Carter Observatory Education Team

Activity booklet Level 3

This booklet contains:

- Teacher's notes for Level 3
- Level 3 assessment points
- Curriculum links
- Classroom worksheets

Classroom worksheets:

Use these flexible worksheets to develop students awareness of abstract scientific concepts.

Survival on the Moon!

Make your own Solar System

Curriculum Links:

Use these ideas to link this science topic with Literacy, Mathematics and Craft sessions.

Literacy

Mathematics

Arts

Notes for Teachers

Level 3 includes Exploring the Solar System, Seasons, Sunspots and Solar cycles workshops. They cover how seasons happen and if this could happen on other objects in Space, how the Earth and other planets go around the Sun and the differences between a planet, a star and a moon and features of the Sun. We explore all of our planets, what else is in our Solar System and how big it really is!

The Earth:

The Earth takes 365.25 days to travel once around the Sun. Every 4 years we add an extra day in February to make up for this- a leap year. At the same time, the Earth is spinning, taking 24 hours to complete 1 spin. The Sun appears to rise in the East and set in the West because of the spin of the Earth. The stars will also appear to move across the sky. We see different stars as the year goes on as we are going around the Sun and we are looking in a different direction at different times of the year. The stars are still there during the day but the Sun is so bright it hides them from view.

The side that faces the Sun gets the daylight, the side that points away from the Sun is in shadow and it doesn't get any light from the Sun so it is night time. At different places or positions on Earth get the day and night at different times, New Zealand has its daytime when Europe has its night and vice versa as they are on opposite sides of the globe. All planets will have day and night. Terrestrial (rocky) planets tend to spin slowly whilst gas planets will spin quickly. In our Solar System, Jupiter has the fastest rotation in 9.8 Earth hours, whilst Venus spins the slowest (244 Earth days).

At the same time, the Earth is spinning, taking 24 hours to complete 1 spin. The tilt (23.5 degrees) of the planet allows parts of the Earth to get different hours and strengths of sunlight during the seasons of the year. When the Earth is slightly tipped towards the Sun, that hemisphere will have more direct sun rays and longer sunlight hours and will be experiencing Summer, whilst the opposite it true when the Earth is tipped slightly away from the Sun.

Phases of the Moon:

At the same time as the Earth moving around the Sun, the Moon is also travelling around the Earth. It takes approximately 29.5 days, a lunar 'moonth' or 'month' to complete one cycle. We only ever see the side of the Moon that is lit up and ***reflects the light*** from the Sun. We will only see the same face of the Moon, as the Moon only spins once for each orbit of the Earth.

Some more challenging questions:

- Could we live on the Moon?
- Why don't we call the Moon a planet?

All the objects in the Solar System are held in place by the Sun's gravitational force. The Sun, in turn is being kept in place by the gravitational pull from the black hole in the centre of our galaxy.
Our Sun orbits this black hole about once every 250 million years.

Notes for Teachers

The Moon

Early history
The Moon was formed about 4.5 billion years ago, soon after the Earth was formed. One theory is that a large object (about the size of Mars) collided with the early Earth and ripped off a large amount of crust and mantle. This material was pulled together by gravity to form the Moon.

Surface
The Moon is composed of an iron core surrounded by rock and is only 1.5% the mass of the Earth. Due to its weak gravity, the Moon lost its atmosphere a long time ago and so has no air. You cannot hear sounds on the Moon. The Moon was bombarded with asteroids and meteorites which left craters on the surface. The largest crater is called Copernicus. The larger craters have mountains in the centre with rays of debris surrounding them. The smooth parts of the Moon are called 'maria' and are plains of dried up lava.

Day and night on the Moon
The Moon used to be much closer to the Earth. The Moon is still moving away, up to 4cm a year. As the Earth and Moon have moved apart, the days on Earth and the Moon have also slowed down. The Moon's day is the same length as it takes to orbit the Earth. This is why we only see one side of the Moon. One day (one rotation) on the Moon is 28 days- 14 Earth days of daytime followed by 14 Earth days of night time. As there is no atmosphere on the Moon to keep in any heat from the Sun, temperatures range from 200°C in the day and –175 °C at night.

The Parkes telescope in Australia is one of several radio antenna used to receive live televised images of the first Moon landing on the 20th July 1969.

Moons in the Solar System

Moons are objects that orbit a planet, sometimes they are known as 'natural satellites'. All the planets in our Solar System have moons except Mercury and Venus. Some dwarf planets also have moons!

Jupiter has the most known moons at 67 at last count, the largest four are called the Galilean moons after Galileo who discovered them. They are called Io, Europa, Ganymede and Callisto.

Pluto, the dwarf planet has at least 5 moons, and its largest Charon is the largest moon compared to its parent planet. It is so large that Pluto and Charon orbit around a point between them.

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Assessment points for teachers

- Can students understand and explain what a star, a planet and a moon are? What are the differences?
- Can children recognise the 8 planets and other Solar System bodies? Can they correctly name them and are they in the correct order?

A star: is a ball of gas called hot plasma. Stars will emit heat and light, planets and moons reflect light from a star. Stars have different colours which indicate how hot they are. Blue and white stars are the hottest around 35,000°C, yellow stars (like our Sun) are average with temperatures around 5,500°C. Red and orange stars are the coolest, around 3000°C . The Sun is made up of mainly hydrogen and helium and creates energy by nuclear fusion which occurs in the centre of the Sun. Red and orange stars are generally billions of years old, whilst blue stars can be only tens of millions years old. Our Sun is halfway through its life, and is around 4.5 billion years old.

A planet: needs to do 3 things to be classed as a planet.

1. It must have enough gravity to pull itself into a ball and become spherical.
2. It needs to orbit a star.
3. It needs to have cleared its orbit around the star of any other objects.

A planet can be rock, gas or even ice! A **dwarf planet** has not cleared its orbit of objects but is spherical and orbits a star.

A moon: orbits a planet. A moon can be made of rock or ice.

Assessment points: The planets

Students should be able to draw and label the 8 planets and the Sun. They may not have drawn them to scale or size. The correct order is:

The Sun - Mercury - Venus - Earth - Mars - Jupiter - Saturn - Uranus - Neptune

Pluto is generally not included in this line up along with the other 4 recognised dwarf planets. These 5 classified dwarf planets are called Ceres, Eris, Pluto, Makemake and Haumea. There may be many more.

Your students may also have added in an asteroid belt between Mars and Jupiter, or the Kuiper Belt after Neptune. The Oort Cloud is the boundary of our Solar System and is where most of the comets in our Solar System are thought to come from. Moons can also be added, 1 for the Earth, 2 for Mars, 67 for Jupiter, 62 for Saturn, 27 for Uranus, 13 for Neptune. Pluto may also be added as a dwarf planet. Pluto has 5 moons, 1 of these moons called Charon is almost as big as Pluto!

Mercury, Venus, Earth and Mars are known as the inner or rocky planets, Jupiter, Saturn, Uranus and Neptune are known as the outer and gas planets.

Students may also add rings. Jupiter, Saturn, Uranus and Neptune all have rings but Saturn has the most obvious ones. Saturn has 9 main rings which are made of icy rocks.

<u>Assessment points for teachers</u>

- Can students explain scientific words like 'light year', 'constellation' and 'satellite'?
- Can students explain why we get seasons on the Earth? Can they work out if any other planets would have seasons like us?
- How can we tell by looking at the sky that the seasons are changing?

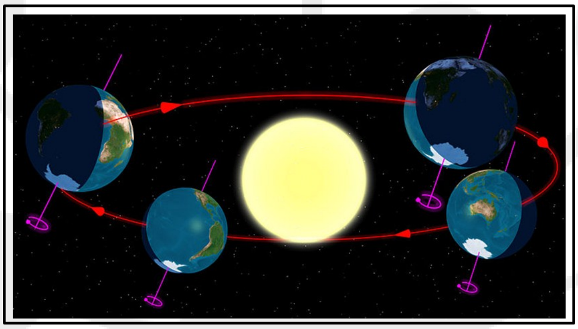
<u>A light year:</u> A light year is far light travels in one Earth year, approximately 10 million million km! Light travels at 300,000km per second.

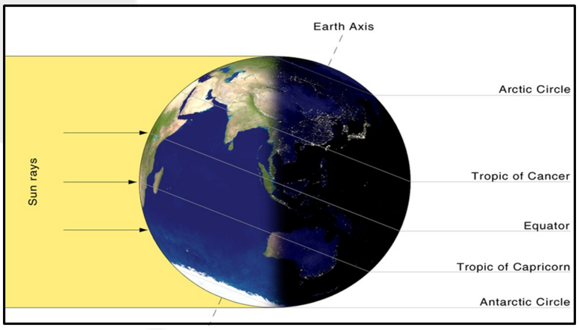
<u>Constellation:</u> A constellation is a set of stars that form a pattern or shape, like a dot to dot picture. Every culture will have their own set of constellations but the scientific community will use the **88 recognised ones.**

<u>A satellite:</u> there are two different kinds of satellites, artificial and natural. Artificial satellites are objects which has been placed into **orbit** by human endeavour. The Moon is known as our natural satellite, as the Moon orbits the Earth.

<u>How do we get seasons?</u>

The Earth is not perpendicular to the Sun on its axis. It is on a tilt of 23.5 degrees. Because of this tilt, for roughly half of the year the Southern Hemisphere tips slightly towards the Sun. At the same time the Northern Hemisphere is tilted slightly away from the Sun. For the second half of the year the Southern Hemisphere tilts away and the Northern Hemisphere tilts towards the Sun.





When the Southern Hemisphere is tilted towards the Sun, it gets concentrated sun rays so we have longer daylight hours and hotter weather. This is Summer. In Winter, the Southern Hemisphere is tilted away from the Sun, the Sun's rays are spread out so we have cooler weather and shorter daylight hours.

There are certain signs or markers in the sky that tell us when the seasons are changing. Spotting the Matariki cluster in the morning sky before the Sun rises in June is one of these signs. This tells us it is the time of the Winter solstice and that the Māori new year will soon begin. Our Summer evening constellation is Orion, our Winter evening constellation is Scorpius. We can also tell the months of the year by looking at the signs of the Zodiac.

Assessment points for teachers

- **Can they explain what is a solar cycle and how it affects the Earth?**

The Sun, like all stars, produce energy through nuclear fusion at the core. In this process energy is released through heat and light and is eventually lost from the Sun's surface. This energy (heat and light) is what lights our days, drives our weather and allows life on Earth to exist.

Sunspots have been observed for hundreds of years and they have given us interesting insights into the Sun's activity and its long term cycles. Sunspots are cooler regions on the Sun's surface, they appear as dark areas as they are about 2000°C cooler than the normal surface temperature (approximately 5500°C). These can range in size from a few thousand to tens of thousands of kms wide.

The Sun is moving towards its current peak of sunspots over the following year (2013-2014) after which there will be a gradual decline in the number of sunspots. With the large number of sunspots visible, now is a good time to follow the changing number, position and shape of sunspots on our nearest star.

The increased solar activity around the time of solar maximum sees solar radiation increased by about 0.1% (1.3 watts per square metre). This is a time when solar storms and aurora are particularly prevalent .

Extended solar minima may lead to cold periods and 'mini-ice ages'. The 'Maunder Minimum' dates was a period associated with very cold winters. Period of extended sunspot activity may be linked to increase temperatures and plant growth. Your students could investigate why this is different to the effect of 'global warming or climate change.'

Key Questions:

- What is the name of the nearest star to the Earth?
- What is the second nearest star to the Earth?
- How long does it take a light to travel from the Sun to the Earth?
- How fast does light travel?
- Do you think all stars have planets? Explain your answer.
- Investigate the 5 different coloured stars in the Universe. What are they?
- Where do stars come from and what happens to them when they die?
- Explain what a **habitable zone** or **Goldilocks zone** is and why it is important.

Survival on the Moon

The year is 2050; your spaceship is on route to an unmanned storage depot on the near side of the Moon. It is daytime on the part of the Moon you are travelling over. There are four astronauts on board and your mission is to deliver supplies, including a lunar rover, to the depot and construct a lunar habitation module for a construction crew to live in whilst they construct a bigger base.

About 300km from the depot a meteor hits the space craft and you have to make an emergency landing. The spacecraft is no longer functional and the propulsion system is wrecked.

Fortunately the lunar rover, with its pressurised cabin is undamaged along with 14 other items. There is not enough room for the astronauts and all the undamaged supplies. The Rover will be able to take you to the depot, but the journey will take 24 hours. A rescue craft will meet you at the depot in 48 hours.

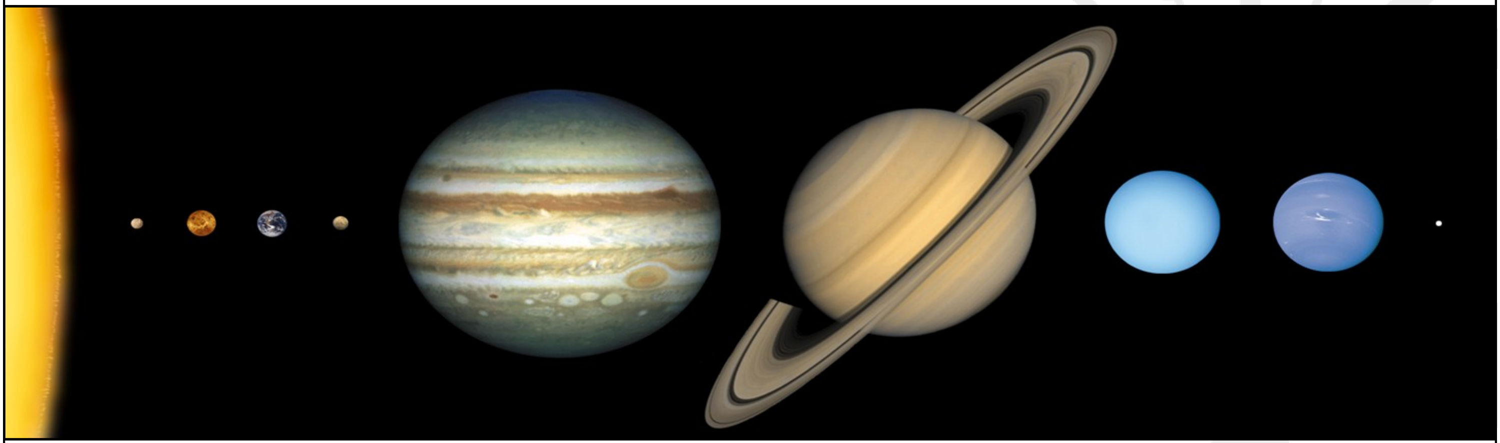
Your team must decide what the most critical supplies to take are and what you will leave behind.

Below is the list of items; list them in order of importance to be taken in the lunar rover.

Box of computer parts	Battery powered lunar navigation computer
Food Concentrate	Box of spare clothes
50 Litres of water	Solar powered heating unit
First Aid Kit	15 meters nylon rope
2 Oxygen recyclers	4 Space suits
Signal Flares	Two heavy duty batteries
Box of multi-purpose tools	Solar powered radio transmitter/receiver

Make a list of items that you would/would not take and why.

Solar System scale model



The Solar System is often portrayed as a line of planets, closely packed to each other. But this picture is misleading! There is a lot of space in space!

Astronomical distances are measured in km and in Astronomical Units (AU). 1 AU is 149,600,000km and is the same distance between the Sun and the Earth.

A light year measures further distances. Light, travelling at 300,000 km/s takes only 8.3 minutes to travel from the Sun to the Earth. Our nearest star after our Sun is 4.3 Light years away. 1 l.y. is approximately 10 million million km.

If we scale 1AU to a metre, the Sun could be represented by a ball bearing or 1cm wide.

Use the table below to create your own accurate Solar System scale model. Create your own Solar System in your classroom, or school corridor!

	Scaled Distance from the Sun	Light travel time	Scale model diameter
Mercury	38.7cm	3.2 minutes	0.035mm
Venus	72.3cm	6 minutes	0.087mm
Earth	1m	8.3 minutes	0.092mm
Mars	1.52m	12.6 minutes	0.049mm
Jupiter	5.2m	43.2 minutes	1.026mm
Saturn	9.54m	1hr 19 minutes	0.862mm
Uranus	19.18m	2hrs 11 minutes	0.360mm
Neptune	30.06m	4hrs 11 minutes	0.355mm
Pluto	39.44m	5hrs 31 minutes	0.016mm
Our Moon	1m	8.3 minutes	0.025mm

Go onto your playground and create a moving Solar System with these distances, how long are each planet's orbits/years?

Literacy linked activities

- Read stories from different cultures about the planets and the creation myths. What are the common themes? Make up a class creation story or a story about a certain Solar System object.
- Investigate the history of the Moon landings or a particular mission like Apollo 13. Who was involved? Choose a character and create a diary entry or recount of this famous event. Read and write from different viewpoints, which character would you want to be?
- Read newspaper reports from the Moon landing, then have a go writing your own. This would be a nice shared writing task. Create a 'news desk' and record your report. You may like to interview characters or talk to other reporters.
- Investigate space related jobs. Create a questionnaire or interview a local or international person. What type of skills would you need to do this job? Role play the main aspects of the job. Can children guess the job?
- Create a factsheet about the Curiosity Rover. Find pictures and use IT tools to create an interesting page. Research information on the internet.
- Give your point of view about whether we should explore the Solar System. What arguments would be for it or against it? What information would you send out into Space?
- Read and collect a journal of simple space stories on different newspapers. Leave this in the library area for children to look through.
- Design an alien landscape with descriptive words. Describe using the 5 senses. You could create a class poem or song.
- Link the classroom daily work and routines to the Space station daily routines. What are they doing day to day whilst we are having Maths? You can find information on this on the internet. What are the main differences or the similarities?
- Create a fact sheet for a planet. Collect a set together to make a Solar System fact sheet collection.
- Read and/or watch H.G. Well's 'War of the Worlds'. Create your own story about aliens and human survival. Create character profiles for your cast list. You could adapt this story to make a play.
- Make a brochure for a space destination. Advertise planets and the features of them. Which Solar System object would be the best place to go on holiday?

Mathematics linked activities

- Read numbers to 2013, create a timeline and order them. Use significant events, like the Moon landings or the Curiosity rover landing on Mars to create a space timeline. Add in dates and events as you learn about them. You could either create a timeline around the room or on a washing line and peg on new events and dates.

- Link astronauts in with arrays and times tables. Ask real life questions about equipment needed or astronaut food supplies to create problems. For example: There are 7 astronauts on the Space station. Each astronaut needs to exercise for 2 and a half hours a day. How long will the exercise room be used for every day? Every week?

- Create a Moon log, does it match up with the months of the year?

- Make a scaled model of the Solar System. Measure out distances accurately. Talk about the distances and units used. Make scale models of the planets and use them in the demonstration. Find out how long it would take to get to each planet.

- Create a favourite Solar System object graph or table. Play with different types of graphs, pictographs, bar charts and pie charts. Why would a line graph not work? Ask questions about which object is the most/ least popular, the differences in popularity between objects and totals.

- Make water rockets. Measure out water capacities accurately and experiment with which rocket is the best. How much water is needed for a long distance? How far will a rocket go? How can you make them more aerodynamic? This would link well to a science experiment.

- Look at a variety of calendars from around the world. How do we get a year? Match up seasons and months of the year. What happens in each season?

- Experiment making parachutes. What size parachute is optimum for landing a toy man accurately on a landing strip? How can you keep the parachute controlled? Create a results table and find out which parachute design works best.

- Use data to create your own real life questions. For example: You can get to Mars in 10 months. If you leave Earth in March when would you arrive on Mars?

- Give children a task to pack a suitcase for a space trip. Give children a weight restriction for their luggage. What would they pack? Itemise your luggage. Has everyone packed the same thing?

- Find how much you would weigh on different planets.

Arts linked activities

- Listen to different types of space music, classical themes like Star Wars or the Planets Suite from Holst. Listen to each piece and describe what you hear. Is it loud or soft? Fast or slow? How do you feel? Create movements to match the music. Link these movements together to create a short dance. Show the rest of your class and evaluate. What did they like about it or what could be done better?

- Using drama and hot seating, re-enact famous space moments in history, like the Space landings. Give everyone a role, including the astronauts, the scientists at NASA and the Parkes Telescope team in Australia. You could include how people felt when they first saw the Moon on TV. Freeze frame and take a photo. Label and caption the photo with speech bubbles. Imagine you are Buzz Aldrin or Neil Armstrong. Allow the class to ask questions to these famous people about the training involved, the journey or how they were feeling.

- Make planet landscapes. What would they look like? Try and recreate the surface of the planets using different materials. What could you use?

- Compose a piece of music about a planet or an object in the Solar System. Would instruments would you use to recreate a planet, a comet, Matariki or an asteroid? Decide on which instruments would work well and compose your music. Perform it to a small group or during an assembly.

- Watch 'Youtube' videos of Col. Chris Hadfield whilst he was on the International Space station. Record your own version of David Bowie's 'Space Odyssey' and play it back to your classmates or in an assembly.

- Use different materials and media to create seasonal pictures. Take leaf rubbings and use them to make inspired lino or block prints. What colours are associated with each season?

- Experiment making energy bars for a pretend trip into space. Create a packet or box to put them in and design an advert around them.

- Make up a new Matariki song to celebrate the new year. Investigate ways of making instruments with junk and play alongside a Māori myth or legend.

- Use photo-sensitive papers to create your own solar artwork. Collect leaves, flowers or manmade objects like keys to create a design. Discuss why this paper works and how different objects appear. How can you get different shades on your design?

- Look at Māori constellations. Create your own constellations that link with Māori myths and legends.