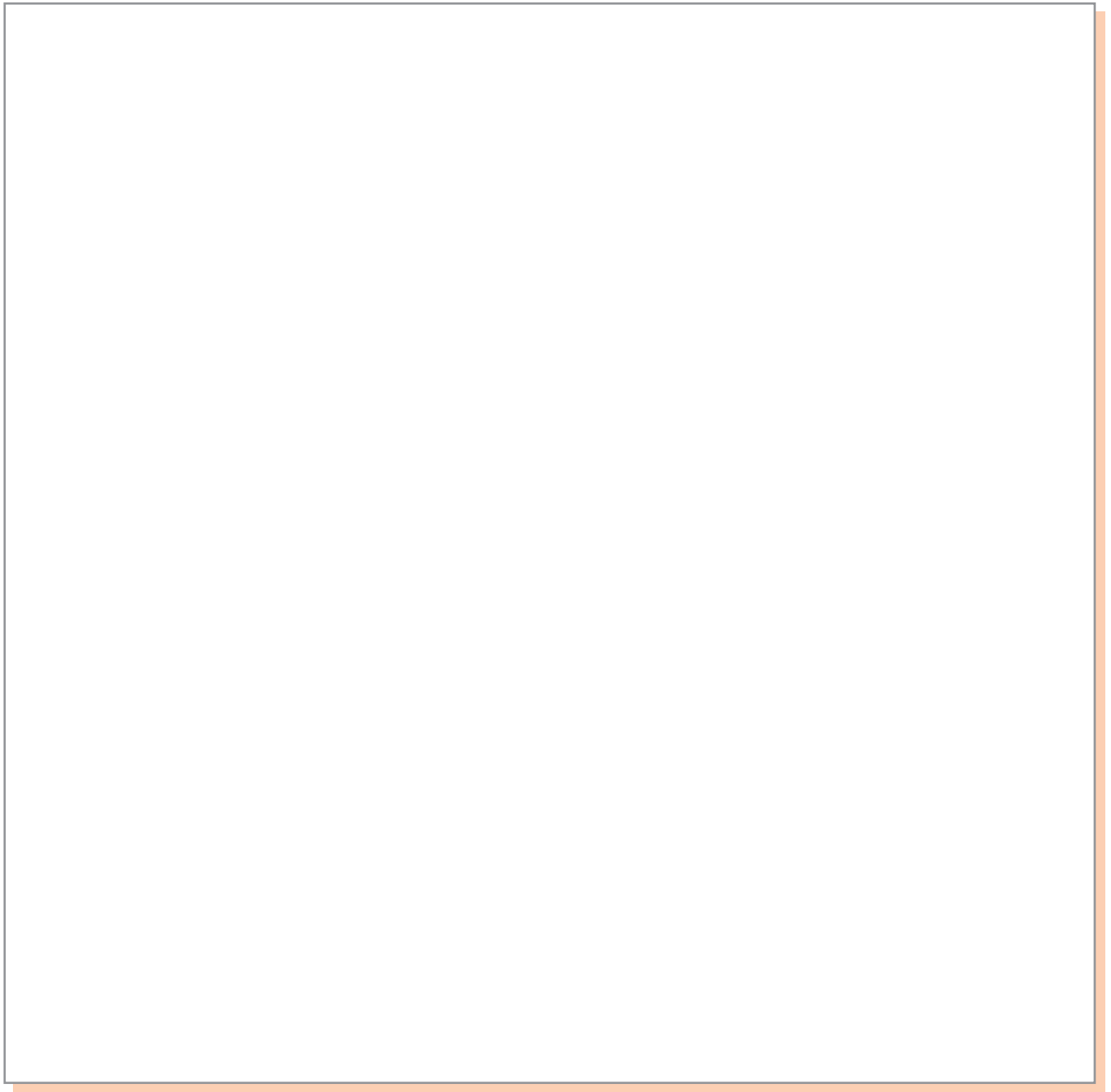
They could find out how telescopes work.

Encourage pupils to list the evidence they would look for as signs of living things in space.

Carry out this activity at home on a clear night.

Look up at the sky. What can you see?

Draw and write to describe your observations of the sky at night.



When you are back at school, describe to a partner as much as possible about the things you have drawn and written about.

Then, look at a photograph of the sky at night taken by the Hubble telescope.

Compare your drawing of the sky at night with the Hubble telescope photograph.

Can you explain the difference?

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Space ideas
- ▶ Internet access
- ▶ schoolsobservatory.org.uk

**Links to skills in the Science PoS**

Pupils represent their prior knowledge in drawings and speech and justify their ideas using available evidence.

Space ideas**Overview**

This activity requires pupils to make drawings to show their prior knowledge and ideas about space. They are required to use evidence to support these ideas and decide on their level of confidence about the evidence to support each idea.

Activity

Ask pupils to draw on a separate piece of paper some of the things they think might be in space that they cannot see with just their eyes. Working in pairs, encourage them to explain their drawings to each other. Probe their ideas about the position, relative distances and number of the different things they have drawn.

Explain to pupils what counts as evidence.

Ask pupils to look again at their drawings. Give them the Enquiry Sheet and ask them to think about and record four ideas they have about space and any evidence they have for each of their ideas. They should also decide how confident they are that this evidence supports their ideas and to record their level of confidence using colour coding: red – not confident; amber – confident; green – very confident.

The pupils could then use the Internet to try and find more information about their ideas. They could use this information to add to their evidence and even to change their level of confidence in their evidence, e.g. from 'red' to 'amber'.

Suggested questions

What things have you drawn?

How far away from Earth do you think these things are?

Do you think these things are moving? What makes you think that?

How old do you think these things are?

Look at one of your ideas. Can you think of any information to support that idea?

How confident are you that this information supports your idea?

Can anyone think of any information that challenges that idea?

Supplementary activities

Pupils could present their ideas about space and any evidence they have found to support their ideas to the whole class.

Look at the drawings you have made.

Choose four of your ideas about space. What is the **evidence** for each of your ideas?
How confident are you about this evidence?

Use colour coding to show how confident you are that your evidence supports your idea:
red – not confident; amber – confident; green – very confident.

idea	evidence	my confidence about evidence
		
		
		
		

Use the Internet to try and find out more about each of your ideas. You might find information that adds to your evidence about an idea. You might even change your level of confidence, for example from red to amber.

Levels 2–5

Resources

- ▶ Enquiry Sheet – Space equipment
- ▶ Internet access
- ▶ www.nasa.gov
- ▶ schoolsobservatory.org.uk



Links to skills in the Science PoS

Pupils are allowed the opportunity to consolidate on their previous knowledge, deciding where and how to find relevant information and reflecting on what they have learned.

Space equipment

Overview

This activity requires pupils to discuss and describe their present knowledge of some of the equipment used by scientists to collect information about space. They should specify what other information they would like to find, how they will find that information and what they have learned in the process.

Activity

Ask pupils to discuss in pairs or in small groups how they think scientists find and collect information about space and what equipment they use.

Then, ask the pupils to use the KWHL* grid on the Enquiry sheet to record: what they already know; what they want to find out; how they will find out and what they have learned about some of the equipment that scientists use to find out and collect information about space.

They could add more equipment in addition to the equipment specified on the Enquiry Sheet.

Encourage the pupils to use the Internet to find out more about their ideas.

Suggested questions

How do scientists find information about space?

What equipment do they use?

How does this equipment help scientists collect information?

What improvements have there been to equipment?

What kind of information does the modern equipment allow them to collect that it was not possible to collect before?

Supplementary activities

Pupils could combine the information gathered about space equipment in their groups to make a whole class poster or booklet.

Pupils could use a KWHL grid to record information about other topics related to space, e.g. comets, asteroids, constellations, etc.

** A KWHL grid has four columns, one for each letter. The K stands for 'What do I already know?' the W for 'What do I want to find out?' the H for 'How I will find out.' and the L for 'What have I learned?'
The strength of this process is that it helps pupils monitor their own learning.*

Scientists find and collect information about space.

Use this **KWHL** grid to record: what you already know, what you want to find out, how you will find out and what you've learned about how scientists collect this information and what equipment they use.

You might be able to add more space equipment that you know about.

What do I Know about:	What do I Want to find out?	How I will find out:	What have I Learned?
Hubble telescope...			
International space station...			
Space shuttle...			

Levels 3–5

Resources

- ▶ Enquiry Sheet – Moon watch
 - ▶ instructions on how to make an inclinometer (available on the CD-ROM)
 - ▶ compass, inclinometer, digital camera
- This activity links to unit 11 – Seashore



Links to skills in the Science PoS

Pupils will use equipment correctly and safely to make careful observations and accurate measurements. They are required to present their work using tables.

Moon watch

Overview

This activity requires pupils to make a series of observations and measurements of the Moon over a four week period, keeping a record of the information collected. They are also encouraged to take photographs of the Moon over the same period.

Activity

Tell the pupils that they are going to make a series of observations and measurements of the Moon over a period of four weeks. To carry out their measurements, each pupil will need a compass and an inclinometer. Instructions for making a simple inclinometer are provided on the CD-ROM. It may be possible for pupils to make this measuring equipment in class. Encourage pupils to make their observations and measurements at the same time each evening and from the same place. After ensuring that pupils know how to make the relevant measurements, ask them to record the time and date of their observation, the direction of the Moon and the inclination and the shape of the Moon on the Enquiry Sheet. Since it may not be possible for pupils to make a recording of the Moon every night, encourage pupils to share their data. A digital camera could be used by the teacher or pupils to take a sequence of photographs of the Moon over the same four week period. Pupils' drawn record of their observations could be compared with these photographs.

Suggested questions

What difficulties did you have in using the equipment?
 How did you make sure your measurements were precise?
 What difficulties did you have in making your observations?
 Was the Moon visible every night? If not, why?
 How does the Moon change?
 Is the Moon always in the same position?
 Is the Moon sometimes visible during daytime?

Supplementary activities

Pupils could compare their own observations of the Moon with those reported in the local or national press.
 Pupils could design and make a model to show how the Moon appears to change shape.
 Some pupils may be able to cope with angular bearings instead of points of the compass.

Make observations and measurements of the Moon using the equipment you have available.

date of observation	time of observation	direction of Moon – N, NE, E, SE, S, SW, W, NW	inclination of Moon	drawing of the Moon's shape

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Moon data

**Links to skills in the Science PoS**

Using data presented by drawings, charts, tables, bar charts and line graphs, pupils make comparisons and identify and describe trends or patterns in data and information. They reflect on their work, suggesting how their method could have been improved.

Moon data**Overview**

This activity requires pupils to present data they collected and recorded for the previous activity – Moon watch – using a variety of chosen methods. Through peer review, they look for emerging patterns in data and suggest improvements in their work.

Activity

Pupils should be encouraged to organise the data they collected from the previous activity, in tables, charts and graphs. Some pupils will need help with the organisation of data.

Ask pupils to review each other's tables, charts and graphs, making suggestions for improvement.

In pairs, pupils should discuss their data and look for any patterns that emerge.

Suggested questions

What do you notice about the Moon's position in the sky?

How does the inclination of the Moon in the sky change?

What conclusions can you draw from these patterns?

Is it possible to predict what the position or shape of the Moon will be next week?

How could you present each set of data as a table, chart or graph?

Is the table, chart or graph you have drawn the best way to present this set of data?

What patterns can you see in your set of data?

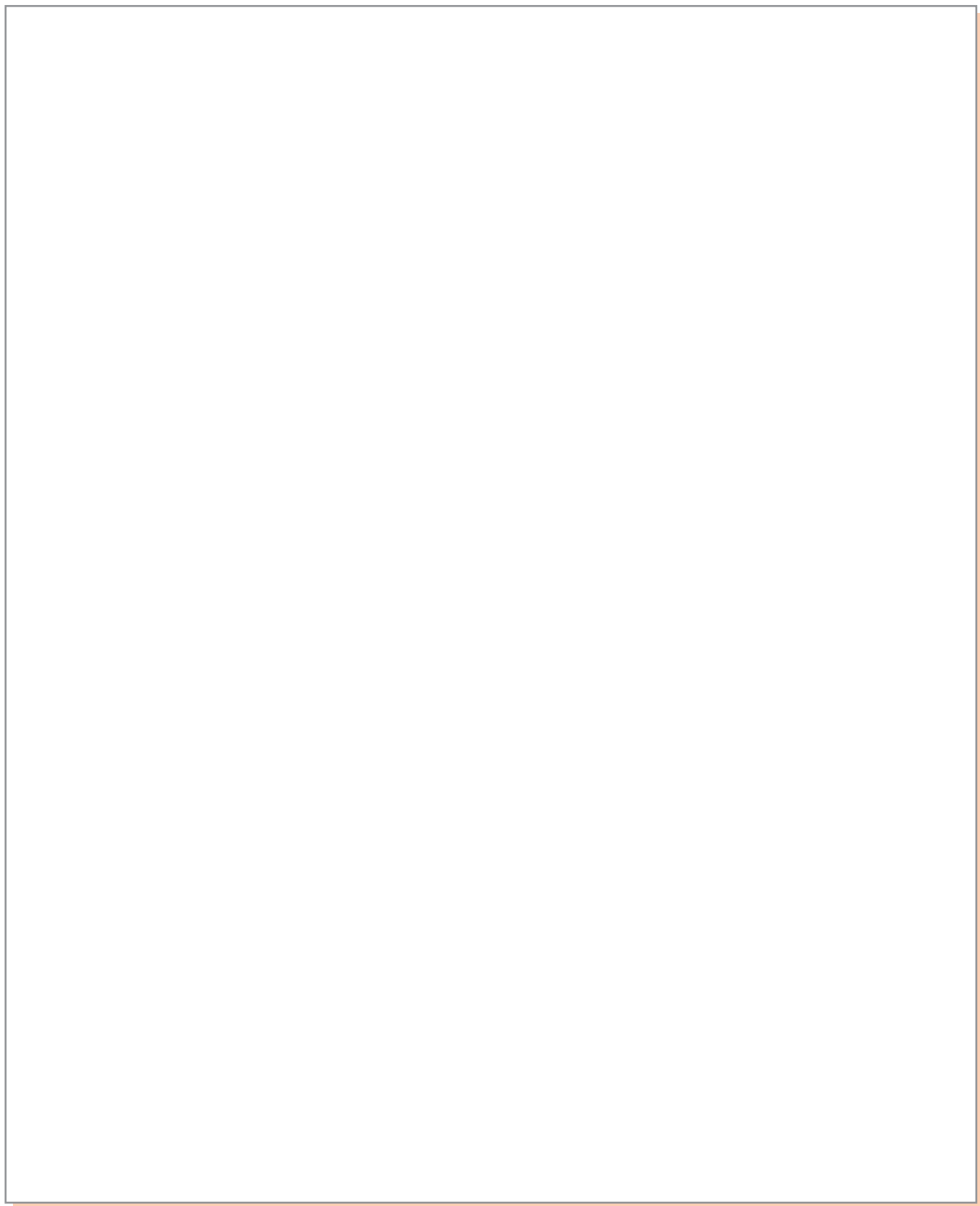
Supplementary activities

Pupils could find out about the names given to the full moon of each month, in myths and folklore.

Pupils could also find out about the harvest moon and decide if it is an optical illusion.

Pupils could explore the first moon landing, building up a fact file about, for instance, journey time, year, number and gender of astronauts etc.

Draw a sequence of diagrams to show how the Moon changes over a period of four weeks. Cut the sheet into four separate weeks and then put the drawings into a month long streamer.

A large, empty rectangular box with a thin black border, intended for drawing a sequence of diagrams showing the Moon's phases over a four-week period. The box is positioned centrally on the page, below the instructions and above the footer.

Levels 3–5

Resources

- ▶ Enquiry Sheet – Moon's surface
- ▶ binoculars / telescope
- ▶ Internet access
- ▶ telescope.org/ *
- ▶ schoolsobservatory.org.uk



Links to skills in the Science PoS

Pupils are given the opportunity to make predictions based on some previous knowledge and to use equipment correctly and safely to make careful observations. Working with their peers, pupils form considered opinions and make informed decisions, communicating their work by drawings and writing.

Moon's surface

Overview

This activity requires pupils to make factual or fictional statements about the surface of the Moon based on prior knowledge, for categorising as true or false by their peers. They are also required to record and compare the features of the Moon that have been observed using binoculars or a telescope.

Activity

Begin this activity by asking pupils to make a number of statements, and drawings, about the surface of the Moon.

Encourage the pupils to make any statements, including fictional statements, e.g. the Moon is made of cheese. Other pupils should then decide whether each statement is true or false, providing the reasoning behind their opinion in each case.

The pupils could then make a series of observations of the surface of the Moon using binoculars or telescopes, recording what they notice about the Moon's surface on the Enquiry Sheet. Encourage pupils to bring their drawings into school so that they can be compared with other pupils' drawings. In pairs, they should make a list of the features of the Moon that have been observed and compare these with evidence available on the Internet or relevant magazines.

Suggested questions

What features of the Moon's surface can you see?

How are people able to see the Moon?

Did you notice anything about the Moon that would support the idea that it is spherical?

What changes in the appearance of the Moon did you observe?

Is the surface of the Moon the same on all sides?

Supplementary activities

Pupils could compare their own observations with images they search for in books, magazines and on the Internet.

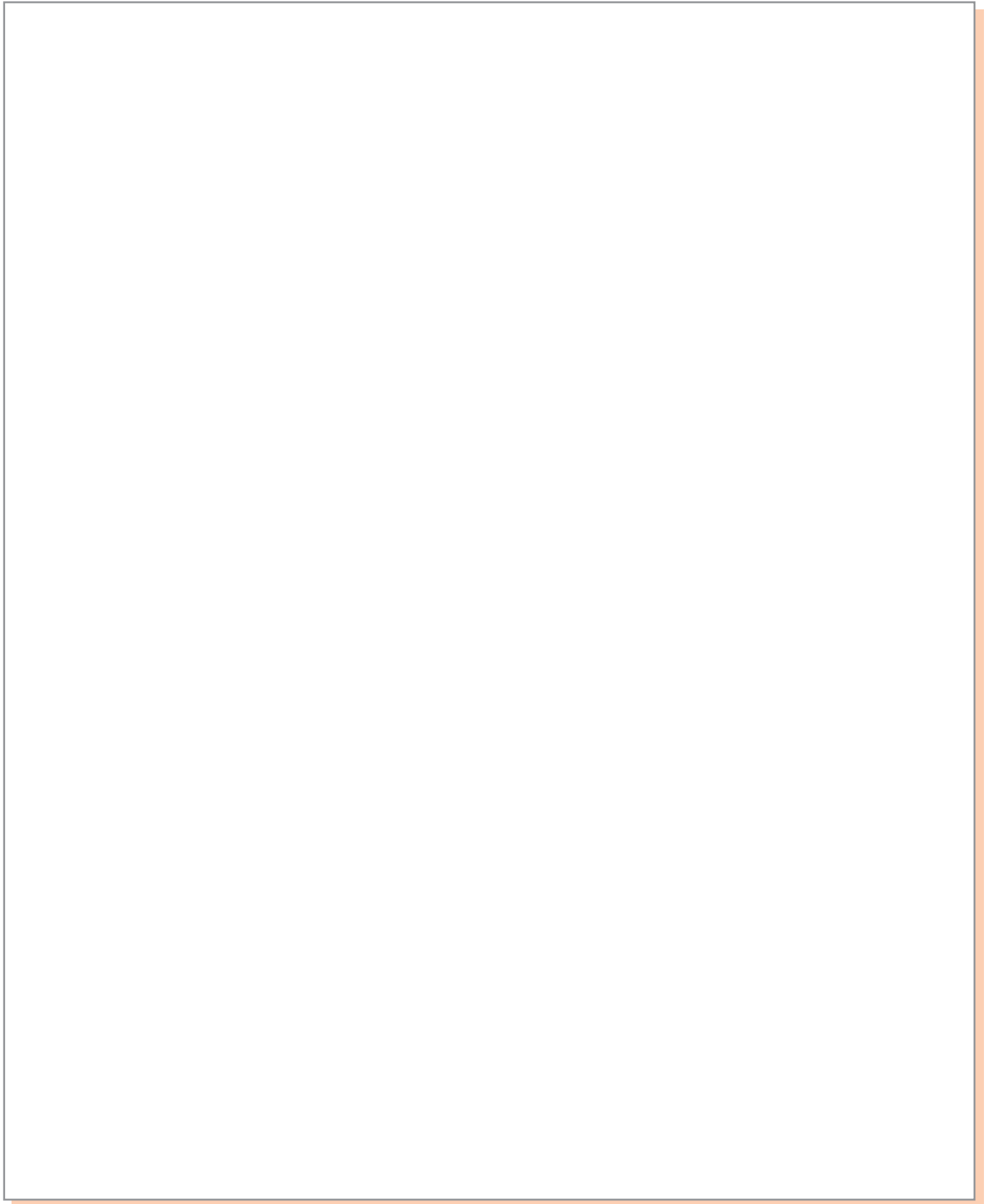
Pupils could make further observations of the Moon to see if they can see some of the features found during their search.

Pupils could make 3-dimensional models in clay, plasticine or papier mache of particular areas of the Moon, (see e.g. www.papiermache.co.uk).

* The web address in the resources list is the homepage of the Bradford Robotic Telescope (BRT). As well as providing a wealth of information, ideas and images for teachers and pupils, it provides learning programmes with a free log-in service that allows users to take their own images of the Moon and have the images sent back to them.

Draw clearly what you can see on the Moon's surface.

Exchange your drawing with a partner. Make a list of things on the Moon's surface that you and your partner have observed.

A large, empty rectangular box with a thin black border, intended for a student to draw the Moon's surface. The box is positioned in the center of the page, below the instructions. It is surrounded by a light orange border on the right and bottom sides.

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Apollo Moon landings
- ▶ video clips of the Moon landings from NASA website available on the CD-ROM
- ▶ Internet access
- ▶ www.nasa.gov

**Links to skills in the Science PoS**

Pupils are offered the challenge of considering different interpretations of events, forming considered opinions, searching for and selecting relevant scientific evidence from other sources.

Apollo Moon landings**Overview**

This activity encourages pupils to discuss and evaluate some of the evidence in relation to the 1969 Apollo Moon landings, giving consideration to the reasons why some people think that some of the photographs of the 1969 Moon landings were not taken on the Moon.

Activity

Discuss with the pupils the idea that information collected needs to be interpreted and that sometimes people, including scientists, disagree about its interpretation. Explain to the pupils that there are some people who do not believe that the Apollo Moon landings in 1969 actually happened. These people claim to have all sorts of evidence, including pictures taken by the astronauts, engineering details, and even some testimony by astronauts themselves to support their claim. Explain to the pupils that some people suggest the photographs on the Enquiry Sheet that have been used as evidence of the Moon landings may not have been taken on the Moon.

Ask pupils to look carefully at these photographs. They should think about and discuss some of the reasons why some people might think the photographs were falsified to make them look as if they were taken on the Moon.

Suggested questions

Photograph 1

Why are there no stars in the photograph?

Why does it look like wind is blowing the flag?

Photograph 2

If the Sun is the only light source on the Moon, how can the different length and direction of the astronauts' shadows be explained?

Photograph 3

This shows the first Apollo mission taking off to return to Earth. If all the astronauts were on board, who took the photograph?

Supplementary activities

Pupils might look for reports and evidence that UFOs have landed on Earth. They could develop an argument for or against the idea that UFOs have landed on Earth.

Some pupils might consider what we have learned about space over 40 years since the main landings and speculate about what we may learn in the future. Pupils might discuss whether or not humans could or should live on the Moon, or planets other than the Earth. They could discuss what would be needed to colonise planets other than Earth.

Many people believe that some of the photographs of the Apollo Moon landings in 1969 do not provide good enough evidence that the first landing on the Moon actually happened.

In your group, think about and discuss whether or not it is reasonable for people to think that these photographs must be forgeries. Share your ideas with the class.

1. An astronaut walks on the Moon.



Why are there no stars in the photograph?
Why does it look like wind is blowing the flag?

2. Two astronauts walk near each other on the surface of the Moon.



If the Sun is the only light source on the Moon, how can the different length and direction of the astronauts' shadows be explained?

3. The Apollo spacecraft takes off to return to Earth after the first Moon landing.



This shows the first Apollo mission taking off to return to Earth. If all the astronauts were on board, who took the photograph?

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Investigating Mars
- ▶ Internet access
- ▶ mars.jpl.nasa.gov

**Links to skills in the Science PoS**

Pupils are given the opportunity to form considered opinions and make informed decisions, communicating their work in writing.

Investigating Mars**Overview**

This activity encourages pupils to identify and explore things they would like to find out about Mars. They should describe the evidence and any samples they would collect in an investigation of Mars.

Activity

Tell pupils that orbiters such as Mars Express travel long distances from the Earth to find out about Mars. In 2003, Mars Express travelled to Mars and carried Beagle 2, a machine that could land on Mars. Beagle 2 had a camera and sensors so that it could collect samples and take photographs and measurements.

Ask pupils to imagine they are planning a similar mission to Mars. Ask them to work in pairs to think of things they would like to find out about Mars and the information they would like a space lander such as Beagle 2 to collect to help them find out these things.

They should describe the evidence they would collect, e.g. it could be samples, an observation, photographs, sounds or measurements. Ask pupils to describe the evidence in as much detail as possible and to record their ideas on the Enquiry Sheet.

Suggested questions

What would you like to find out about Mars?

What information would you collect if you were to compare Mars with Earth?

What size of sample would you collect?

What photographs could you take?

What measurements could you take?

Supplementary activities

Pupils could imagine they are looking for funding for this trip to Mars. They should agree who they should approach and explain their reasons.

Pupils could research what information different space missions to planets have actually collected and compare these findings with their own ideas.

Include the number of samples and the size of each sample.

[illegible]

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Astronauts on Mars?
- ▶ video camera

**Links to skills in the Science PoS**

Pupils are offered the challenge of forming considered opinions and making informed decisions, communicating their work in writing and using videos and ICT.

Astronauts on Mars?**Overview**

This activity requires pupils to list arguments 'for' and 'against' travel to Mars. They should sum up these arguments and the reasons for their final decision.

Activity

Explain to pupils that astronauts do not yet travel to Mars. Scientists first used machines like Beagle 2 to collect information about Mars before deciding whether or not astronauts should be allowed to travel to Mars. Ask pupils to think of arguments 'for' and 'against' allowing astronauts to travel to Mars and to record their ideas on the Enquiry Sheet.

Ask pupils to sum up their arguments so that they can decide whether they are 'for' or 'against' sending astronauts to Mars. They could prepare a short video clip of their ideas.

Suggested questions

What do you think might be gained from sending astronauts to Mars?
 What do you think might be the problems with sending astronauts to Mars?
 What evidence influenced your final decision?

Supplementary activities

Pupils could discuss the arguments 'for' and 'against' different aspects of space programmes, e.g. the development of a habitable space station on the Moon. They could consider how space travel might change over the next fifty years.

In pairs, think of arguments '**for**' and '**against**' sending astronauts to travel to Mars. Record your arguments on this diagram.

Then, use your arguments to make your final decision to answer the question: 'Should we send astronauts to Mars?'

**yes
to Mars
because:**

**no
to Mars
because:**

Our final decision is:

What influenced your final decision?
Plan and develop a presentation of your ideas.

Levels 3–5**Resources**

- ▶ Enquiry Sheet – Surviving on Mars

Links to skills in the Science PoS

Pupils are invited to make predictions based on some previous knowledge and to form considered opinions that they can justify.

Surviving on Mars**Overview**

This activity requires pupils to consider some of the items astronauts may need if they were to survive on Mars. They are encouraged to discuss the relative importance of each of the resources suggested, putting the items in rank order according to their importance.

Activity

Tell the pupils that some scientists believe that it may be possible to send astronauts to Mars in the next ten or twenty years. Ask the pupils to imagine it may be possible to live on Mars. They should think of things they would need in order to survive on Mars. Use the pupils' ideas to draw up a class list of items. Ask pupils to work in pairs to agree the importance of each of the items in the class list and place them in rank order on the Enquiry Sheet. The more important items should be placed at the top of the circle shape. Those of less importance should be placed underneath and so on*.

Encourage pairs of pupils to justify their decisions for listing the items in a particular order, to another pair of pupils.

Suggested questions

Are there any items that you will need on Mars that you do not need on Earth? Why do you think that each item is important?

Supplementary activities

The trip to Mars by Beagle 2 was not successful. Pupils could find out why it failed and what plans there are for future trips to Mars.

* *Diamond ranking is a strategy that promotes discussion or reflection about the relative importance of a range of factors. In this example, pupils can put together items of similar importance.*

Think of things that you would need to survive on Mars.

Working in pairs, put these things in rank order, from more important to less important.

The most important suggestions should go at the top of the circle.

Think carefully about your reasoning.

A large circle is centered on a light orange rectangular background. The circle is divided into three horizontal sections by two dashed orange lines. The top section is the smallest, the middle section is the largest, and the bottom section is the smallest. The text "more important" is written in bold black font above the top dashed line, and "less important" is written in bold black font below the bottom dashed line.

Tell another pair of pupils why you listed things in this order.

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