YEAR 3
STEM Projects

Science Technology Engineering and Mathematics

(STEM) Projects – Teacher's Guide

PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

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EARTH SCIENCE WESTERN AUSTRALIA

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How To Use This Resource

The PALMS STEM projects are designed to be used either to supplement normal science lessons in the Earth and Space Science area or to be used as stand-alone projects with science classes, STEM clubs or extension classes.

This Year 3 STEM Project differs from the PALMS STEM projects for Years 4-6 in recognition of the abilities of younger students. This project is more teacher-guided with some shorter preliminary activities designed to stimulate student thinking about the topic and one longer project. The accompanying Student Booklet provides areas for students to record their findings and results for the activities described in this Teacher's Guide.

To assist teachers to introduce students to the STEM Skills they need to be using when working on STEM projects, an accompanying PowerPoint presentation titled 'What do STEM Skills look like?' has been prepared. This should be discussed with the students before starting the main project. It should be reinforced with the students that we are not asking them to think of ways to address the scenarios presented in this resource, but to identify the skills they would use. The STEM skills discussed here align with the WA Department of Education definitions found here: https://www.education.wa.edu.au/what-is-stem-
Students will be asked at the end of the project to identify which STEM skills they have used, to increase their overall understanding of the importance of these skills.

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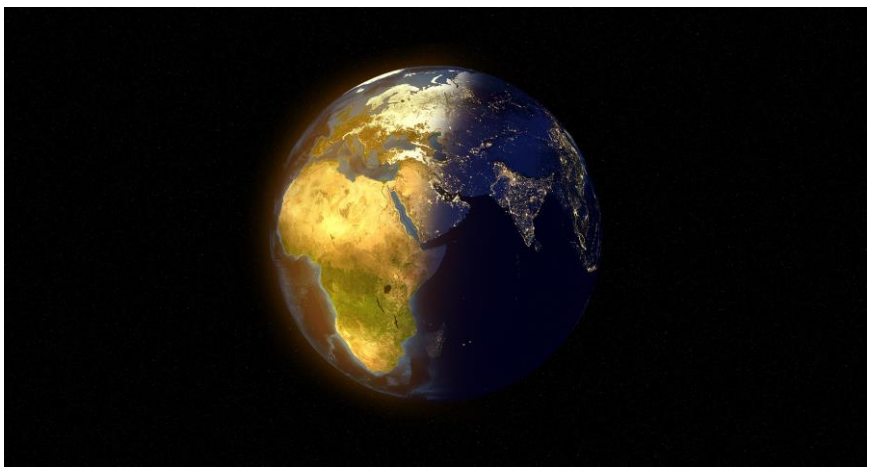
Make My Day (& Night)

Introduction

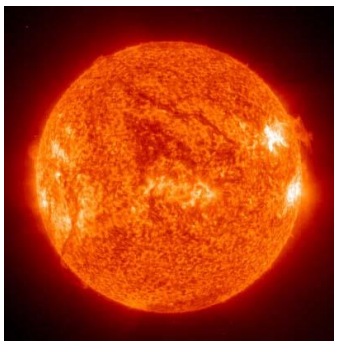
Humans have always looked up at the sky and wondered about the movements and interactions of the Earth, the Sun and the Moon. Many cultures have stories about the movement of the Sun and Moon. As our technologies have progressed, we have been able to look at these objects in more detail or from different perspectives, helping us to gain a deeper understanding.



We now know the shape of planet Earth and can track its rotation very accurately using technologies such as satellites and GPS. Scientists have also been able to map the path the Earth takes as it orbits the Sun and the orbit of our own natural satellite, the Moon. The movements and interactions of the Earth, Sun and Moon dictate many aspects of our lives such as how we describe time.

Without our Sun, there would be no life on Earth. The Sun is a star composed of electrically charged hot gas (approximately 71% hydrogen, 27% helium & small amounts of other heavier elements). It has its own

magnetic field which flips about every 11 years or so (a solar cycle) and a huge gravitational force that keeps all the planets in our solar system orbiting around it. The Sun has weather patterns and releases of energy from the surface of the Sun affect Earth in a variety of ways, such as disrupting communications and causing the beautiful coloured aurora seen in some parts of the world. The light and heat that the Sun provides are essential for most forms of life on Earth.



There is strong evidence that the Moon was formed in the early stages of the solar system when a giant object or impactor (about the size of Mars) hit the newly formed planet Earth and parts of our planet and the impactor were pulled together by gravity to form the Moon. The Moon is held in orbit around Earth by our gravity, but the Moon also has a gravitational field (about 1/6 that of the Earth's) which affects our oceans and causes tides.

The movement of the Earth and Moon around the Sun and the effect each of these objects have on each other are a balanced system that affects many aspects of daily life. The rotation of the Earth on its axis, causing day and night, is a concept best explained to students through a demonstration. You can find a PALMS blog post with a link to a video showing how you can demonstrate this concept at this link: https://ausearthed.blogspot.com/2020/05/day-and-night.html

This STEM Project will focus on the changes that the Earth's rotation causes (day and night) along with the importance of the Sun as a source of light.

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Addressing Misconceptions

There are many misconceptions associated with the movement and interaction of the Earth, the Moon and the Sun which are often reinforced by the terminology we use. Some common misconceptions are addressed below:

- *There is a dark side of the Moon that never receives sunlight*

  Many people are not aware that the Moon rotates on its own axis, just like Earth. It rotates at about the same speed that Earth, so that means we always see the same side of the Moon from the Earth's surface. We see the part of the Moon that is experiencing 'daytime'. The side of the Moon we do not see from Earth receives just as much sunlight, so it is more accurate to call this side, the 'far side'.

- *Moonlight*

  The Moon does not have its own source of light, so the term 'moonlight' is quite misleading. We can see the Moon in the sky because it is reflecting light from the Sun from its surface – this may be during the day or night. The brightness of the Moon depends on where the Moon is on its orbital path around Earth so how much sunlight is reaching the surface.

  The phases of the Moon are caused by our view of the Moon as it orbits Earth. When we cannot see the Moon (New Moon phase), the

Moon is between the Sun and Earth, so all sunlight is shining on the side of the Moon facing away from Earth. During the phase called Full Moon, the Moon is on the opposite side of the Earth to the Sun so the side of the Moon facing Earth is fully illuminated by sunlight.

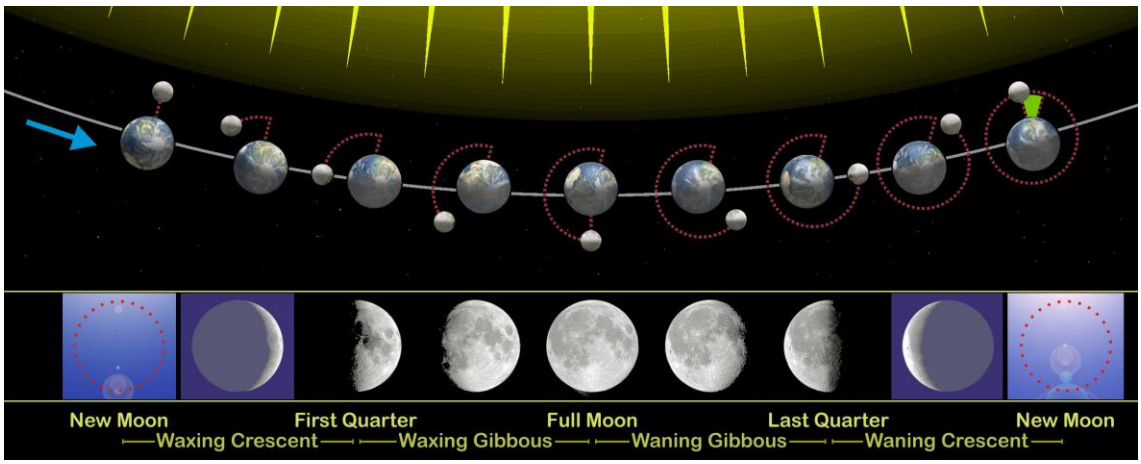

Image: Wikipedia Commons

- *Blast off to the Moon and arrive almost instantly*
  Many movies and television shows depict characters blasting off in a rocket in a straight line and arriving at the Moon in just a few moments. Whilst this may be possible in the future, with current technology it takes about three days to travel to the Moon. You will officially be in what we define as space about 2.5 minutes after liftoff and most of the energy a rocket requires is just to combat the force of gravity to get it off the Earth's surface. Since there AT a completely different level of forces such as friction and gravity in space, along with the fact that the Moon is constantly moving, the journey to the Moon will take some time.

- *There is no gravity on the Moon.* Since the Moon has a much smaller mass than Earth, it only has about one sixth of Earth's gravity on its

surface. Objects dropped on the Moon will take longer to fall to the surface, but they will not float away into space.

- *Sunrise and sunset*
  These terms imply that it is the Sun that is moving across the sky, not the Earth rotating away from or towards the Sun. From our perspective on the surface of Earth, it does appear as if the Sun is moving so it is easy to understand that early civilisations believed this was what was occurring. Greg Quicke, an astronomer based in Broome suggested that the phrase to ask someone to watch the sunset with you should instead be 'Let's go and watch the Earth turn away from the part of the sky that the Sun is in'. This may be more accurate but is not quite as quick or easy to say!

  This interactive animation is a fun way to demonstrate how the Earth's rotation causes day and night https://education.abc.net.au/home#!/media/1390621/earth-rotation-night-and-day

- *The Sun will 'go out'.* The Sun is composed of electrically charged hot gases as discussed above. Like all stars, our Sun does have a finite lifespan, but scientists predict it's currently a little less than halfway through its lifetime and in an estimated 6.5 billion years. When it runs out of energy it will first expand then shrink to become a White Dwarf. The Solar System website by NASA offers some more information about the Sun https://solarsystem.nasa.gov/solar-system/sun/in-depth/

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Facts and Figures

There are many facts and figures to know about the Sun, Moon and Earth and how they interact. Some of these are summarised in the table below:

Fact	Figure
Diameter of Moon	3,476 km
Diameter of Earth	12,756 km (3.7 times larger than Moon)
Diameter of Sun	1,391,000 km (109 times larger than Earth) (400 times larger than Moon)
Distance from Earth to Sun (average)	148,286,559 km
Distance from Earth to Moon (average)	384,400 km (about 32 planet Earth's could fill this distance)
Length of Moon's orbit of Earth	2,290,000 km
Length of Earth's orbit of Sun	940,000,000 km
Speed of Moon's rotation	3,683 km/hr
Speed of Earth's rotation	107,208 km/hr
Time taken for one complete rotation of Earth	23 hrs 56 min (1 day)
Time taken for one complete rotation of Moon & therefore time taken for one complete Moon cycle (New Moon to Full Moon)	27 (Earth) days
Time taken for Earth to orbit Sun once	365.25 days
Time taken for light to travel from Sun to Earth (one way)	8.24 minutes
Distance Moon travels around Earth in 24 hours	Approx. 88,400 km (13° of its orbit around Earth)

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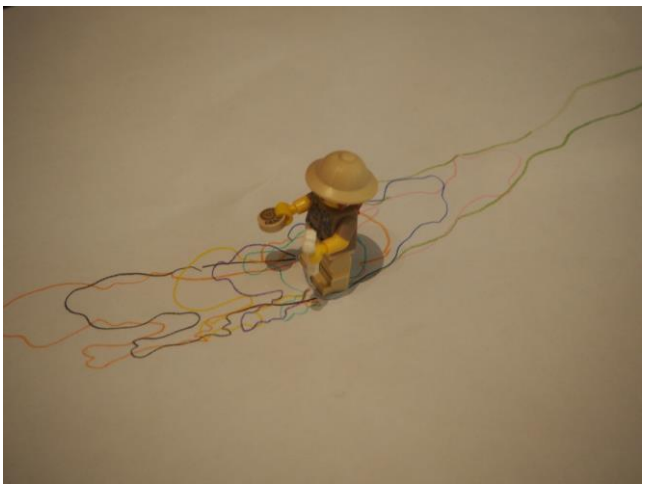
Short Preliminary Activities

This series of short activities will help students to start thinking about the movement and interactions of the Earth, Sun and Moon.

The StoryBots animation found on YouTube (https://youtu.be/Vb2ZXRh74WU) is a fun way to introduce students to the planets, Earth, Sun and Moon although you may like to view it in short sections. The same animation series also has an episode on day and night (https://youtu.be/plL1qvjuqtU).

Shadow Tracking

Students can track a shadow over the course of a day to observe how it moves and changes as the Sun appears to move across the sky. They could track their own shadow or the shadow of a figurine or other object, tracing around the shadow with chalk on the ground or on a large piece of paper. To make it a quantitative exercise, the length of the shadow could be measured.



If possible, try and time one of the shadow observations for the middle of the day when the Sun is directly overhead and it is difficult to see any

shadow.

This activity is a good opportunity to discuss the concept of fair testing in science with students. To ensure this is a scientifically accurate observation or fair test, the student or object must always be in the same place when the shadow is observed. The easiest way to do this is to draw a chalk mark on the ground or anchor the piece of paper the students are drawing on to ensure it stays in place. If you are measuring the shadow length, the measurement should always be of the distance between the same points e.g. head to toe of a student. You might also like to discuss the weather on the day of observation – is it fine and clear or are there some clouds in the sky that may affect how a shadow appears?

Here are some links to some more resources about shadow tracking:

- AusEarthEd blog post on investigating shadows https://ausearthed.blogspot.com/2020/06/investigating-shadows.html
- PALMS video on Investigating Shadows activity https://youtu.be/2MegZptsjAk
- PALMS Teacher Guide for Investigating Shadows activity https://www.palms.edu.au/mod/resource/view.php?id=578
- PALMS Student Worksheet Investigating Shadows https://www.palms.edu.au/mod/resource/view.php?id=579

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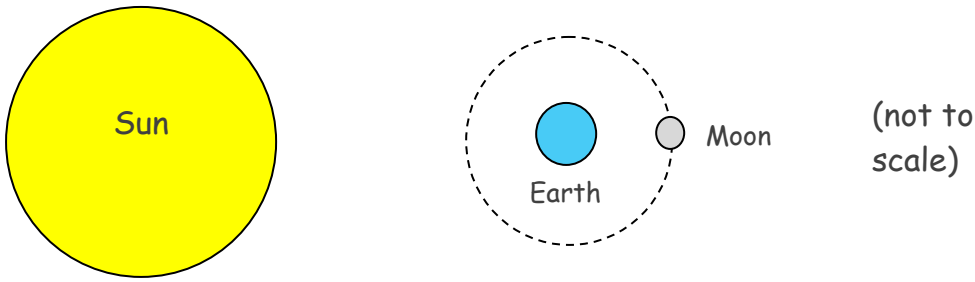
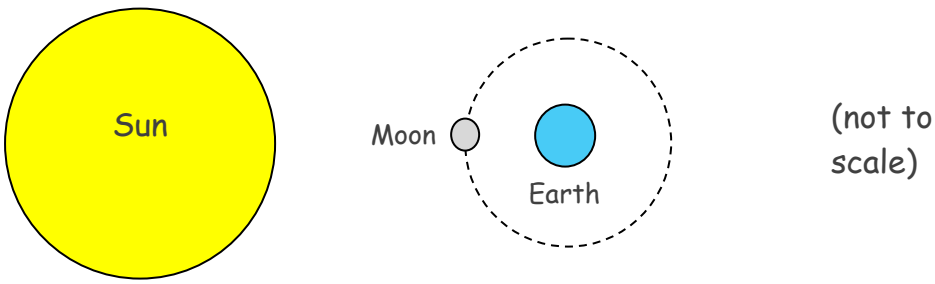
Moon Diary

Our view of the Moon from Earth changes as the Moon orbits Earth over the course of a month.

We see a 'Full Moon' when the Earth is between the Sun and the Moon.



We don't see the Moon, just a dark sky or 'New Moon', when the Moon is between the Sun and the Earth.



Students can observe the Moon each night, for a month, to track the phases and discover how the positions of the Earth, Sun and Moon affect what we see. To record their observations, students shade in circles in their Student Booklet to indicate how much of the Moon they can see each night.

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Phases of the Moon -This Photo by Unknown Author is licensed under CC BY-ND

This video demonstrates an easy way to demonstrate how the phases of the Moon occur https://www.youtube.com/watch?v=wz01pTvuMa0

Cultural Stories

Aboriginal and Torres Strait Islander Peoples have been observing the sky and the movements of the Sun, Earth and Moon for tens of thousands of years. There are many cultural stories about the creation and interaction of these celestial objects that students may be interested in.
It is best to try and find stories from your local language group and ask local language centres or cultural groups for their recommendations.

These links provide some background information for teachers and possible sources for relevant stories:

- Indigenous histories and culture elaborations for the Earth & Space Science content of the Australian Curriculum https://australiancurriculum.edu.au/TeacherBackgroundInfo?id=56601

- Information and links to find more information on Aboriginal and Torres Strait Islander astronomy
  http://www.aboriginalastronomy.com.au/
- Audio recording providing an overview of indigenous Australian's inclusion of stars and movement of the Sun and Moon in Dreamtime stories
  https://www.sbs.com.au/programs/first-contact/article/2014/11/14/stories-sky-indigenous-astronomy
- Noongar stories of the Sun travelling across the sky
  https://anthropologyfromtheshed.com/project/light-time-traditional-noongar-culture/
- Resource from South Australian DECS Aboriginal Education
  https://csem.flinders.edu.au/thegoodstuff/IndigiSTEM/docs/astronomy/The_Sun_and_Moon_Aborigin_1.pdf
- TedTalk by Aboriginal astronomer Kirsten Banks (contains ads)
  https://www.youtube.com/watch?v=mYr7ZCn04eA&feature=emb_logo

Here are a few suggestions of children's storybooks on Indigenous stories of the Earth, Moon and Sun:

- *Brother Moon* Written by Maree McCarthy Yoelu, Illustrated by Samantha Fry
- *Staircase to the Moon* written and illustrated by Bronwyn Houston
- *Gidja the Moon (Stories of the Dreamtime – Tales of the Aboriginal People)* written by Percy Trezise and Dick Roughsey

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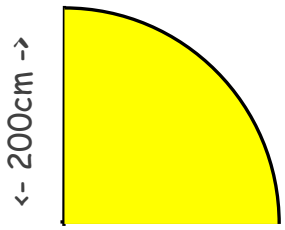
Scale Models

Making scale models is a great way for students to visualise the difference in the size of the Sun, Earth and Moon but the enormous size of the Sun can make this a little tricky. To make a 3D model, you could use a large piece of fabric pinned to a wall and stuffed with newspaper to represent $\frac{1}{4}$ of the Sun. Students could then make their own Earth and Moon from balls of plasticine using the following dimensions:

- 1cm diameter Moon,
- 3.7cm (4cm) diameter Earth,
- 400cm diameter Sun or to make $\frac{1}{4}$ Sun it would be 200cm radius



Scale models of the distances between the Earth, Sun and Moon are a little trickier. If you make the distance between the Earth and Moon 8cm, the Sun would be approx. 3,700cm (37m) away from Earth (about 3 bus lengths!). Another way to visualise these distances is if you have a hula hoop (approx. 76cm in diameter) to represent the orbit of the Moon around the Earth (so the moon is 38cm (0.38m) away from Earth in the centre of the hula hoop), the Sun is approx. 147m from the centre hula hoop!

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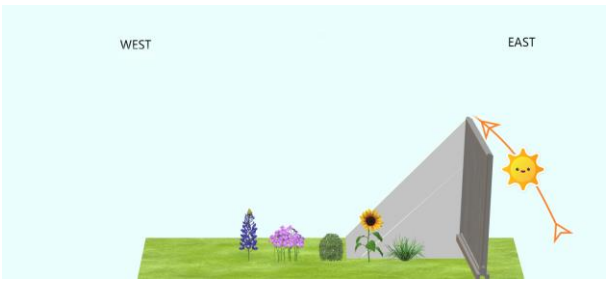
Longer Project - Design a Garden

This project is designed to get students thinking about how the light from the Sun is so important for life on Earth. They are asked to consider a garden with a fence or wall. The shadow of the wall means some plants will get more time in the sunlight than others. Students will be asked to plan the planting of the garden beds, considering where plants should be planted to get the optimum amount of sunlight.

In the example garden below, the shadow from the fence (on the right of the diagram) will become shorter as the day progresses, meaning plants closest to the fence will get less sunlight than plants further from the fence.

Early morning



Mid-morning

Midday

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Some plants will grow more successfully if they are grown in full sun (in sunlight all day), whereas others prefer part sun or full shade. Students could research different plant types and look at their labels or tags to find out their sunlight needs. You may like to arrange an excursion to a local garden centre or botanic garden to help the students research or you could just prepare some examples or photographs of plant tags. They can record their research findings in their Student Booklet.

Examples of plant tags showing best position for planting

Students need to choose a range of plants that include an assortment of different sunlight requirements.

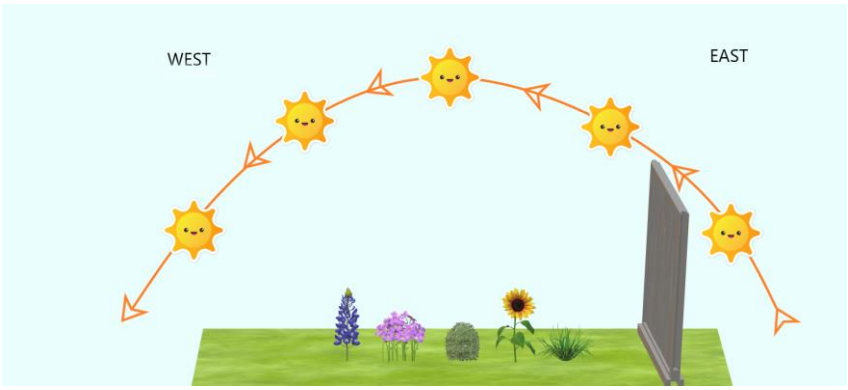
Next, ask the students to think about where plants should be placed in a garden that has a fence that casts a shadow across the garden beds, as in the example above. They can then draw a design of their garden, labelling where each type of plant could be planted. It would be easiest for students to draw a birds-eye view of their garden (you may need to explain this idea

to students).

Once students have drawn their design, depending on the resources available to you, they could:

- Build a model of the garden and test if they've placed the plants in the correct locations by using a torch to represent the Sun. The model could be built using a shoe box with all but one of the sides removed (and no lid) where the remaining side represents the garden wall. The torch would start the day behind the garden wall then move in an arc to be directly above the garden at midday, then move down to the evening position on the opposite side from where it started.
- Or alternatively, students could plant the garden in the school grounds and monitor the health and growth of plants over a few weeks or even a term. This may require some thought regarding the orientation of the garden and where a wall or other structure that casts a shadow over the garden should be placed.

In the student booklet, there are discussion questions related to both options mentioned above. Feel free to add any others you may come up with during the project.



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To conclude the project, students could communicate what they found out by writing a report, making a video report or making a poster including diagrams or photographs of what they discovered. You can then discuss with the class if they think their garden was successful and if they might change where they put some plants if they designed the garden again.

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Appendix 1

Make My Day (& Night) Project Keywords

Sun	sunset	scale
Moon	axis	measure
Earth	moon phase	model
rotation	sunlight	distance
orbit	reflection	garden
day	Dreamtime	plant
month	space	plant tag
year	gravity	position
shadow	star	design
light	diameter	garden bed
sunrise	fair test	grow

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Appendix 2

Year 3 Australian Curriculum links

Note: All curriculum areas may not be covered by each student depending on how the project is organised and assigned.

Science	Technology*	Engineering*	Mathematics
Science Understanding Biological Sciences Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ACSSU044) Earth and Space Sciences Earth's rotation on its axis causes regular changes, including night and day (ACSSU048)	**Technologies and Society** Ways products, services and environments are designed to meet community needs, including consideration of sustainability (ACTDEK010) **Representation of data** Different types of data can be represented in different ways (ACTDIK008)	**Engineering principles and systems** Forces, and the properties of materials, affect the behaviour of a product or system (ACTDEK011) **Materials and technologies specialisations** Suitability and safe practice when using materials, systems and components for a range of purposes (ACTDEK013)	**Number and Place Value** Recognise, model and order numbers to at least 10 000 (ACMNA052) Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems (ACMNA053) **Measurement and Geometry** Measure, order and compare objects using familiar metric

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Physical Sciences Heat can be produced in many ways and can move from one object to another (ACSSU049) **Science as a Human Endeavour** Nature and development of science Science involves making predictions and describing patterns and relationships (ACSHE050) Use and influence of science Science knowledge helps people to understand the effect of their actions (ACSHE051)	**Digital implementation** Use visually represented sequenced steps (algorithms), including steps with decisions made by the user (branching) (ACTDIP011)	**Investigating and defining** Create a sequence of steps to solve a given task (WATPPS16) **Designing** Develop and communicate ideas using labelled drawings and appropriate technical terms (WATPPS17) **Evaluating** Use criteria to evaluate design processes and solutions developed (WATPPS19) **Collaborating and managing** Work independently, or collaboratively	units of length, mass and capacity (ACMMG061) Create and interpret simple grid maps to show position and pathways (ACMMG065) **Statistics and Probability** Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (ACMSP069)

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Science Enquiry Skills Questioning and predicting With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge (ACSIS053) Planning and conducting With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment (ACSIS054)		when required, to plan, create and communicate sequenced steps (WATPPS20)	

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Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately (ACSIS055) Processing and analysing data and information Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS057) Compare results with predictions, suggesting possible reasons for findings (ACSIS215)			

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Evaluating Reflect on investigations, including whether a test was fair or not (ACSIS058) Communicating Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS060)			

*Drawn from Design and Technologies and Digital Technologies curriculum

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Links to other curriculum areas

Humanities and Social Science (HASS)

Language groups of Australia's Aboriginal and Torres Strait Islander Peoples divides their Country/Place and differs from the surveyed boundaries of Australian states and territories (ACHASSK066)
Identify current understanding of a topic (e.g. brainstorm, KWL chart) (WAHASS26)
Locate and collect information from a variety of sources (e.g. photographs, maps, books, interviews, internet) (WAHASS28)
Record selected information and/or data (e.g. use graphic organisers, develop note-taking strategies) (WAHASS29)
Present findings and conclusions in a range of communication forms (e.g. written, oral, visual, digital, tabular, graphic), appropriate to audience and purpose, using relevant terms (WAHASS37)

English

Understand that languages have different written and visual communication systems, different oral traditions and different ways of constructing meaning (ACELA1475)

Discuss texts in which characters, events and settings are portrayed in different ways, and speculate on the authors' reasons (ACELT1594)

Draw connections between personal experiences and the worlds of texts, and share responses with others (ACELT1596)

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Appendix 3

References used in preparing this project

GENERAL INFORMATION

Scale model of Sun, Earth & Moon- distances between, views from each as they rotate, scale of rotations https://www.childrensuniversity.manchester.ac.uk/learning-activities/science/the-earth-and-beyond/introduction/

Misconceptions about the Moon https://moon.nasa.gov/about/misconceptions/

Interactive animation on sun position and shadows
https://education.abc.net.au/res/i/L756/index.html (Runs with Adobe Flash Player so may not be supported by your browser)
https://education.abc.net.au/home#!/media/1390621/earth-rotation-night-and-day

Moon phases simulation viewed from Earth and Space
https://www.pbslearningmedia.org/resource/buac19-35-sci-ess-earthsunmoon35model/moon-phases-simulation-viewed-from-earth-and-space/support-materials/

Academic papers on Indigenous astronomy ideas
https://www.atnf.csiro.au/people/rnorris/papers/n301.pdf
https://www.academia.edu/41717740/Solstice_and_Solar_Position_observations_in_Australian_Aboriginal_and_Torres_Strait_Islander_traditions

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Audio recording giving overview of how indigenous Australian's include stars and the movement of the Sun and Moon in Dreamtime stories https://www.sbs.com.au/programs/first-contact/article/2014/11/14/stories-sky-indigenous-astronomy

Noongar stories of Sun travelling across sky
https://anthropologyfromtheshed.com/project/light-time-traditional-noongar-culture/

Indigenous histories and culture elaborations on Earth & Space Science section of Australian Curriculum https://australiancurriculum.edu.au/TeacherBackgroundInfo?id=56601

Resource from South Australian DECS Aboriginal Education
https://csem.flinders.edu.au/thegoodstuff/IndigiSTEM/docs/astronomy/The_Sun_and_Moon_Aborigin_1.pdf

http://www.aboriginalastronomy.com.au/

NASA information about the Sun, Earth and Moon
https://solarsystem.nasa.gov/planets/earth/overview/
https://solarsystem.nasa.gov/solar-system/sun/by-the-numbers/
https://solarsystem.nasa.gov/solar-system/sun/in-depth/
https://spaceplace.nasa.gov/all-about-the-moon/en/
NASA Space Place – designed for kids to use https://spaceplace.nasa.gov/

Resources to explore on this topic https://www.inquisitive.com/unit/83-the-sun-earth-and-moon

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Videos

TedTalk by Aboriginal astronomer Kirsten Banks
https://www.youtube.com/watch?v=mYr7ZCn04eA&feature=emb_logo

StoryBots animation on Outer Space https://youtu.be/Vb2ZXRh74WU

Story Bots animation on Night and Day https://youtu.be/plL1qvjuqtU

Overview of Earth, Sun and Moon - https://youtu.be/riMAITbLqZI Does mention tides and minerals – perhaps too much info for Yr 3

Earth's rotation and revolution https://youtu.be/6SzjlsuyTdk

Phases of the Moon – good for teacher info (too high level for Year 3)
https://youtu.be/1sj2otIjZfM

Easy demo of phases of the Moon https://www.youtube.com/watch?v=wz01pTvuMa0