St Julian's Knowledge Organiser - SCIENCE- Earth and Beyond - Year 5/6

National Curriculum learning objective (Physics)	• 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	
Vocabulary:	Earth, Sun, Moon, Axis, Rotation, Day, Night, Phases of the Moon, star, constellation, gravity, sphere/spherical, planets and names of each planet, solar system, eclipse, shadow Aldebaran, Arctic, Antarctic, British Summer Time, Earth, Greenwich Meridian, International Date Line, Jupiter, Mars, Mercury, Milky Way, Moon, North Pole, Saturn, South Pole, Sun, Neptune, Universe, Uranus, Venus, asteroid, autumn, axis, compass, crescent, dawn, degrees, dusk, equator, equinox, fixed stars, Full Moon, galaxy, gibbous, hemisphere, horizon, illuminate, leap year, longitude, lunar month, meridian, nebula, New Moon, northern, orbit, planet, reflect, rotate, rotation, solar system, solstice, southern, spin, spring, star, summer, sunrise, sunset, telescope, temperature, tilt, time zone, waning, waxing, winter, year	
Essential prior knowledge / vocabulary to check:	• observe changes across the 4 seasons • observe and describe weather associated with the seasons and how day length varies • *Observe the apparent movement of the Sun during the day.* light, dark, shadow, solar system, Earth, sun, moon, Summer, Spring, Autumn, Winter, Sun, Day, Moon, Night, Light, Dark	
National Curriculum learning objective (Working Scientifically)	• planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments	**Suggested enquiries:** **Asking Questions** **Pattern Seeking**: How does the Earth's rotation cause night and day? **Observing over time**: How does the Earth's rotation cause shadows to change during the day? **Research using Secondary Sources**: How close / far away are the planets in our solar system away from the sun?
Vocabulary:	what, how, why, when, question, observe, pattern, test, measure, compare, enquiry, function, relationship, notice, group, classify, answer, scientific phenomena, analyse, systematic, abstract, theory, justify	

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	patterns, relationships, cause, effect, data, changes, similarities, differences, predict, question, observations, conclude, improve, investigate further, causal, interpret, data, graphs and charts, anomaly, atypical, typical, impact notice, patterns, observations, careful, accurate, evidence, increase, decrease, predict, conclude, relationships, appearance, unit measurements, accuracy, precision, unit measurements secondary source, practical investigation, argument, movement, opinion, fact
Essential prior knowledge/skills to check:	● asking relevant questions and using different types of scientific enquiries to answer them ● setting up simple practical enquiries, comparative and fair tests ● making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers ● gathering, recording, classifying and presenting data in a variety of ways to help in answering questions ● recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables ● reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions ● using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions ● identifying differences, similarities or changes related to simple scientific ideas and processes ● using straightforward scientific evidence to answer questions or to support their findings.
Suggested sequence of learning	Prior learning check: seasons, day and night Follow Snap Science sequenced lessons. This is a 2-term unit of learning.
Useful facts to support teaching this unit	● Stars are held together in a galaxy by gravity. (Our star, the Sun, is in the Milky Way galaxy.) 'Constellation' is not a scientific term but is commonly used for a pattern of stars in a clearly defined area of the sky. These stars may be vast distances apart and in different galaxies. The stars are called fixed because they were long believed not to move. ● Galaxies rotate: the distances between them are so great that this can only be detected using modern scientific equipment. The sky today looks as it did thousands of years ago and many of the constellations were named in ancient times. ● When viewed from above the North Poles of the Sun and the Earth, the Earth and other planets orbit the Sun anticlockwise, causing an apparent shift in the positions of the stars over the year. This is not to be confused with the apparent rotation of the stars around the North Star Polaris, which is caused by the Earth's rotation. ● The ancient Sumerians (3rd millennium BCE) based time around the number 60 – the smallest number divisible by every number from 1 to 6. This simplifies fractions based on 60: an hour can easily be divided into segments of 30, 20, 15, 12, 10, 6, 5, 4, 3, 2 and 1 minute. The measurement of angles is based around 60 for the same reasons, making the analogue clock face ideal for measuring time. ● Shadow clocks could be based on an ancient Egyptian sun clock from before 1500 BCE, which was rotated once a day at noon in order to tell the time in both morning and afternoon.

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	● Places that are close to each other have sunrise and sunset at different times so, historically, cities and villages agreed to local times, but this caused problems as industrialisation and rail travel developed. Great Britain and Ireland adopted the local time of London (Greenwich) as standard time. In the United States and Canada the times of sunrise and sunset differ enormously across the country, so railway companies specified junctions where changes in time were made. ● Increased communication and travel brought the need for global agreement on dates and times. An international congress met in Washington DC in 1884 where the world was divided into 24 time zones (one for each hour of the day), each covering 15° of longitude. The time for each zone is that of the meridian (line of longitude) that passes through its centre. As the Earth's rotation, and with it sunrise and sunset, is a continuous process, a starting point was established. This is the meridian that passes through the Greenwich Observatory (the zero or prime meridian). ● Children might think seasons occur because the Earth is nearer to the Sun in the summer and farther away in winter. The slight variation in the Earth's distance from the Sun, due to the Earth's elliptical (rather than circular) orbit, is not the cause. It makes no detectable difference because of its vast distance from the Sun. The tilt of the Earth's axis angles either the northern or southern hemisphere towards the Sun in the summer and away from it in winter, with midway points in spring and autumn. Day and night are the same lengths on the equinoxes: September 22nd/23rd and March 20th. The solstices are the 'longest' and 'shortest' days (with the longest or shortest period of daylight): June 20th/21st and December 22nd/23rd. Arctic and Antarctic regions have 24-hour, or almost 24-hour, daylight or night. Days and nights in tropical and equatorial regions are equal, or almost equal, in length throughout the year. Daylight Saving, in which clocks are adjusted by an hour (for example, British Summer Time), affects times in many countries.
Common misconceptions	● Children often think that day and night are caused by the Earth orbiting the Sun (or even the Sun orbiting the Earth, rather than the Earth's rotation on its axis). ● Children may think that stars are 'star-shaped' with five points. ● Children may think that the Moon gives out light – actually it reflects light from the Sun. ● Children may consider the Universe to be the same thing as the solar system, with no other suns or planets; a solar system is a star with planets orbiting round it; a galaxy consists of hundreds of billions of stars, all of which are potential solar systems. ● Children may think that the change in shape of the Moon during the course of a month is to do with light being blocked because of shadows, when it is actually caused because the portion of the Moon and the Sun's reflection on it keeps changing, so we see it part-illuminated.

Threshold Concept	**Learning**	**Scientific enquiry skills to teach, use, apply and deepen**	**Milestone expectations**
Physics - Earth in Space Throughout this unit children should be using the skills of **asking questions**: *Children independently ask scientific questions. This may be stimulated by a scientific experience or involve asking further questions based on their*	**Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.** To describe the shapes, positions and movement of the planets in the solar system and some of the differences between these and stars By the end of this lesson they know about the shapes and positions of the Earth and other planets in the solar system, their relative sizes and orbits around the Sun. They have some idea about where our solar system is in the Universe.	**Research using Secondary Sources**: How close / far away are the planets in our solar system away from the sun? *Recognise which secondary sources will be most useful to research their ideas.* *Identify scientific evidence that has been used to support or refute ideas or arguments.* *Separate opinion from fact.*	**1) Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.** *B: Describe the movement of the Earth relative to the Sun. Label and describe our solar system. Answer questions about the scientists who first observed the Earth's movement around the Sun. Describe how the movement of the Earth gives rise to seasonal changes.* *A: Explain why the Earth's movement gives rise to the seasons. Explain why the effect of the Earth's movement on seasons is more acute further away from the equator.*
	Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.	**Research using Secondary Sources**	

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developed understanding following an enquiry. *Children explore and talk about ideas, ask their own questions about scientific phenomena, analyse functions, relationships and interactions more systematically.* *They begin to recognise more abstract ideas and begin to recognise how these ideas help them to understand how the world operates.* *They begin to recognise scientific ideas change and develop over time.* *Given a wide range of resources the children decide for themselves how to gather evidence to answer a scientific question (including observing changes over different periods of time, noticing patterns, grouping and classifying, carrying out comparative and fair tests and finding things out using a wide range of secondary sources of information.) They choose a type of enquiry to carry out and justify their choice.*	**Describe the Sun, Earth and Moon as approximately spherical bodies.** To use a model to describe and compare the movements of different planets in space By the end of this lesson children know that a year is the time a planet takes to orbit the Sun and that for the Earth this takes 365¼ days, so that every four years we have a 'leap year' with an extra day (366 days). NB - The SS lesson only covers the movement of the planets. Teachers will need to also teach about the sun, earth and moon as approximate spheres and the reasons for this.	*Recognise which secondary sources will be most useful to research their ideas.* *Identify scientific evidence that has been used to support or refute ideas or arguments.* *Separate opinion from fact.*	*D: True or false: A year is always 365 days, no matter where one is in our solar system? Relate your knowledge of the Earth's movement relative to the Sun to time zones. Assess the significance of this to our daily lives. Do you agree: At any time of day it is always 5 O' Clock somewhere on Earth.* **2) Describe the movement of the Moon relative to the Earth.** *B: Identify and label the Moon and Earth. Describe the Moon's movement relative to the Earth. Answer questions about theMoon's movement relative to the earth. Observe, name and record the phases of the Moon.* *A: Explain why the moon's movement affects the tides of oceans and seas on Earth. Explain how we can predict the times of high and low tides.* *D: Could this be true: the shape of the moon's phases is a natural calendar? Is it possible (prove or disprove) to calculate how long until a particular moon shape will appear again? Explain the concept of a leap year.* **3) Describe the Sun, Earth and Moon as approximately spherical bodies.** *B: Observe pictures and videos of the Sun, Earth and Moon and describe them using mathematical vocabulary.* *A: Explain , using your knowledge of gravity, why the Sun, Earth and Moon are almost spherical.* *D: Investigate reasons why planets and moons are not completely spherical. Explore terms such as 'equatorial bulge' and suggest an experiment that would prove this phenomenon.* **4) Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky.**
	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky. To use a model or diagram to explain the effect of the Earth's rotation in space. By the end of this lesson they understand that the Earth's rotation causes night and day.	**Pattern Seeking**: How does the Earth's rotation cause night and day? *Children can identify patterns that might be found in the natural environment.* *Children can interpret data and find patterns.* *Children look for different causal relationships in their data and identify evidence that refutes or supports their ideas.* *children identify results that do not fit the overall pattern*	
	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky. To make a shadow clock and test its accuracy In this lesson children build on their learning about how the Earth's rotation makes the Sun appear to move across the sky. They test different types of shadow clock. Children record the position and length of a shadow and by the end of this lesson have evaluated the accuracy and potential uses of their clocks.	**Observing over time**: How does the Earth's rotation cause shadows to change during the day? *Children make their own decisions about what observations to make, what measurements to use and how long to make them for and whether to repeat them.* *The children select measuring equipment to give the most precise results e.g. ruler, tape measure or trundle wheel, force meter with a suitable scale.* *They take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings where appropriate. Measurements are accurate and precise – N, g, kg, mm, cm, mins, seconds, cm²V, km/h, m per sec, m/ sec Graphs – pie, line, bar (Year 6)*	

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		Children can make a set of observations and say what the interval and range are. *During an enquiry, children make decisions e.g. whether they need to: take repeat readings (fair testing); increase the sample size (pattern seeking); adjust the observation period and frequency (observing over time); or check further secondary sources (researching); in order to get accurate data (closer to the true value).*	*B: Draw, label and describe how the Earth's rotation gives rise to day and night.* *A: Explain and demonstrate how and why a sundial, used to tell the time, works.* *D: At night, sun dials do not work. Suggest or investigate other ways one could tell the approximate time using views of the night sky.*
	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky. To use a model to explain why sunrise and sunset occur at different moments in time in different parts of the world By the end of this lesson children are able to explain changes in sunrise and sunset times through the year and use a map to find times around the world.	**Research using Secondary Sources** *Recognise which secondary sources will be most useful to research their ideas.* *Identify scientific evidence that has been used to support or refute ideas or arguments.* *Separate opinion from fact*	
	Describe the movement of the Earth, and other planets, relative to the Sun in the solar system. To explain how the Earth's tilt leads to seasonal changes By the end of the lesson children are able to explain that the Earth's tilt causes seasons, and how seasons in the northern hemisphere differ from those in the southern hemisphere and from those in tropical regions.	**Observing over time** *Children make their own decisions about what observations to make, what measurements to use and how long to make them for and whether to repeat them.* *The children select measuring equipment to give the most precise results e.g. ruler, tape measure or trundle wheel, force meter with a suitable scale.* *They take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings where appropriate. Measurements are accurate and precise – N, g, kg, mm, cm, mins, seconds, cm²V, km/h, m per sec, m/ sec Graphs – pie, line, bar (Year 6)* *Children can make a set of observations and say what the interval and range are.* *During an enquiry, children make decisions e.g. whether they need to: take repeat readings (fair testing); increase the sample size (pattern seeking); adjust the observation period and frequency (observing over time); or check further secondary sources (researching); in order to get accurate data (closer to the true value).*	

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	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky. To be able to explain how the Earth's tilt affects the times of sunrise and sunset in different places at different times of the year By the end of the lesson children are able to explain how the Earth's tilt affects the times of sunrise and sunset in different places at different times of the year.	**Research using Secondary Sources** *Recognise which secondary sources will be most useful to research their ideas.* *Identify scientific evidence that has been used to support or refute ideas or arguments.* *Separate opinion from fact*	
	Describe the movement of the Moon relative to the Earth. To identify the phases of the Moon and explain why these occur By the end of the lesson the children are able to explain that the Moon looks as if it changes shape because, although half of it is always illuminated by the Sun, we can't always see the entire illuminated half from the Earth.	**Observing over time** *Children make their own decisions about what observations to make, what measurements to use and how long to make them for and whether to repeat them.* *The children select measuring equipment to give the most precise results e.g. ruler, tape measure or trundle wheel, force meter with a suitable scale.* *They take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings where appropriate. Measurements are accurate and precise – N, g, kg, mm, cm, mins, seconds, cm²V, km/h, m per sec, m/ sec Graphs – pie, line, bar (Year 6)* *Children can make a set of observations and say what the interval and range are.* *During an enquiry, children make decisions e.g. whether they need to: take repeat readings (fair testing); increase the sample size (pattern seeking); adjust the observation period and frequency (observing over time); or check further secondary sources (researching); in order to get accurate data (closer to the true value).*	
Assessment of learning task and/or title of double page spread outcome	Teachers should assess children's learning of knowledge and vocabulary frequently throughout the unit. Use recap, refresh and revision to start the unit and each lesson. Use the BAD outcomes to assess depth of learning each lesson against the 4 expected outcomes for this unit. Teachers should refer to the milestone expected outcomes for scientific enquiry when assessing these skills (see St J's Science Progression Document)		

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Assessment of the National Curriculum Objective by applying understanding of Threshold Concepts and demonstrating Milestones/Skills.	