ACET Junior Academies'

Scheme of Work for Science

Big Idea – Our World

Year 5 – Earth and Space

About this unit:

PoS – Earth & Space

In this unit, students will be learning about the Earth and the Moon, and how their interactions with other planets and the Sun affect us here on Earth. We will be looking at how the light of the Sun, and reflections from the Moon, cause light, day and shadows. Students will have considered this in Y3, and will be going on to study light and shadows again in Y6; the focus in Y5 is on the light sources rather than their effects.

Following the common theme of year 5, we will be looking at scientists, and how they discovered/are discovering about space. The unit ties in with the History unit 'The Greeks', and we will look at the theories Ptolemy developed, and how later Copernicus changed them, and whether they had evidence for what they thought. In doing so, we will consider how scientists made observations and discoveries before the invention of telescopes, and look at how progress in science is tied in with the development of technology and tools to help the scientists. Students will see that scientists keep building on each others' knowledge. We will look at space exploration today, consider a diverse range of British scientists who are making exciting discoveries right now, and look at the different ways those scientists are going about their work.

You should have a globe available for students to use as reference during all of these lessons. Using a globe to represent the Earth where possible rather than a generic spherical object reduces the potential for misconceptions/confusion.

Unit structure

This unit is structured around seven science enquiries:

1. What is in space – and how do we know?
2. What did we know about space before we had telescopes?
3. Investigating the planets
4. Investigating moonlight
5. What makes night and day?
6. What can a sundial tell you?
7. What do you want to know about space?

Links to previous and future National Curriculum units

Y3 – Light

- Y6 – Light

KS3&4 Physics

Enquiry 1: What is in space – and how do we know?

Links to previous learning	Scientific skills	Assessment criteria	Curricular links
Previous Y5 work looking at scientists and how they work	EA - Identifying, grouping & classifying **Asking questions** Making predictions **Key concepts:** We are still finding out more about space all the time. Lots of different people are space scientists, and they work in different ways.	**Can your children:** - State one fact about space, and one thing they'd like to find out - Name a space scientist, and tell you about how they do their work	**Horizontal:** **Vertical:** KS3&4 Physics

Key terms	Common misconceptions
Earth, space, scientists, calculations, astronaut, disabled,	

Suggested activities	Resources	Useful links
Students to bring together all that they know about space. Can you group these into facts, things we think are true but aren't sure, and things that may not be true/that we have no evidence for. Watch the links – they are short and varied, give an insight into the different ways of exploring space, and introduce British scientists involved in the work. Stephen Hawking, Helen Sharman, Brian Cox, Tim Peake and Maggie Aderin-Pocock are all British scientists who have found out more about space. Not only cool facts, but things that will help on Earth. Class discussion should focus on how they come up with their ideas, and what they do to get proof? They watch the planets and stars moving in the sky. They do lots of maths/calculations to work out how things are changing. They listen to radio waves that come from the stars. They use various different telescopes, some of which are on Earth, some in space, to watch the light from different planets. They go in to space, and carry out experiments. They tell other people and scientists about what they find out, so that other people can come up with ideas and do even more observations, calculations and experiments.		https://www.natgeokids.com/uk/discover/science/general-science/stephen-hawking-facts/ https://www.youtube.com/watch?v=T8y5EXFMD4s Show the beginning of the clip – S Hawking https://www.youtube.com/watch?v=x0-nMl0jf5E Helen Sharman – Britain's first Astronaut. ** She is from Grenoside, and went to the University of Sheffield. https://www.youtube.com/watch?v=5xldz4EuV2U Watch the beginning of Stargazing Episode 1 with Brian Cox (just the introduction) https://www.bbc.co.uk/bitesize/topics/zw44jxs – Tim Peake https://www.youtube.com/watch?v=2Lz5UeROyXM Time Peake's dizziness experiment https://www.youtube.com/watch?v=0YTnTBpOLIs ***Brilliant video for engagement***

Homework/project work – investigate the different telescopes that are used around the world and in space. *GD how do the different telescopes gather information about space?* Find out about experiments that have been carried out in space – how will they be useful on Earth?		https://www.nasa.gov/mission_pages/station/research/experiments_category NASA – Experiments carried out on the space station https://www.mentalfloss.com/article/59639/12-cool-experiments-done-international-space-station 12 cool experiments done in space https://www.bbc.co.uk/bitesize/topics/zdrrd2p BBC – answers to lots of questions about space

<table>
<tr><th colspan="4">Enquiry 2: What did we know about space before we had telescopes?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA - Research

Asking questions
Making predictions
Interpreting and communicating data

Key concepts:
The Greeks thought that the sun and stars went around the Earth, because of how they appeared to move in the sky.
Scientists can only have theories – things they think must be right – until they get evidence to prove that they are right.</td><td>Can your children:
- Describe a change in our understanding of the solar system over time
- State that we now have evidence rather than theories, as we can use telescopes and space probes</td><td>Horizontal:
History – Ancient Greeks
Maths – circles and ellipses

Vertical:

KS3&4 - Physics</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Earth, Sun, planets, orbit, circular, elliptical, theory, evidence</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Ptolemy developed one of the first theories about Earth & Space. He believed that the sun and stars went around the Earth. GD students can look into why this model didn't really work. There were no telescopes – he found out by looking at how the sun and stars seemed to move across the sky.

Copernicus, many years later, considered Ptolemy's work, studied the planets he could see in the sky, and realised that the Earth and other planets go around the Sun. He had no telescopes – he observed the sun, stars and planets, and realised – by using maths – that Ptolemy's ideas were not quite right. He used maths to work out that it made sense that the planets went around the Sun. He couldn't actually prove his theories (ideas), but he could do calculations which made it seem like he was right.

50 years after Copernicus died, Galileo invented the telescope, which helped to prove Copernicus' was right about the position of the sun. However, Copernicus thought the planets went round the sun in perfect circles, but now we can take measurements, and use telescopes, we know that they move in ellipses – so he was wrong too!

Students could summarise how 'science' changed over time in a variety of methods.</td><td></td><td>https://amazing-space.stsci.edu/resources/explorations/groundup/lesson/basics/g37/
Ptolemy vs Copernicus

https://people.physics.carleton.ca/~watson/Physics/NSCI1000/Pseudo-science/Copernicus_vs_Ptolemy.html
How do we know who is 'right ' in science (resource for teachers not students)

https://www.bbc.co.uk/teach/class-clips-video/science-ks2-the-work-of-nicolaus-copernicus/z64skmn
Why Copernicus thought Ptolemy was wrong</td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 3: Investigating the planets</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA - Research

Asking questions
Making predictions
Interpreting & communicating data

Key concepts:
8 planets move in set orbits around the sun.
The distances involved are colossal, and should be put into perspective compared to distances on Earth/between the Earth and Moon.
GD could consider the Milky Way and other galaxies.</td><td>Can your children:
- Name the 8 planets,
- Discuss the scales involved – either distances, or how the orbits are not evenly spaced apart</td><td>Horizontal:
Maths - scale

Vertical:

KS3&4 Physics</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Earth, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, Sun, orbit, distance</td><td colspan="2">Students often think that the planets are evenly spaced from the sun outwards.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">The word planet is derived from the Greek word which means ‘wanderer’.

Students/teachers can explore this however suits them.

8 planets – Pluto has been changed to a ‘dwarf planet’ – opportunity for looking into why this has happened – it’s the furthest planet away, so the one we’ve always had least information about (we discovered, and looked at, the nearest ones first). As we got better telescopes, and better space probes, we found out more.

Learn the names of the planets and put them in order. Lots of good activities for looking at scale – the planets are not spread out evenly away from the sun.

Excellent opportunity for maths – orders of magnitude are useful here.
GD students could consider the concept of ‘light years’</td><td></td><td>https://www.bbc.co.uk/bitesize/topics/zdrrd2p</td></tr>
</table>

Enquiry 4: Investigating moonlight

Links to previous learning	Scientific skills	Assessment criteria	Curricular links
Y3 – Light	EA – Pattern seeking **Asking questions** Making predictions	**Can your children:** - Describe the difference between light from the Sun and the Moon - Describe the difference between theories and facts	**Horizontal:** D&T **Vertical:** KS3&4 Physics
	Key concepts: The Sun is a source of light, the Moon reflects light. Light travels in straight lines. Alhazen was one of the first scientists to look for **evidence** to back up his theories.		

Key terms	Common misconceptions
Sun, Moon, light, source, reflect, rays,	*Students are often confused by the fact that the image is reversed in a pinhole camera. The clip below explains it well – but if students are still unsure, they should be assured that the camera was evidence for some of the theories Alhazen had.*

Suggested activities	Resources	Useful links
What stories/legends do we know about the moon? Look at other planets, and investigate their moons. Do all planets have moons? What is the difference between a moon and a planet? *Planet orbits the sun, moon orbits a planet.* Model how the Earth moves round the sun, and the moon moves round the Earth – we will look at the effects of this (night and day etc) in the following lessons. See resource. Investigate Alhazen, a notable scientist who built on some of Ptolemy's ideas (and Euclid and Aristotle). He's known as the 'father of light'. He confirmed that light travels in straight lines, and that our eyes don't emit light (as the Greeks thought), but that we see light that shines, or is reflected, into our eyes. He also was the person who developed scientific investigations to **prove** the ideas/theories he came up with. Some people say this makes him the first proper scientist. Compare the sun and the moon – review learning about light.	Y5 Moon's movement Pinhole camera resource Eyeball, scalpel, sharp pointy scissors, chopping board, disinfectant	https://www.bbc.co.uk/teach/class-clips-video/science-ks2-the-work-of-the-father-of-optics-alhazen/zry7vk7 V good clip which illustrates the scientific theory, and how Alhazen developed it. https://www.youtube.com/watch?v=VK-x-8-JMwY Eyeball dissection – relevant up to about 1.30.

Light travels in straight lines. The sun is a source of light, the moon just reflects light. Alhazen used camera obscura (pinhole cameras) to show that light travels in straight lines. The clip explains this well. You could dissect an eye to show the students what's inside. This will not help with learning the aims of the lesson, but will really engage them, and reinforces what Alhazen was doing, which was actually investigating things to find them out (how the eye works), rather than thinking about them and just doing maths, like the Greeks did. *Note that both methods are valid – current day scientists like the ones in lesson 1 still have to 'think about things and do maths to prove them' until some other scientists invent even better telescopes to see all we want to see.* • Students could investigate planets that have different numbers of moons – and those that have none. • Students could investigate the effect of the moon's movements – tides etc.		

<table>
<tr><th colspan="4">Enquiry 5: What makes night and day?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="3">Y3 – Light and day</td><td colspan="2">EA – Pattern seeking

Asking questions
Making predictions</td><td rowspan="3">Can your children:
- State that it is the Earth rotating that leads to night and day
- Describe how the rotation of the Earth leads to different time zones</td><td rowspan="3">Horizontal:
Maths – calculating and interpreting time differences

Vertical:
KS3&4 Physics</td></tr>
<tr><td colspan="2">Key concepts:</td></tr>
<tr><td colspan="2">The relative positions of the Sun, Earth and Moon as the Earth rotates.
There are different time zones across the Earth, not just ‘night’ and ‘day’.
GD – discuss how the time zones have been set by humans- look at how they are not in straight lines like longitude lines.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Earth, axis, rotate, 24 hours, day, night, light, dark, morning, evening, midday, midnight, zone</td><td colspan="2">Students often confuse the significance of the Earth orbiting the Sun, and the Earth rotating on its axis.</td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Show how the Earth rotates, and that this affects how and where the light shines.
Use a chocolate orange to illustrate time zones – use this in conjunction with a map of the world that has time zones marked on it.

Maths opportunity – calculating differences in time in different places in the world.

Try and find opportunities to call someone in another country, or tune in to live breakfast TV in another country. You can look at live traffic cameras in different parts of the world, and try and guess what time of day it is.

Look at the live feed from the international space station – this orbits the Earth every 90 minutes. Can you tell which part of the Earth it is over at the moment? Is it day or night? Students can look out for the ISS passing overhead on clear nights.</td><td>Chocolate orange

Globe
Map of the world with time zones mapped
Spherical objects to model the Earth and the Moon</td><td colspan="2">https://www.bbc.co.uk/bitesize/clips/z38f9j6 The clip isn’t great, but it gives a good idea.
Night and day and chocolate orange

https://www.youtube.com/watch?v=EEIk7gwjgIM
NASA live stream from the international space station</td></tr>
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<table>
<tr><th colspan="4">Enquiry 6: What can a sundial tell you?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2">Y3 - Light</td><td>EA – Problem solving

Asking questions
Making predictions
Evaluating</td><td rowspan="2">Can your children:
- Describe how a shadow is formed
- Relate the time shown on a sundial to the position of the sun relative to the Earth</td><td rowspan="2">Horizontal:
D&T

Vertical:

KS3&4 Physics</td></tr>
<tr><td>Key concepts:
Light travels in straight lines. A shadow occurs when an object blocks light from behind it.
Rotating the Earth relative to the Sun is the same as changing the angle of a torch.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Earth, Sun, rotate, light, shadow, straight, block, time, position, angle</td><td colspan="2">Students often confuse the significance of the Earth orbiting the Sun, and the Earth rotating on its axis.</td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Build a sundial. Review information about light and shadows – light travels in straight lines, and the size of shadows depends on the distance and angle of the light.

Model how a sundial works by attaching a vertical object to a globe, and rotating it relative to a stationary light source.

Main focus – reinforcing understanding of the Earth moving relative to the sun.
Evaluate your sundial/a sundial – does it tell the time accurately? How could you make improvements to the sundial?

How did the Greeks use sundials?</td><td>Globe
Small object to act as a sundial
Method of attaching the ‘sundial’ to the globe
Stationary light source.</td><td colspan="2">http://www.bbc.co.uk/norfolk/kids/summer_activities/make_sundial.shtml
Making a sundial – see templates in resources</td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 7: What do you want to know about space?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="2"></td><td>EA - Problem solving

Asking questions
Making predictions
Setting up tests</td><td rowspan="2">Can your children:
- Recognise questions that scientists might be able to find answers to
- Suggest an ideas for how space scientists could research something</td><td rowspan="2">Horizontal:

Vertical:
KS3&4 Physics</td></tr>
<tr><td>Key concepts:
There are lots of things that we don't know about space.
In 15 years time, students who are currently in KS2 will be the ones making new discoveries.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Space, exploration, astronaut, International Space Station, space probe, telescope</td><td colspan="2"></td></tr>
<tr><th>Suggested activities</th><th>Resources</th><th colspan="2">Useful links</th></tr>
<tr><td>Students always have lots of questions about, and interest in space. This lesson can be used however suits the class – but try and bring a focus on scientists, and how they find out the things they do.

Students could design an experiment to find something out in space.

If they don't have any particular ideas, there are many school based investigations that have been carried out in space. Chris Hadfield has a huge resource of videos showing how to do different things in space (search Chris Hadfield on YouTube).</td><td>Space probe resource</td><td colspan="2">https://www.bbc.co.uk/bitesize/topics/zdrrd2p
BBC – answers to lots of questions about space</td></tr>
</table>