Earth and Space

Contextual Ideas

- In the solar system, the Earth, and other planets, revolve around the sun.
- The Sun, Earth and Moon are approximately spherical bodies.
- Day and night occur due to the Earth's rotation on its axis.
- The moon appears differently in the sky throughout a lunar month, as the position of the Moon around Earth and of the Earth around the Sun shift.

National Curriculum Objectives

- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- Describe the movement of the Moon relative to the Earth
- Describe the Sun, Earth and Moon as approximately spherical bodies
- Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.

Additional Support Resources

- Reach Curriculum: Y4 Space
- Switched on Science 2: Out of This World

Assessment Outcome

- Essay Question

Scientist Focus

- **Mae Jemison (1956-present)** First African-American woman to travel to space.
- **Galileo Galilei (1564-1642)** Astronomer who championed heliocentric model.
- **Nicholas Copernicus (1473-1543)** Heliocentric model.

Science In Action

	Question&PlanFairTest	Knowledge	• Plan different types of scientific enquiry to answer questions, including recognising and controlling variables where necessary. -Set variables as a class, in groups or individually (What variables **could** we change, to answer the enquiry question? What **will** we change? If we are changing x variable, what will we keep the same to make it a fair test?) -Make predictions • -Explain predictions linked to knowledge.
		Context	• Do all planets orbit at the same speed? Which planet orbits the fastest / slowest? • Predict, using their understanding of the position of the planets relative to the sun, which planet will have the quickest/slowest orbit. Back up their predictions with their research. • Investigate moon craters (Switched on Science 2) How does the height of the drop affect the size (width, depth) of the crater? If I keep the mass (weight) the same but change the shape, e.g. wider, what affect does it have on the size of the crater?
	Test	Knowledge	• Take increasingly accurate measurements, using a range of scientific equipment, taking repeat readings where appropriate.
		Context	• Encourage children to make their measurements as accurately as possible (crater experiment SOS), given that they are measuring flour, and to consider whether a repeat reading should be used.t
	Record	Knowledge	• **<u>Record more complex data using scientific diagrams, classification keys, tables, scatter graphs, bar and line graphs.</u>**
		Context	• Classify the planets into gas planets and rock planets. • Create classification keys to identify the different planets using their physical features. • Create line graphs which show the increase/decrease in daylight hours across the months in a year.
	FuturePredictions	Knowledge	• Use test results to make predictions to set up further comparative and fair tests.
		Context	• Children should use their results to suggest new questions, e.g.: How does the angle the object hits the Moon affect the size, depth or shape of the crater? What happens if I keep the object the same but change the surface, e.g. wet or dry?
	Report&Conclu	Knowledge	• Report and present findings, including conclusions from enquiries using oral and written presentations. Suggest whether test results are trustworthy.

	de	Context Knowledge	• Using their research about night and day and the movement of the earth, sun and moon, demonstrate their understanding of this to the class using physical objects, such as, globes, tennis balls and torches.
	Explain	Context	• **<u>Identify scientific evidence that has been used to support or refute ideas or arguments</u>.** • Using their research of Copernicus and Galileo on their theories of the solar system, persuade others how we know the sun is at the centre of the solar system. • **Essay Question**: How did Copernicus' and Galileo's theories about the solar system differ? • Children can take on the roles of these scientists and present arguments and refute the geocentric ideas of the time.

***Key Science in Action for this study identified is <u>underlined.</u>**

1	Session Question

Why do we have night and day?

Key Concepts		Vocabulary	
Celestial bodies Light		Celestial body Space Sun Earth Moon Orbit	Spherical Axis Leap year Night Day

Prior Knowledge (Retrieval) Year 3- Light

- As the Earth spins on its axis, the position of the sun in the sky changes.
- When one side of the Earth is facing the sun it is daytime for that part of the Earth.
- The side facing away from the sun is cooler and darker and experiences night.
- Due to the spin of the Earth on its axis, the sun appears to change position in the sky throughout the day.

Substantive Knowledge

- A celestial body is any natural object that is found in Space.
- The Sun, the Earth and the moon are examples of celestial bodies.
- Many celestial bodies orbit other celestial bodies.
- To orbit means when something moves around another object in a curved (often circular) path.
- The Earth orbits the Sun and the Moon orbits the Sun.
- In medieval times and before, it was commonly accepted that Earth was flat.
- Nowadays, we have photographic and other evidence to show that, like other planets and the Moon, Earth is spherical in shape.
- Earth and the Moon both move.
- Earth orbits the Sun once every 365 ¼ days and spins on its axis once a day (24 hours).
- The ¼ day adds up so that every four years, there is a leap year (366 days- 29 days instead of 28 days in February)
- Although when you look up into the sky the Sun seems to move around the Earth, this is an illusion: in fact the Earth spins and causes night and day.
- The part of the Earth that faces the Sun is in daylight and the part that is not facing the Sun is in darkness.

2	Session Question

What are the other planets in the solar system?

Key Concepts		Vocabulary	
Celestial bodies		Solar system Hydrogen Helium Rock Planets Mercury Venus Earth	Mars Jupiter Saturn Uranus Neptune Meteor Meteorite Asteroid Comet

Prior Knowledge (Retrieval)

- To orbit means when something moves around another object in a curved (often circular) path.
- The Earth orbits the Sun and the Moon orbits the Sun.
- Earth orbits the Sun once every 365 ¼ days and spins on its axis once a day (24 hours).
- Although when you look up into the sky the Sun seems to move around the Earth, this is an illusion: in fact the Earth spins and causes night and day.
- The part of the Earth that faces the Sun is in daylight and the part that is not facing the Sun is in darkness.

Substantive Knowledge

- Our Solar System has a large star, the Sun, at its centre and eight planets and their moons, which orbit the Sun.
- The Sun is a very large ball of very hot gases. The main gases in the Sun are called Hydrogen and Helium.
- As the Sun is so hot, these gases are knocked together very hard which makes the Hydrogen turn into Helium. This releases lots of heat and light.
- Planets are large pieces of rock in the shape of a sphere. They formed a long time ago and orbit the Sun, usually in a roughly, circular path.
- All planets have almost circular orbits that lie within a nearly flat disc called the ecliptic plane.
- The vast majority of the Solar System's mass is in the Sun, with most of the remaining mass contained in Jupiter.
- The planets in order of their distance away from the Sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- The four smaller inner planets, Mercury, Venus, Earth and Mars, are mainly composed of rock.
- The four outer planets, called the 'gas giants', are substantially more massive.
- The two largest, Jupiter and Saturn, are composed mainly of hydrogen and helium.
- Moons are balls of rock that orbit around planets.
- Different planets have different amounts of moons and they are at different sizes. For example, the largest moon in the solar system is known as Ganymede which so large that it is bigger than Mercury, the planet closest to the Sun.

- Some large objects, like Pluto, are now classified as dwarf planets.
- There are a range of large rocks which are not orbiting planets so do not count as moons. They can be categorised as meteors, meteorites, asteroids and comets.
- Asteroids are large chunks of rock that also orbit the Sun at a set distance (they are mainly found in the asteroid belt between Mars and Jupiter). Whereas planets are the only objects in their orbit, asteroids will have lots of other objects in the orbit that they are in.
- Comets are large chunks of ice and dust that also orbit the Sun but move very close to the sun and then very far away from the sun as part of their elongated orbit.
- Meteoroids are parts of asteroids or comets that have been knocked or fallen away. If a meteoroid comes into our atmosphere, it becomes a meteor. If a meteor reaches the earth's surface we call it a meteorite.
- Mae Jemison was the first African-American woman astronaut to travel to space.

3	Session Question

How was the solar system discovered?

Key Concepts		Vocabulary	
Celestial bodies		Geocentric Heliocentric Nicolaus Copernicus Galileo Galilei	

Prior Knowledge (Retrieval)

- Our Solar System has a large star, the Sun, at its centre and eight planets and their moons, which orbit the Sun.
- The planets in order of their distance away from the Sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- The four smaller inner planets, Mercury, Venus, Earth and Mars, are mainly composed of rock.
- The four outer planets, called the 'gas giants', are substantially more massive.
- The two largest, Jupiter and Saturn, are composed mainly of hydrogen and helium.
- Different planets have different amounts of moons and they are at different sizes.
- Some large objects, like Pluto, are now classified as dwarf planets.
- There are a range of large rocks which are not orbiting planets so do not count as moons. They can be categorised as meteors, meteorites, asteroids and comets.

Substantive Knowledge

- The model of the Solar System has been refined over many centuries.
- Geocentric: (Earth-centred) the Earth is at the centre of the Solar System
- Heliocentric: (Sun-centred) the Sun is at the centre of the Solar System. The belief that the Sun is at the centre of the Solar System is heliocentrism.
- https://www.bbc.co.uk/teach/class-clips-video/science-ks2-the-work-of-nicolaus-copernicus/z64skmn
- Aristotle (384 BC–322 BC) proposed the geocentric model, with Earth at the centre of the Universe. The five known planets (Mercury, Venus, Mars, Jupiter and Saturn), the Moon, the Sun and the stars moved around Earth in perfect spheres.
- Ptolemy (c. 90–168 AD) refined the geocentric theory. Ptolemy said they did not travel in exact spheres but moved around the spheres on elliptic orbits, turning around on themselves.
- Alhazen (965–1038 AD) first used maths to describe the motions of the planets.
- Nicolaus Copernicus (1473–1543) made accurate observations of the Moon and the planets. He used maths to show that their movements could be explained much better if he put the Sun at the centre of the Solar System.
- Johannes Kepler (1571–1630) used maths to show that the orbit of a planet is an ellipse with the Sun at its focus and that it moves faster when it is closer to the Sun than when further away.
- Galileo Galilei (1564–1642) championed the heliocentric model and used telescopes to show that Jupiter had moons. A devout Roman Catholic, Galileo came into conflict with the church by challenging its doctrines. Hence, the biggest argument in history.

4	Session Question

What are the phases of the moon?

Key Concepts		Vocabulary	
Celestial bodies		Moon Phases Full moon Half moon First quarter Third quarter	Waxing Waning Gibbus Eclipse Solar Lunar

Prior Knowledge (Retrieval)

- Geocentric: (Earth-centred) the Earth is at the centre of the Solar System
- Heliocentric: (Sun-centred) the Sun is at the centre of the Solar System. The belief that the Sun is at the centre of the Solar System is heliocentrism.
- Nicolaus Copernicus (1473–1543) made accurate observations of the Moon and the planets. He used maths to show that their movements could be explained much better if he put the Sun at the centre of the Solar System.
- Galileo Galilei (1564–1642) championed the heliocentric model and used telescopes to show that Jupiter had moons. A devout Roman Catholic, Galileo came into conflict with the church by challenging its doctrines. Hence, the biggest argument in history.

Substantive Knowledge

- The moon does not produce any of its own light so it could have been the case that we wouldn't see it at all.
- The reason we can see the bright side of the moon is because the sun's light is shining on the moon as well as the Earth.
- When we can see a part of the moon, it is because we can see the part that the Sun is shining on.
- However, because the moon is always moving, we only see this part of the moon and sometimes can't see it at all.
- We call these changes in the moon's appearance the phases of the moon.
- Before modern calendars, people used to keep track of the days by watching the phases of the Moon.
- One full cycle of the Moon's phases is approximately 28 days, which is very close to the amount of time we now know as one month.
- Its regular movement around Earth, as seen by its phases, gives rise to one 'month of time'.
- As the moon, Earth, and the sun go through their orbital dance, the part of the moon that's illuminated by sunlight moves in and out of our view, creating a predictable series of lunar phases.
- In any given month we see eight distinct phases of the moon, defined by how much of the lunar disk is illuminated from our perspective and whether the moon is heading toward or away from being full.

- New moon: During this phase the moon is between Earth and the sun, which means none of the lunar half we see is illuminated, and the moon becomes nearly invisible in the night sky.
- Waxing crescent: As the moon's illuminated surface increases, it's in a stage known as waxing, and it's a crescent as long as it's less than half full.
- First quarter: This is the phase when half of the moon is illuminated and the percentage of the lit surface is still increasing.
- Waxing gibbous: When the moon is more than half full and still increasing its illuminated surface, it's called waxing gibbous.
- Full moon: In this phase, the moon is behind Earth with respect to the sun, and its face is fully illuminated.
- Waning gibbous: This is the stage when the moon is more than half lit but the illuminated surface we can see is decreasing.
- Last quarter: During this phase, the moon is once again half illuminated, but the lit area that's visible is on the decline.
- Waning crescent: As the next new moon nears, the moon shrinks back to a crescent that's less than half full.
- Full moon: One of the most dramatic sights in the night sky—occur every 29.5 days or so, as the moon moves to the side of Earth directly opposite the sun.
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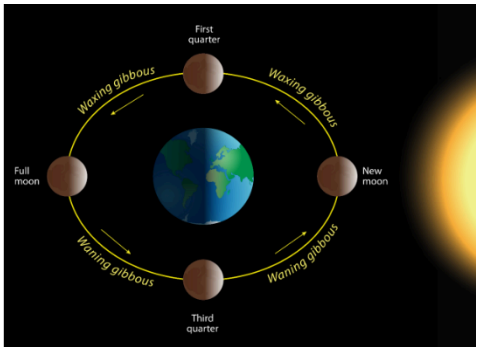

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- https://www.bbc.co.uk/bitesize/clips/z3jd7ty
- An eclipse takes place when one objects blocks light from hitting another object.
- On Earth, we experience two types of eclipse – a solar eclipse and a lunar eclipse.
- During a solar eclipse, the sun’s light is blocked out by the moon which makes it dark for people on the Earth for a short time. This is because the Moon casts a shadow on the Earth.
- During a lunar eclipse, the sun’s light is blocked out by the Earth which makes a full moon become dark for a short time. This is because the Earth casts a shadow on the Moon.

5	Session Question

What are stars and star constellations?

Key Concepts		Vocabulary	
Celestial bodies Life cycles		Stars Dust Gas Nuclear fusion Hydrogen Helium	Red giant Blue giant Constellation Orion Telescope

Prior Knowledge (Retrieval)

- The reason we can see the bright side of the moon is because the sun's light is shining on the moon as well as the Earth.
- When we can see a part of the moon, it is because we can see the part that the Sun is shining on.
- However, because the moon is always moving, we only see this part of the moon and sometimes can't see it at all.
- We call these changes in the moon's appearance the phases of the moon.
- One full cycle of the Moon's phases is approximately 28 days, which is very close to the amount of time we now know as one month.

Substantive Knowledge

- Stars are balls of gas burning across space in the universe but there are different types of star and each star goes through a number of stages.
- Before a star is created, dust and gas can be found across space in large amounts. Over time, gravity pulls these bits of dust and gas together so that they form large clumps of dust and gas.
- As more and more dust and gas is pulled in, this ball of dust and gas begins to get very hot indeed. Eventually, when it is hot enough, the ball ignites in a process called nuclear fusion. It shines brightly and gives off heat – it has become a star.
- For a very, very long time, the star uses up the Hydrogen it has to keep shining and giving off heat and light. This is what our Sun is doing at the moment.
- Eventually (after billions of years), it runs out of Hydrogen and begins to use Helium. This makes it much, much bigger and change colour as it becomes a Red Giant star.
- After a while longer, it will run out of Helium. This makes the star collapse and release a lot of material which may later form rocks, dust, planets and stars of the future.
- This leaves behind a glowing core that slowly cools down and disappears.
- Humans have been fascinated by stars for a very long time, wondering what they were. For a long time, they were associated with gods and legends. Many of the greek and romans that studied them, grouped them in constellations.
- Constellations are stars that you join together in your mind to look like a shape.
- For example. The constellation Orion includes a series of stars which created the rough shape of a hunter holding a bow and arrows.
- Sometimes it may take some imagination to see the shapes but it has helped people map out different skies across the sky.

- As telescopes were created and we were able to see stars more closely, we have found there are actually a range of stars.
- Very large stars tend to be called either Blue Giants or Red Giants.
- Stars that are more red are not as hot on the outside and stars that are closer to blue are the hottest ones and are brighter.
- There are also stars called dwarf stars that are much smaller and do not burn as brightly. They can be yellow, orange, red and brown depending on how hot they are and how much light they give off.