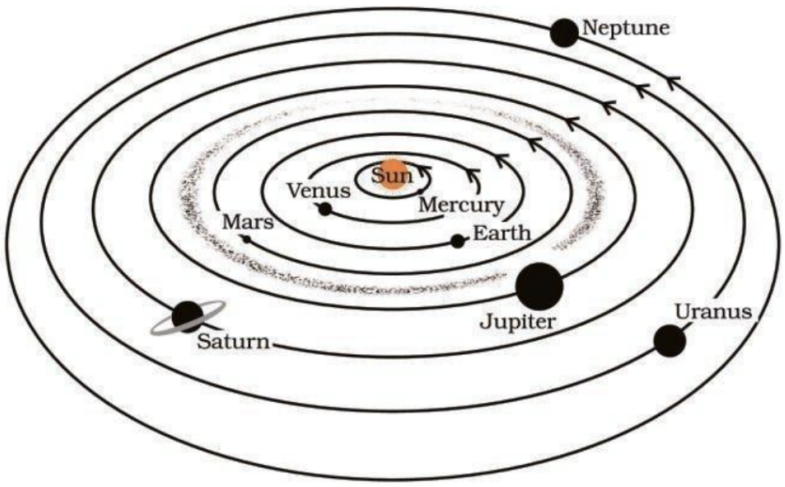
The Moon And Stars In My Life (Level 3)

Description	Learners will explore celestial bodies and how they are connected to our day-to-day lives. They will then make their own rockets that can travel to distant planets and capture details of imagined alien lives that exist on them.
Leading question	How are the celestial bodies related to our daily lives?
Subjects covered	Science, Art and Design, English, Math
Total time required	40-50 minutes a day for 5 days
Resources required	Clay, flashlight (or a cellphone with a flashlight), ball, tape, pencil, straw, and marker *Optional*: a globe
Learning outcomes:	By the end of this project, learners will be able to: Knowledge-Based Outcomes: 1. Explain how days, nights, and seasons occur. 2. Observe and draw the phases of the Moon. 3. Describe the solar system and identify the key celestial objects visible from the Earth. 4. Define a constellation and identify some commonly known constellations. 5. Understand the importance of artificial satellites. 21st Century Skill Outcomes: 1. Creatively design an alien and imagine the details of alien life on a celestial body. 2. Critically think and relate the effects of celestial bodies and planetary movements on their daily lives. 3. Effectively communicate while describing the imagined alien life and explaining the design of their rockets. 4. Collaborate with adults to understand the roles of the Sun, the Moon, and various constellations in our lives.
Previous Learning	None
Supervision required	Medium

Day 1 -

Today, you will learn about celestial objects and their movement.

Time	Activity and Description

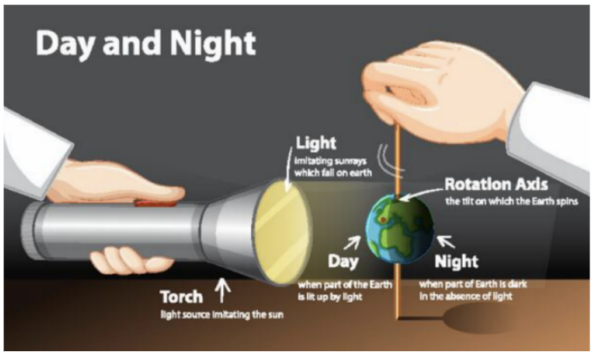
5 minutes	Let us imagine that all of us are astronomers (*an astronomer is a scientist who studies celestial bodies such as stars, planets, galaxies, and the overall structure and origins of the universe*), what can you draw about space and any of the "celestial objects"? ***Note:*** *Revise some of the key terms: Celestial objects are natural objects that are located outside of the Earth's atmosphere (e.g. the Moon, the Sun, planets, stars, asteroids*). These celestial bodies seem very far away but have a lot of impact on our daily lives. During this project, we will learn how these celestial objects impact our daily lives. We will also think of the possibility of aliens and imagine what their surroundings look like!
15 minutes	Let us explore the various celestial bodies! ***Note:*** *In the case of one learner, they can pick any 2 celestial bodies to research.* *Each learner should research the celestial body from the textbook or through any other resource possible and write down answers to the questions below. Some facts are given in* ***Appendix 1****.* - *Name of the celestial body: (e.g. Mars, star etc.)* - *Type of celestial body: (star, planet, etc.)* - *Five facts about the celestial body:* - *Two things you were surprised to learn about the celestial body* ***Tip:*** *If they do not know this, they can revisit this at the end of the project*
15 minutes	Draw the solar system and add/ mark the celestial body you research about. ***Note:*** *Show learners the drawing of the solar system if they need help.*  *The solar system (not to scale)*

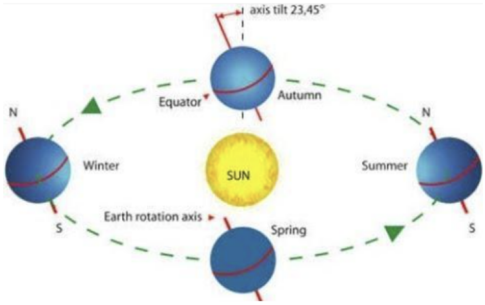
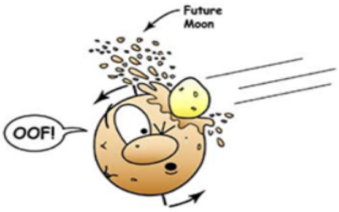
	- Which is the coldest planet and why? *(Neptune; it is farthest from the Sun and hence receives the least amount of heat through Sunlight)* - Which is the hottest one? *(Venus. Even though Mercury is closer to the Sun, Venus is the hottest planet in our solar system because it has a thick atmosphere made up of greenhouse gases which trap heat)* - Which are the biggest *(Jupiter)* and the smallest *(Mercury)* planets? - Which is the only planet known to support life? *(Earth)* Is there a possibility of planets colliding with each other? (*The way the solar system works, all these celestial bodies are held in their various positions because of gravity.)* The gravitational pull of the Sun is the force that keeps planets moving in fixed orbits around it. It is this force that determines their paths and maintains the stability of the solar system.
5 minutes	The celestial bodies in space are very far from us. Do you think they impact our lives in any way? Think of the Sun and the Moon, what impact does it create in our daily life? ***Note:*** *State how weather, climate, and seasons are things that impact our lives and these are caused due to the relation Earth shares with these celestial bodies in space.* We will learn more about the impact of these celestial bodies in the coming classes.
At-home activities	Which celestial bodies can you see at night with the naked eye? Ask elders in your home, were they able to see more in the sky when they were younger? **Study the Moon phases:** - Look at the Moon at night and draw and describe what you see in the "Night 1" box on the table. - Repeat the same exercise on Day 2 and label it as "Night 2", and so on. - Continue looking at and drawing the Moon daily for a month. Ask learners to bring a torch (or use a flashlight of the mobile phone), some clay, and a thin stick (or toothpick) for the next class's activities. Learners can also bring a ball (or foil/ paper can be crushed).

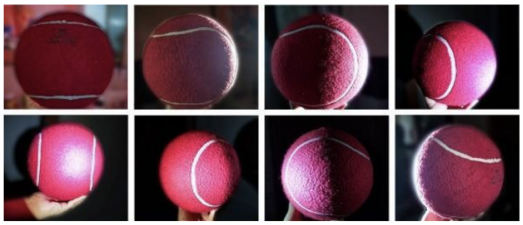
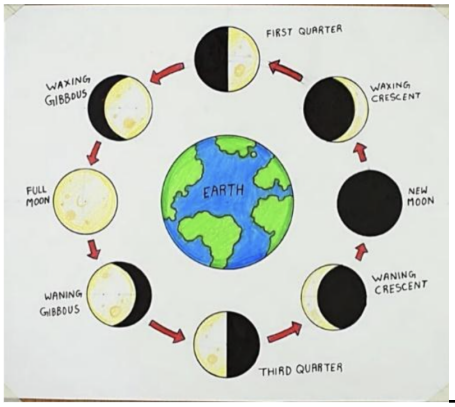
Night	Shape of the moon (drawing)	Description
Night 1		
Night 2		
Night 3		

Day 2

Today, you will learn about the motions shown by the Earth and Moon, and how motions of celestial bodies were used to develop calendars.

Time	Activity and Description
15 minutes	Let's explore time and how closely this is connected with the movements of the Earth. We will start by exploring the concept of **day and night** first. For this, let us do an activity. ***Note:*** *Ask learners to follow the steps given below. In the case of only one learner, the educator can partner with them to do the activity.* 1. Use clay to make a ball. This represents the Earth. ***Note:*** *If there is a globe available, please use that instead of the clay model.* 2. Pass a stick through its centre. This is the Earth's axis. 3. Divide the ball into two halves horizontally (northern and southern hemispheres) with a marker. This is the equator. 4. Draw an 'X' to show your country. ***Tip:*** *Challenge learners to outline continents at scale.* 5. Draw a 'Y' exactly opposite to the 'X' on Earth. 6. One person holds up a torch and the other holds up the Earth at a distance. ***Note:*** *Ensure that the clay globe is tilted while conducting the activity.* 7. Let the torch's light fall on the 'X'. 8. Rotate the Earth slowly.  ***Note:*** *While doing the activities, ask learners to think and share the answers to the following questions:* - *Does X and Y receive daylight at the same time?* - *If it is daytime in Asia, would it be daytime in North America too? Why or why not?* - *How are day and night formed? (Explain through demonstration how* ***rotation*** *causes day and night)* - *How long does it take the Earth to complete one rotation? (24 hours)* - *Do you know how years are formed?* *Now, as you rotate the 'Earth', ask learners to move it around the Sun (the torch) in an imaginary orbit. Since the Sun shines in all directions, we can have a different torch pointing*

	*in each direction or move the torch to face the Earth. Explain that this is called one **revolution**.* - How long does one revolution of the Earth around the Sun take? *(365.25/ 364 days and 6 hours days)* - Why do we have an extra day in February every 4 years? *(To account for the extra 0.25 days/ 6 hours in the year, which, in four years add up to one day.)*
10 minutes	Now, using the same activity, let us find out how seasons are formed. We know that the Earth spins on its axis. The axis is tilted (*by about 23.5 degrees*). ***Note:** Ask learners to tilt their model and observe how the light falls on their Earth when it rotates and revolves around the Sun.* Observe how the Northern and Southern hemispheres receive light.  - Earth's tilted axis causes the seasons. - Throughout the year, different parts of Earth receive the Sun's most direct rays. So, when the North Pole tilts toward the Sun, it's summer in the Northern Hemisphere. - And when the South Pole tilts toward the Sun, it's winter in the Northern Hemisphere. ***Note:** Ask learners to guess what causes the Earth to tilt. Share this fun fact:* **But what caused Earth to tilt?** Long, long ago, when Earth was young, it is thought that something big hit Earth and knocked it off-kilter. So instead of rotating with its axis straight up and down, it leans over a bit. By the way, that big thing that hit Earth is called Theia. It also blasted a big hole in the surface. That big hit sent a huge amount of dust and rubble into orbit. Most scientists think that that rubble, in time, became our Moon.  As Earth orbits the Sun, its tilted axis always points in the same direction. So, throughout the year, different parts of Earth get the Sun's direct rays.
15 minutes	Now let us explore the phases of the Moon. ***Note:** To do this activity, ensure the room is as dark as possible. Ask learners to follow the steps given below:* 1. *Hold up the flashlight (Sun), clay ball (Earth) and smaller ball (Moon) as shown in the figure.* 

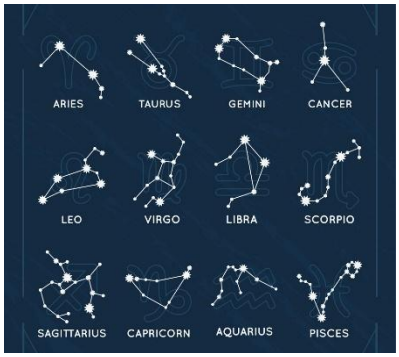
	2. *The Moon will revolve around Earth, but it does not rotate like Earth.* *Ask learners to carefully observe and notice which part of the Moon is dark and which part is illuminated. Get learners to draw what they observe. Explain what they see illuminated are the phases of the Moon that we get to see.*  - The Moon's shape looks different to us because of the way it orbits or travels around Earth. - The Moon doesn't produce its own light, it reflects the light from the Sun that falls on it. As the Moon moves around the Earth, different parts of it are lit up by the Sun, while other parts are in shadow. When the Moon is between the Earth and the Sun, we can't see it at all because the side that's facing us is in shadow. This is called a ***new Moon***. - As the Moon moves around the Earth, we start to see more and more of it lit up by the Sun. This is called a **waxing moon**, and it leads up to the full Moon. - Then the Moon starts to **wane**, or get 'smaller' again until it becomes the new Moon again. 
At-home activities	- Observe the night sky and try to find patterns or shapes formed by the stars. Draw them in your notebook.
Optional Literacy Activities	Write an essay on the importance of the Sun or the Moon in a religion of your choice. Interview community members to learn more about this.

Day 3 –

Today, you will learn about the stars, constellations, star signs and asteroids in our solar system.

Time	Activity and Description
10 minutes	We studied the Moon yesterday and last night you saw some stars in the night too. Do we see stars in the day? Can you name one such star? (*The Sun!*)

	Let's explore why the Sun shines brighter than others and is visible to us in the morning. For this, we will try out an activity. - Shine the light source (*flashlight of a mobile phone or a candle or torch*) on the wall and explore how we can make the light appear brighter or dimmer. - As you move further away from the wall the light will get dimmer and so we observe that the brightest star (*the Sun*) is the closest to us and so on. - Similarly, the object closer to you appears bigger than the object further away. (*which is why the Sun appears bigger than the stars even though it is further away*)

15 minutes	Did you notice any patterns or shapes in the stars last night?
	- These are called constellations (*a group of stars*).
	- Can you name any constellation? (*Orion, Cassiopeia, etc.*)
	- Create your own constellation in your notebook.
	  - What would you call it?
	  - What would it look like?
	
	Let us now explore your star sign!
	- Do you know your zodiac sign?
	- In the olden days, astronomers divided the sky into 30-degree sections across the 360-degree zodiac circle (*which is a belt-shaped region of the sky*) that marks the elliptical plane of the Earth with the Sun.
	- Each of these sections was marked by a different zodiac sign and represented by a different month of the year and has a different constellation of stars connected to it.
	- It is believed that personality traits are associated with the placement of the stars at the time of birth. This is used in astrology.
	
	 
	
	Note: *Allow learners to explore how their zodiac sign is represented as a constellation. Ask learners what shape or object these constellations form.*
	
	People commonly associate zodiac signs with personality traits. Do you believe it to be true? Why or why not?

10 minutes	We know that there are billions and billions of stars in the universe! Apart from stars, moons and planets, what are the other celestial bodies we find in our universe? (*Asteroids, comets, etc.)* - Do you know what asteroids are? - Asteroids are small rocky bodies that orbit the Sun, primarily found in the asteroid belt between Mars and Jupiter. - Do you think they play any importance in our lives?

	- They are important to us because they hold secrets about the formation of our solar system. Learning more about asteroids will help us understand how life began on our planet. - It's also important to know about these asteroids because there is a chance that these asteroids will hit Earth due to the current path it is around the Sun. - Have you heard about asteroids hitting the Earth in the past? - *Scientists think that the dinosaurs and other species during that time period became extinct due to a large asteroid crashing into the waters of Earth. This triggered a possible flood and change in Earth's temperature, killing off more than 75 per cent of Earth's species.*
5 minutes	Today we learned how various celestial bodies, such as the Sun, stars, constellations, and asteroids mean something to us. What are you most curious to know about our universe? Considering there are so many objects in the universe, is it possible that there could be life on any other celestial body?
At-home activities	Learners along with their parents observe stars and constellations in the night sky and compare their observations to each other. They also ask about some of the stories and myths related to these constellations.
Optional Literacy Activities	Several songs and poems make references to celestial bodies such as the Moon and stars. Listen to three such songs/poems and make an analysis of how these celestial bodies are described and use adjectives to describe these metaphors (e.g.: the Sun as the most important loved one, the Moon as distant and cold etc.)

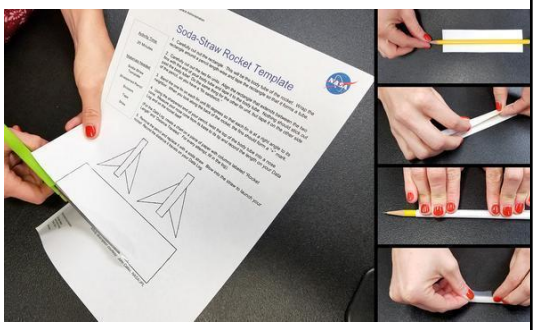
Day 4 –

Today, you will learn about some human-made objects designed to explore space and how this has impacted our lives.

Time	Activity and Description
5 minutes	Apart from the celestial bodies, there are many human-made objects in space. Can you think and name any? - There are thousands of satellites orbiting Earth. - Do you know what these satellites are used for? - Most satellites are used for communication, some are used for research and some are used by the military. - Apart from these satellites, there are space stations with labs that allow scientists to do research right in space!
10 minutes	Let us learn more about artificial satellites. - They are machines that are launched into space and move around the Earth or other celestial bodies in space. - They help in having a bird's eye view of the celestial body they are capturing and they also help capture and share signals (*including telephone and TV signals*). - Can you list 1-2 things from your daily life where you are taking the help of a satellite?

<table>
<tr><td></td><td>Note: Explain how satellites help with communicating around the world and how satellites help with navigation and detecting real-time traffic. Also, share how satellites help with weather forecasts.</td></tr>
<tr><td>20 minutes</td><td>Learners will now make their own rocket to launch into space as a satellite to begin observing.

Note: Guide learners through the steps given below:

<table>
<tr><td>1. Learners draw and cut out the following shapes (see figure). Roll the rectangular body over a pencil and tape it.
  </td><td>2. Tape the fins of the rocket over the rolled-up paper and bend them as shown:
  </td></tr>
<tr><td>3. Pinch the top of the rocket to make a nose cone. Tape it/twist it to prevent air from escaping.
  </td><td>4. Replace the pencil with the straw.
  </td></tr>
</table>

Ask learners to blow into the straw and launch their rocket.

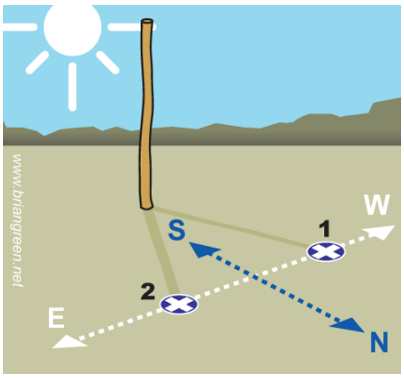
Most rockets have similar designs:
- Why do rockets have a long cylindrical shape? (to minimize air resistance)
- What is the role of the fin? (provide stability to the rocket during flight)
- How would it affect the rocket if the nose cone was a flat surface? (would increase air resistance and not allow the rocket to reach its destination)
- Have you seen fireworks being launched? Do they follow similar principles? (Yes)</td></tr>
</table>

5 minutes	For our final project, we will be launching the rocket you just created to a celestial body of your choice. Think of a celestial body that you would like your rocket to travel to and why. You can also make up your own celestial body.
At-home activities	Observe and list any uses of satellites in your daily life – e.g. TV, Radio, Satellite Phones, Weather Predictions, GPS Location Mapping etc.

Day 5 -

Today, you will write an imagined description of the planet your rocket satellite is visiting and share this with your family/ friends.

Time	**Activity and Description**
20 minutes	In the previous class you decided where your rocket would travel to. Imagine that you travelled to this celestial body and realise that it has life on it. Put together a drawing and an essay/ story about the alien life. This needs to include: - What does the celestial body and alien look like? - How do these aliens survive on the celestial body? (*humans need heat, sunlight, oxygen, water etc.*) - What is available on the planet? - How will you communicate with the aliens? (On the Earth, sound travels through air, but how will this work in a vacuum?) - What do they eat? Are there animals and how will they live and can there be plants and how will these live? They can get creative and also say that the beings eat light or do not need nutrition at all! - How will time be measured? What is the equivalent of a day/ year on this planet? - What are the weather and the seasons on this celestial body? - What is the celestial body made of? ***Tip**: Ask learners to remember to add an image of the alien with a name and features that help with the adaptation e.g. gills to breathe, skin/ hair designed to manage the heat etc.*
10 minutes	Present your drawing and essay/ story with family and friends. Collect feedback from them on what they enjoyed and what could have been done better.
10 minutes	Let us reflect! - What did you learn from this project? - What did you enjoy doing the most during this project? - What is something you are curious to know more about after this project? - Do you think the celestial bodies around us play an important role in our lives? ***Note:** Acknowledge and celebrate the efforts and achievements of the learners. Recognize outstanding projects, creativity, and engagement throughout the week.*

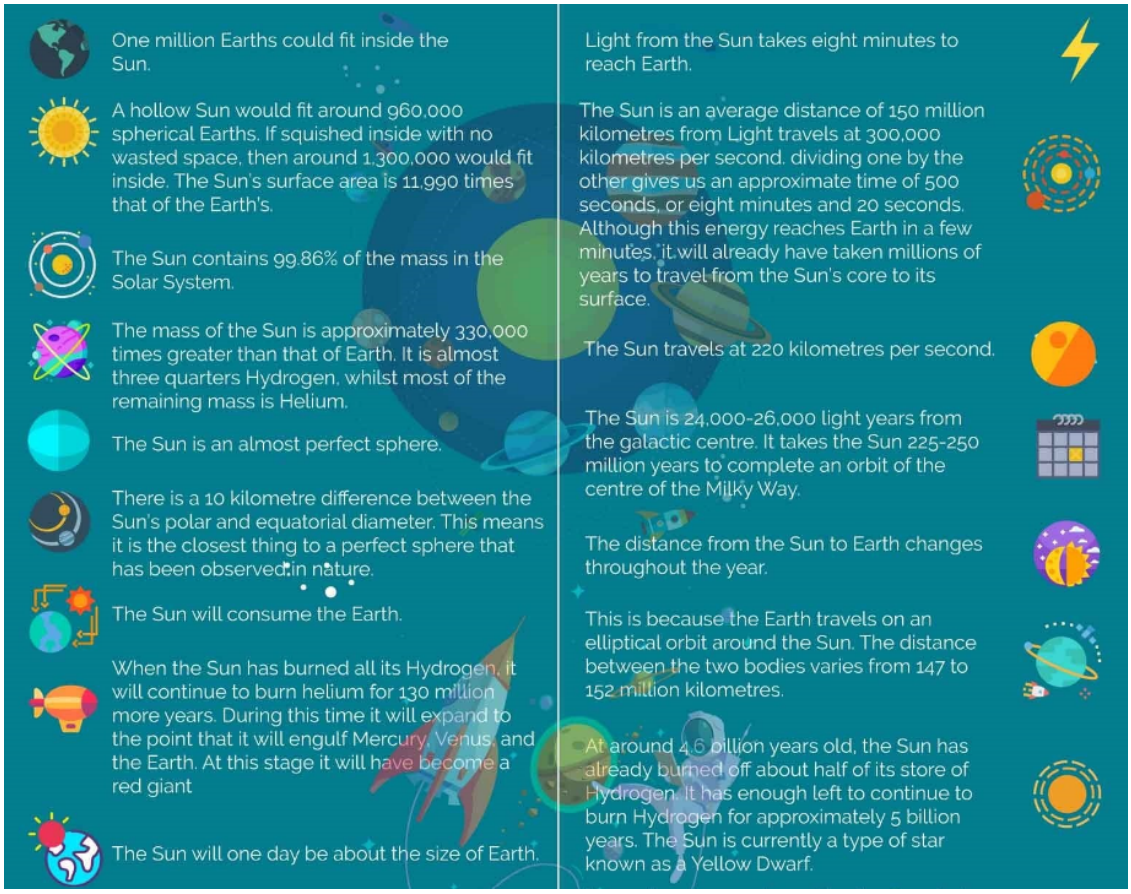
Additional enrichment activities:	**Earth Rotation** - Take a 1 meter-long and straight stick during the daytime in Sunlight, choose a clean and flat place in the ground and make this stick stand where it gets a clear shadow. - Mark the uppermost point of the shadow of the stick with a stone or some object, it is shown as **1** in the figure. After fifteen minutes again mark the upper point of the shadow and mark it as **2**. Now stand in such a way that mark '1' is on your left and mark '2' is on your right. In which direction will you be facing now? - Draw a line from point '1' to point '2' with the help of your partner. What is the direction of the line thus obtained? If this condition is true at any place on the Earth, then tell in which direction the Earth is rotating. *(It should be the opposite of the shadow's movement.)*  **Explore the concept of a light year** - A unit of distance that expresses how far light can travel in a year. Light can travel almost 300,000 km per second. Calculate how much it can travel in a year to get the estimate for a light year. (Hint: there are 86400 seconds per day and 365 days per year!). Can you write the figure in a place value chart? (hint: it's in the trillions, which comes after billions) **Watch a Movie** - Show learners a movie on space exploration.

ASSESSMENT CRITERIA

A majority of my learners were able to:
☐ Identify and classify celestial objects.
☐ Explain how days, nights, and seasons are formed.
☐ Understand how space and the celestial objects are connected to our everyday lives.
☐ Explain the phases of the Moon.
☐ Understand the benefits of artificial satellites.

APPENDIX

Fun Facts About The Sun



Fun Facts About The Planets

1. No one knows how old Saturn's rings are

There's a field of ice and rock debris circling Saturn that from afar, appear as rings. Early telescope observations of the planet in the 1600s caused some confusion: does that planet have ears, or Moons, or what? With better resolution, however, it soon became clear that there was a chain of small bodies encircling the gas giant. It's possible that a single Moon tore apart under Saturn's strong gravity and produced the rings. Or, maybe they've been around for the last few billion years, unable to coalesce into a larger body but resistant enough to gravity not to break up.

2. Uranus is more stormy than we thought.

When Voyager 2 flew by the planet in the 1980s, scientists saw a mostly featureless blue ball and some assumed there wasn't much activity going on in Uranus. We've had a better look at the data since then that does show some interesting movement in the southern hemisphere. Additionally, the planet drew closer to the Sun in 2007, and in more recent years telescope probing has shown some storms going on. What is causing all this activity is difficult to say unless we were to send another probe that way. Unfortunately, there are no missions yet that are slated for sure to zoom out to that part of the Solar System.

3. Neptune has supersonic winds.
While on Earth we are concerned about hurricanes, the strength of these storms is nowhere near what you would find on Neptune. At its highest altitudes, according to NASA, winds blow at more than 1,100 miles per hour (1,770 kilometres per hour). To put that in context, that's faster than the speed of sound on Earth, at sea level. Why Neptune is so blustery is a mystery, especially considering the Sun's heat is so little at its distance.

4. **Jupiter is a great comet catcher.**
The most massive planet in the Solar System probably had a huge influence on its history. At 318 times the mass of Earth, you can imagine that any passing asteroid or comet going near Jupiter has a big chance of being caught or diverted. Maybe Jupiter was partly to blame for the great bombardment of small bodies that peppered our young Solar System early in its history, causing scars you can still see on the Moon today.

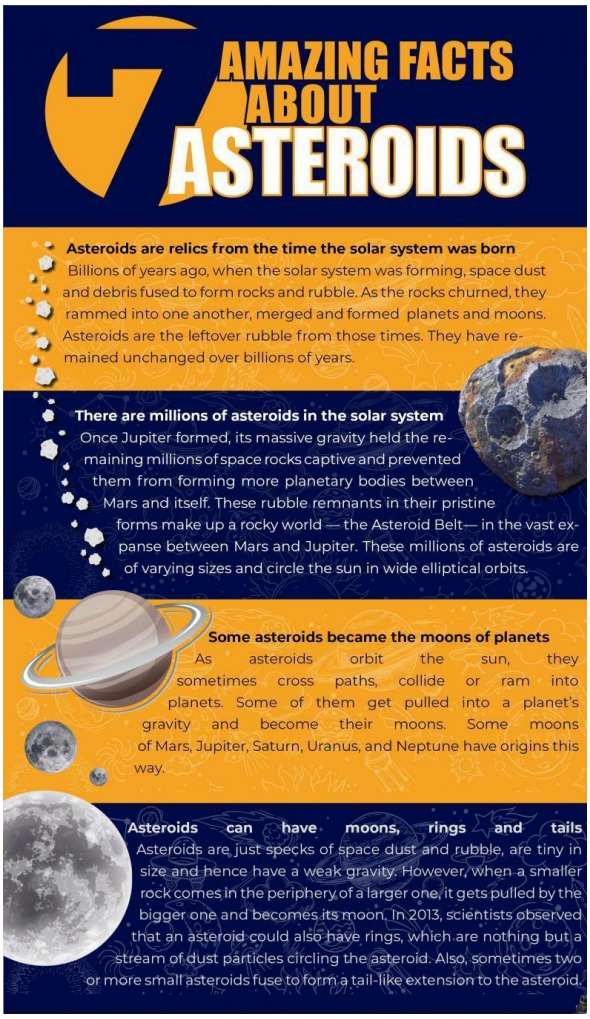
5. Mars had a thicker atmosphere in the past.
What a bunch of contrasts in the inner Solar System: practically atmosphere-less Mercury, a runaway hothouse greenhouse effect happening in Venus' thick atmosphere, temperate conditions on much of Earth and then a thin atmosphere on Mars. But look at the planet and you can see gullies carved in the past from probable water. Water requires more atmosphere, so Mars had more in the past. Where did it go? Some scientists believe it's because the Sun's energy pushed the lighter molecules out of Mars' atmosphere over millions of years, decreasing the thickness over time.

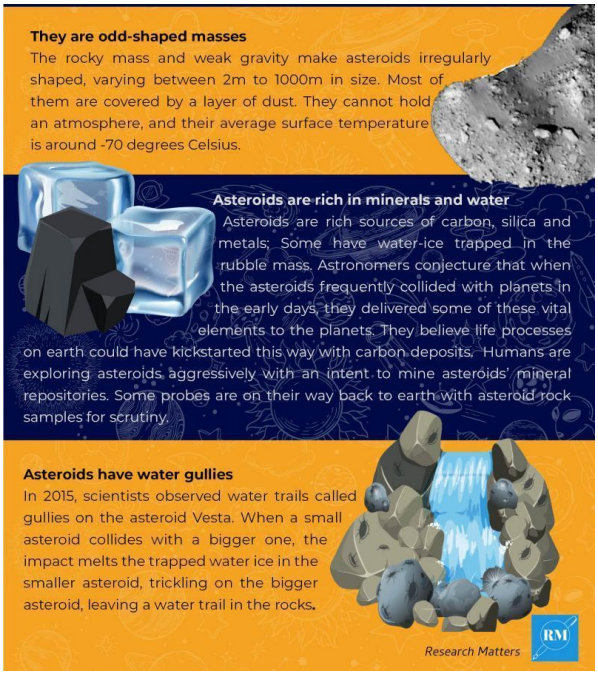
6. Venus doesn't have any Moons, and we aren't sure why.
Both Mercury and Venus have no Moons, which can be considered a surprise given there are dozens of other ones around the Solar System. Saturn has over 60, for example. Some Moons are little more than captured asteroids, which may have been what happened with Mars' two Moons, for example. So what makes these planets different? No one is really sure why Venus doesn't, but there is at least one stream of research that suggests it *could* have had one in the past.

7. Mercury is hot, but not too hot for ice
The closest planet to the Sun does indeed have ice on its surface. That sounds surprising at first glance, but the ice is found in permanently shadowed craters — those that never receive any Sunlight. It is thought that perhaps comets delivered this ice to Mercury in the first place. In fact, NASA's MESSENGER spacecraft not only found ice at the north pole, but it also found organics, which are the building blocks for life. Mercury is way too hot and airless for life as we know it, but it shows how these elements are distributed across the Solar System.

Explore more fun facts here:
www.space.com/35695-weirdest-solar-system-facts.html

Fun Facts About The Asteroids





Fun Facts About The Earth's Moon

1. The Moon is Earth's only permanent natural satellite
It is the fifth largest natural satellite in the Solar System, and the largest among planetary satellites relative to the size of the planet that it orbits.
2. The Moon's surface is actually dark.
Although compared to the night sky it appears very bright, with a reflectance just slightly higher than that of worn asphalt. Its gravitational influence produces the ocean tides, body tides, and the slight lengthening of the day.
3. The Moon is drifting away from the Earth
The Moon is moving approximately 3.8 cm away from our planet every year.

4. The Moon always shows Earth the same face

The Moon is in **synchronous rotation** with Earth. Its near side is marked by large dark plains (volcanic 'maria') that fill the spaces between the bright ancient crustal highlands and the prominent impact craters.

5. The Moon has quakes too

They're not called Earthquakes but **Moonquakes**. They are caused by the gravitational influence of the Earth. Unlike quakes on Earth that last only a few minutes at most, Moonquakes can last up to half an hour. They are much weaker than Earthquakes though.

6. There is water on the Moon!

This is in the form of **ice** trapped within dust and minerals on and under the surface. It has been detected on areas of the lunar surface that are in permanent shadow and are therefore very cold, enabling the ice to survive. The water on the Moon was likely delivered to the surface by comets.

Fun Facts About Meteors

1. Out of the 24,000 meteors that have landed on Earth, only 34 is believed to have originated from Mars.
2. Meteors are said to contain the oldest known rocks in the universe.
3. Scientists claim that there are over 4 billion meteors that fall into the Earth every single day. Most meteors are minuscule in size.
4. All meteors are protected by the National Heritage Law. These meteors must be surrendered to authorities unless found within the borders of South Africa.
5. A meteoroid is defined as any interplanetary object bigger than a speck of dust and smaller than an asteroid. A meteoroid, upon landing on Earth becomes a meteorite. A meteor refers to the streak of light we see tailing the meteoroid.
6. Only one injury has ever been verified from a meteorite impact.
7. A 30-foot-wide meteoroid struck the atmosphere of Antarctica in 2004.

Fun Facts About Planet's Satellites (Moons)

1. There are over 600 moons in our Solar System, and more are yet to be discovered.
2. Moons are natural satellites that orbit planets, dwarf planets, and asteroids in our Solar System.
3. Our Moon formed 4.5 billion years ago after a gigantic meteor struck Earth.
4. Most of the moons were formed from the discs of dust and gas which circulated around the planets billions of years ago.
5. Not every planet has its own natural satellite. Some moons are captured objects.
6. Saturn has 82 Moons, being the planet with the most Moons in our Solar System.
7. Earth has only one moon, which was discovered in prehistorical times, before any other moons.
8. The largest Moon in our Solar System is Ganymede, a satellite of Jupiter.
9. It is believed that life can exist on Jupiter's Moon, Europa, and Saturn's Moon, Enceladus.
10. The most important moons in our Solar System, besides our own, are the four Galilean Moons. The Galilean moons are Europa, Io, Ganymede, and Callisto. They orbit Jupiter and were discovered by the famous astronomer Galileo Galilei.
11. Through the discovery of Jupiter's Moons, Galileo concluded that not everything revolves around the Earth. (Earth was considered to be at the centre of the universe in the olden days.)

12. Any planet which has Moons can experience eclipses.
13. A planet that is too close to its star is unlikely to have a moon. This is because a star's gravity is stronger, and it will steal the Moon. Venus and Mercury are the only planets in our Solar System without moons.