# YEAR 6
# SURFACE CHANGES

**Australian Curriculum Earth Science activities**

**with links to other subjects.**

PALMS

PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

Santos & ESWA supporting earth science education

EARTH SCIENCE WESTERN AUSTRALIA

Santos

# YEAR 6 - Teacher Introduction

The Primary Australian Literacy Mathematics & Science (PALMS) Program aims to enrich and support the teaching of earth science from Kindergarten to Year 6 across Australia. This will be achieved by providing, within the mandated Earth and Space Science curriculum, hands-on activities integrating aspects of Chemical Sciences, Physical Sciences and Biological Sciences as well as relevant components of English, Mathematics and other subjects into teaching packages.

These teaching packages will be made available at www.palms.edu.au.

*Activities marked **PPP** (PALMS PARENT POWER) are ones you may wish to send home with the students to do with their parents or by themselves. They replay the concepts recently covered in Science. Studies demonstrate that if a student describes what they have learned to another, they deepen their own understanding and retain it longer.*

| Topic No. | Topic | Activities | Student worksheet | Subjects | Page No. |
|---|---|---|---|---|---|
| 1 | Our Changing Surface | How Did That Get There? | X | Science & HASS | 4 & 15 |
| | | Making Craters | X | Science & Maths | 18 & 22 |
| | | PPP - Splash Down | X | Science | 25 |
| | | Having a Blast | | Science | 26 |
| | | All the Rivers Run | X (extension) | Science | 31 & 35 |
| | | Sculpting Sand Dunes | X | Science | 39 & 41 |

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| Topic No. | Topic | Activities | Student worksheet | Subjects | Page No. |
|---|---|---|---|---|---|
| 2 | Shifts and Changes | Salt Lake Puddles | X | Science & Maths | 44 & 48 |
| | | Change Caused By Humans | X | HASS | 52 & 53 |
| | | Eco-Tourism Poster | X | HASS & English | 54 & 55 |
| 3 | It's a Disaster! | Literature Landscapes | | English | 57 |
| | | Community Meeting | X | Science, HASS & English | 58 & 62 |
| | | Water in Soils | | Science | 64 |
| | | Flooded Landscape Model | X | Science & Design & Technology | 66 & 69 |
| | | Measure a Quake Shake | | Science | 72 |
| | | PET Bottle Cyclone | | Science & Design & Technology | 75 |
| | | Blow a Cyclone | | Science | 78 |
| | | PPP – Air Pressure and Cyclones | X | Science & HASS | 80 |

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# YEAR 6 - Teacher Introduction

| Topic No. | Topic | Activities | Student worksheet | Subjects | Page No. |
|---|---|---|---|---|---|
| 4 | Be Prepared | Disaster Response | | Science, HASS, Maths & English | 81 |
| | | International Space Farm | | Science, HASS, Maths, English & Design and Technology | 86 |
| | | How Would Your Area be Impacted? | | Science & HASS | 92 |

A WORD ON VARIABLES:
Throughout the PALMS resources for younger year groups, the acronym Cows Moo Softly has been used to introduce the scientific method of change one thing, measure one thing and everything else stays the same. In Year 6, it is a good idea for students to start to use the more scientific terminology of independent, dependent and controlled variables in their experimental work as these are the terms they will be expected to use as they move in to high school. As such, these terms will be introduced and used throughout this resource.
INDPENDENT VARIABLE – This is the variable that we change.
DEPENDENT VARIABLE – This is the variable that we are testing and therefore the one we measure.
CONTROLLED VARIABLES – These are the factors that we keep the same to ensure a fair test is carried out. Students should always be encouraged to list more than one of these.

# YEAR 6 - Teacher Introduction

**Australian Curriculum (WA)**
**Earth and Space Sciences**
Sudden geological changes and extreme weather events can affect Earth's surface (ACSSU096)
**Other Sciences**
The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)
Changes to materials can be reversible or irreversible (ACSSU095)
Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE100)
**Mathematics**
Convert between common metric units of length, mass and capacity (ACMMG136)
Compare observed frequencies across experiments with expected frequencies (ACMSP146)
Interpret secondary data presented in digital media and elsewhere (ACMSP148)
**English**
Identify and explain how analytical images like figures, tables, diagrams, maps and graphs contribute to our understanding of verbal information in factual and persuasive texts (ACELA1524)
Make connections between students' own experiences and those of characters and events represented in texts drawn from different historical, social and cultural contexts (ACELT1613)
Participate in and contribute to discussions, clarifying and interrogating ideas, developing and supporting arguments, sharing and evaluating information, experiences and opinions (ACELY1709)
Use comprehension strategies to interpret and analyse information and ideas, comparing content from a variety of textual sources including media and digital texts (ACELY1713)

# YEAR 6 - Teacher Introduction

**HASS**

Choices about the use of resources result from the imbalance of limited resources and unlimited wants (i.e. the concept of scarcity) (ACHASSK149)

Decisions about the alternative use of resources result in the need to consider trade-offs (e.g. using the land to grow crops or to graze cattle) (ACHASSK149)

Locate and collect information and/or data from a range of appropriate primary sources and secondary sources (e.g. museums, media, library catalogues, interviews, internet) (WAHASS52)

Record selected information and/or data using a variety of methods (e.g. use graphic organisers, paraphrase, summarise) (WAHASS53)

Interpret information and/or data collected (e.g. sequence events in chronological order, identify cause and effect, make connections with prior knowledge) (WAHASS56)

**Design and Technology**

How people address competing considerations, including sustainability when designing products, services and environments for current and future use (ACTDEK019)

Characteristics, properties and safe practice of a range of materials, systems, tools and equipment; and evaluate the suitability of their use (ACTDEK023)

# Our Changing Surface- Teacher's Notes

Many different processes have shaped the surface of the Earth over billions of years to make the landscapes that we see today. Surface features such as mountains, craters, floodplains and sand dunes impact the way that humans interact with their environment. This may be evident in the choice of locations where settlements are established, where farms are most successful or where mining operations are economically viable. Surface landforms we can see now, give clues as to what has happened on our planet in the past, and even how it was formed approximately 4.6 billion years ago. This also helps scientists understand discoveries they make on other rocky planets, by comparing extra-terrestrial landscapes with our own. By understanding how these landscape features are formed on Earth, scientists can form hypotheses about weather and conditions on other planets. For example, knowing about impact craters helped in the design of vehicles for the Moon landings and understanding how dunes form informed specific design features of the Mars rovers.

This section will examine some of these different landforms and introduce the students to four main ways they are created: by impact, volcanic, fluvial or aeolian processes.
There are many objects travelling through our universe that, at times, will make it to the surface of the planet as meteors. When this occurs, the surface is changed due to **IMPACT** processes. The result of these processes is impact craters which can vary greatly in diameter and depth according to the size of the meteor and the speed with which it hits. An example of this surface landform in Western Australia is the famous Wolfe Creek Crater, south of Halls Creek. Our Moon also has many impact craters dotting its surface as it has been frequently bombarded due to its very thin

atmosphere not protecting it like Earth's atmosphere does. It's interesting to note that craters on the moon are very well preserved as there is very little erosion occurring there.

As the name suggests, **VOLCANIC** processes are caused by volcanoes and include landforms and features such as calderas, lava and ash flows and volcanoes themselves. There are no active volcanoes left on mainland Australia; the most recently active volcano in Australian territory is Big Ben, on Heard Island in the southern Indian Ocean, which last erupted in 2016. There is evidence of very ancient volcanic activity in Western Australia which formed the basalt rocks around Bunbury and brought the diamonds in the Argyle Diamond Mine in the Kimberley closer to the surface. The lakes around the town of Mt Gambier in South Australia were formed in the craters of dormant volcanoes and the Glasshouse Mountains in Queensland are cores of volcanoes that erupted around 26-27 million years ago.

**FLUVIAL** processes (*floo-vee-al*) are caused by the movement of flowing

water in rivers. Surface features such as channels, valleys and deltas are created by fluvial processes. They will vary in shape and size depending on the type of rocks in the area, how much water is flowing through, and the topography of the area. The gorges in the Karijini National Park in north-west WA are stunning examples of surface landforms formed by fluvial processes. The Swan Valley on the outskirts of Perth is also an example and the fertile soils of this area can be attributed to mineral-rich sediments (broken rock material) being deposited here over a long time.
Wind can wear away (weather), move (erode) and deposit sediments. These are called **AEOLIAN** processes (*ay-oh-lee-an*). Landscape features such as sand dunes (eg. Yeagarup dunes near Pemberton) and rock formations such as the Pinnacles near Cervantes are formed, or shaped by, these processes. The Yeagarup dunes are particularly interesting as they are currently situated about eight kilometres inland from the coast and are moving further inland, through the action of the wind, at an approximate rate of four metres per year.

The NASA website has a search engine for photos taken of other planets:
https://nasasearch.nasa.gov/search/images?affiliate=nasa&query=
There is also a page where you can search for images taken from the International Space Station (ISS) and you can even submit a request for a photograph to be taken!
https://eol.jsc.nasa.gov/Collections/EarthFromSpace/

# How Did That Get There? - Teacher's Notes

Many landforms seen on the surface of the Earth can also be observed on the terrestrial planets in our solar system – Mercury, Venus and particularly Mars, whose surface has been well studied. The NASA website is an excellent resource for photographs and information about the surface of other planets.

*In this activity students will examine photographs of examples of four different processes.*

**Materials**

- A selection of the sixteen supplied photographs (printed or projected). It's suggested to use only some of these photos, ensuring at least one from each process is included as sixteen is too many for students to analyse in one sitting. A copy of the photos is available to download as a PowerPoint file that contains larger images on the PALMS website (www.palms.edu.au). The captions are noted in the presenter's notes sections so you can mix the photos up if you prefer.
- Worksheets – again, there are sixteen boxes but this should be adapted for the amount of photographs you use.

**Method**

Start with a class discussion introducing the four ways that landforms may be created – impact, volcanic, fluvial and Aeolian, see 'Surface Landforms – Teacher's Notes'.

Once they have a general understanding of the four processes the students can fill in a description of each of these processes on the first worksheet. Students are then shown the supplied aerial photographs of landscapes that are on the following pages (less photos should be used but ensure you have some from each process and that they are jumbled for variety). They may either be printed out and laminated or projected on a smart board/screen.

In small groups they should discuss and describe the landforms they can

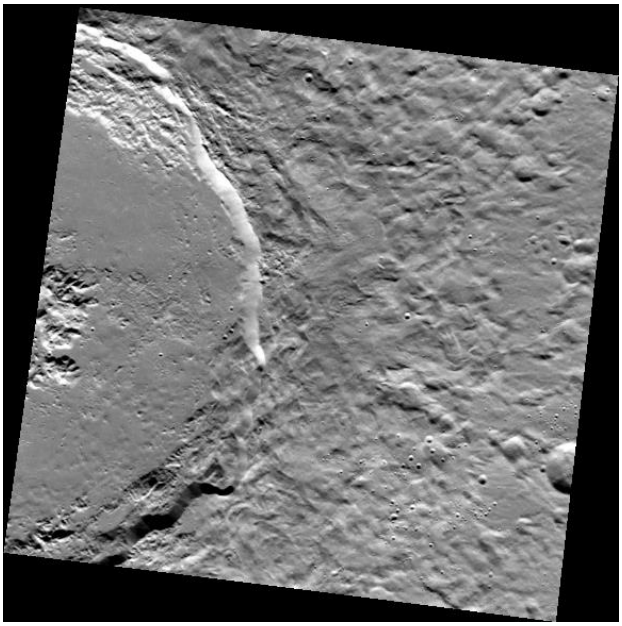
see in the photographs, noting any observations on the first worksheet. Some questions to guide their thinking and discussion are:

- **What kind of process or action would result in this being formed? (How were they formed?)**
- **How long would it take to make these landforms?**
- **Were they formed naturally or were they man-made?**
- **Where might they be located? (it would be more exciting for them to find out that some of these formations are not actually on Earth later).**

Once students have decided which process has formed each of the landscapes pictured, the answers can be revealed to them. To make it even more interesting, the teacher could hint that some of the landforms are on planets other than Earth and get the students to guess which ones are. The teacher could also explain that these formations are evidence that similar weather and geological processes occur on other planets.

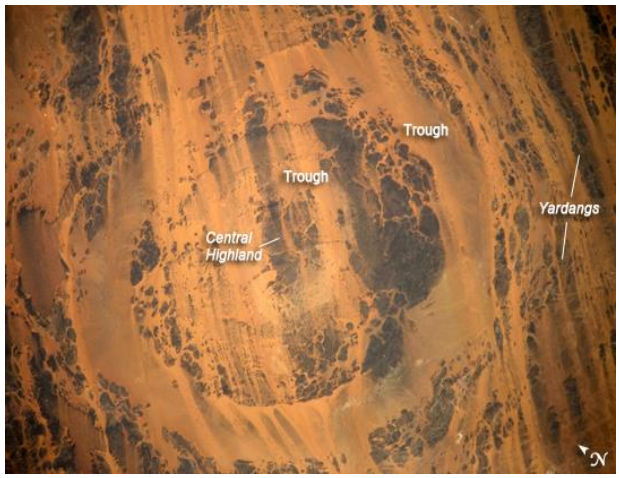
## IMPACT LANDFORMS

**Picture 1 - Mars.** Impact crater in the Sirenum Fossae area on Mars. *Image credit: NASA/ JPL/ University of Arizona, Photo taken by the Mars Reconnaissance Orbiter (MRO)*



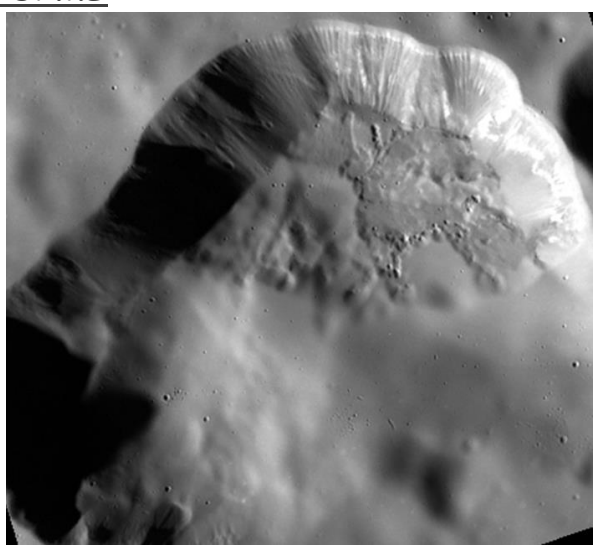
**Picture 2 - Mercury.** Abedin impact crater on surface of Mercury.
*Image Credit: NASA/Johns Hopkins University Applied Physics Laboratory/ Carnegie Institution of Washington*

**Picture 3 - Earth.** Gosses Bluff in the Northern Territory, Australia. An impact crater that is about 142 million years old.
*Image credit: NASA/JSC Earth Science and Remote Sensing Unit.*

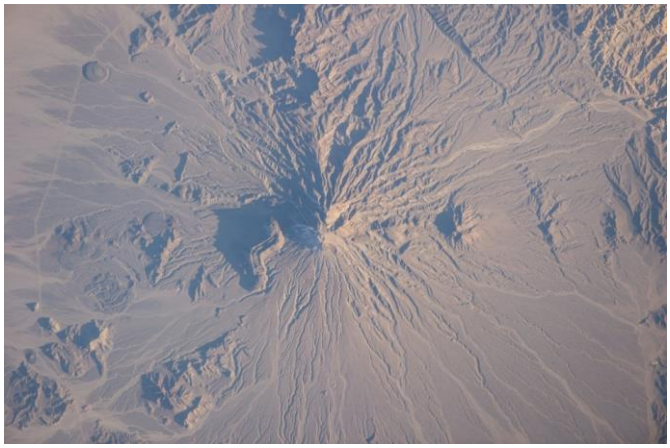



**Picture 4 - Earth.** Aorounga impact crater in the Sahara desert, Chad. It is approximately 345-370 million years old.
*Image credit: NASA/ JSC Earth Science and Remote Sensing Unit*

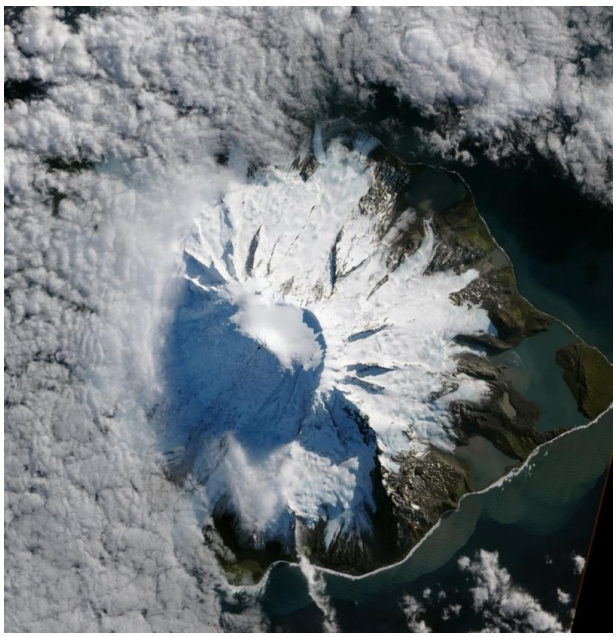
## VOLCANIC LANDFORMS



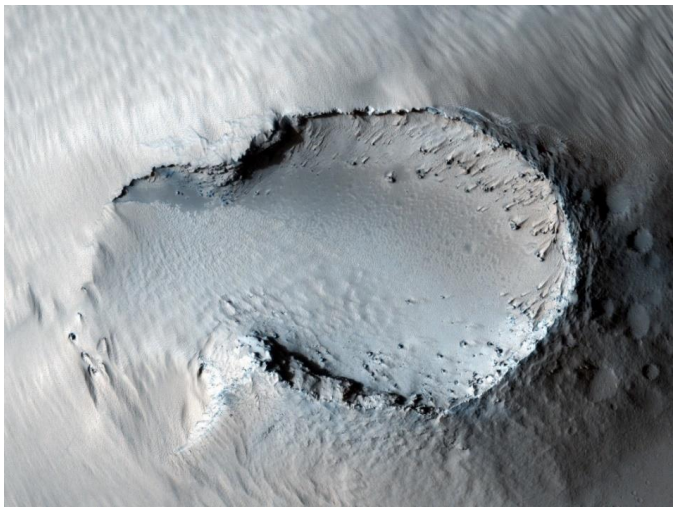
**Picture 5 - Mercury.** Volcanic vent in the Rachmaninoff basin on Mercury.
*Image credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington*



**Picture 6 – Earth.** Bazman, a dormant volcano in Iran.
*Image credit: NASA/JSC Earth Science and Remote Sensing Unit*

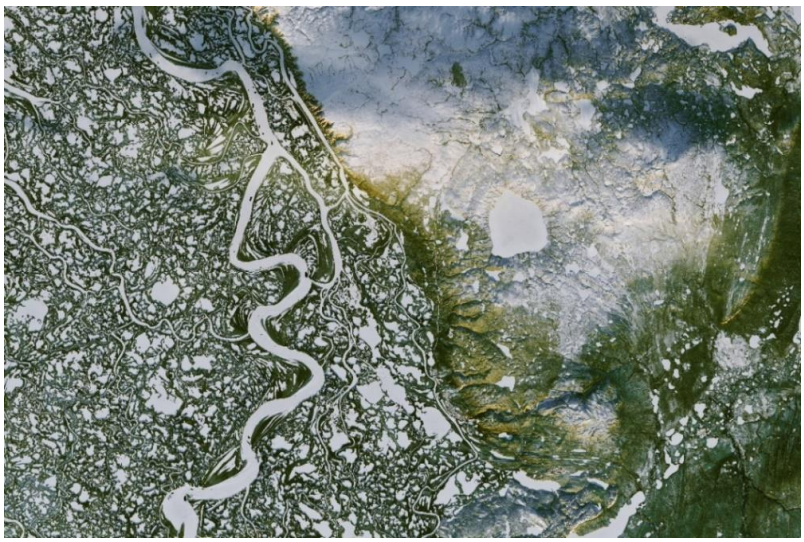


**Picture 7- Earth**. Mawson Peak on the remote Heard Island (near Antarctica but considered Australian territory) is actually Australia's most active volcano.
*Image Credit: NASA Earth Observatory*

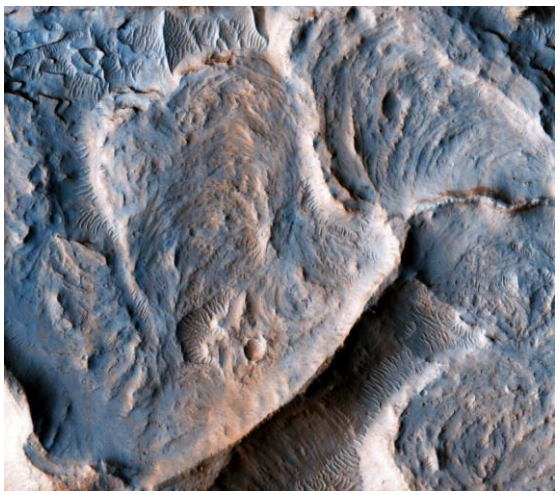


**Picture 8 – Mars.** Small cone on one of Mars' giant shield volcanoes.
*Image Credit: NASA/ JPL-Caltech/ University of Arizona*

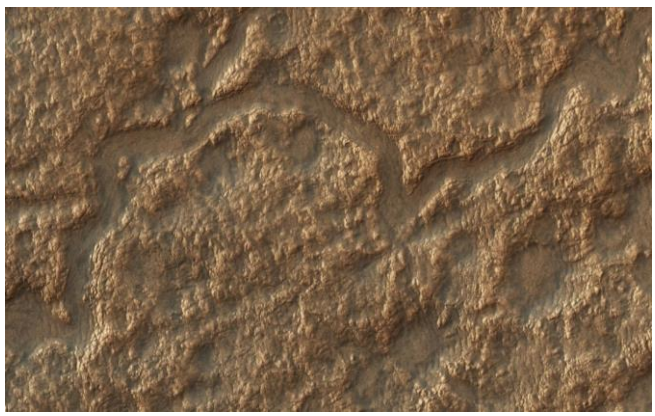
## FLUVIAL LANDFORMS



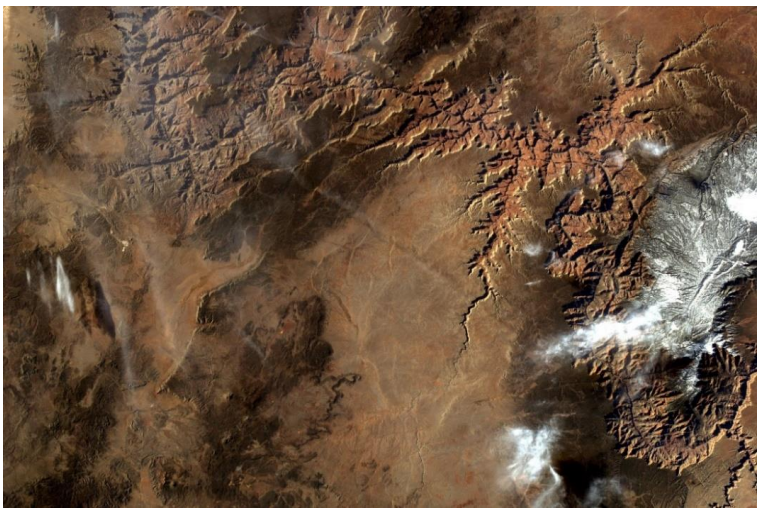
**Picture 9 - Earth.** The frozen Mackenzie River Delta in Canada shows how water has carved the landscape.
*Image credit: NASA Earth Observatory images by Joshua Stevens, using Landsat data from the U.S. Geological Survey*



**Picture 10 – Mars.** This photo shows an inverted fluvial channel near the equator of Mars. This is evidence of water possibly being present on Mars in the past.
*Image credit: NASA/JPL-Caltech/Univ. of Arizona*



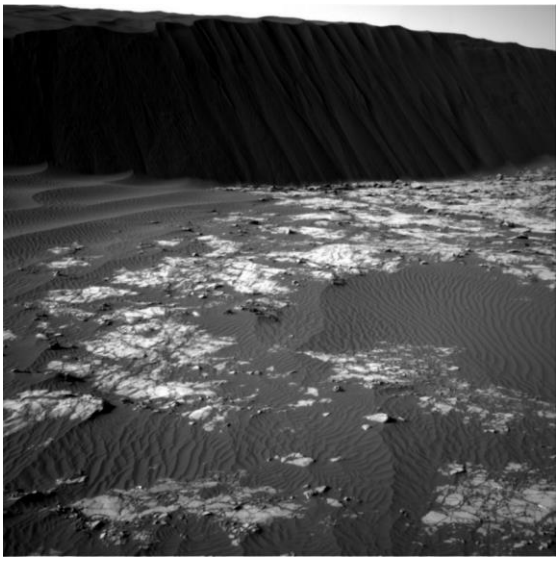
**Picture 11 – Mars.** These channels on the floor of the Lyot crater on Mars resemble streams common in the Arctic region of Earth, suggesting there has possibly been water on Mars.
*Image credit: NASA/JPL-Caltech/Univ. of Arizona*



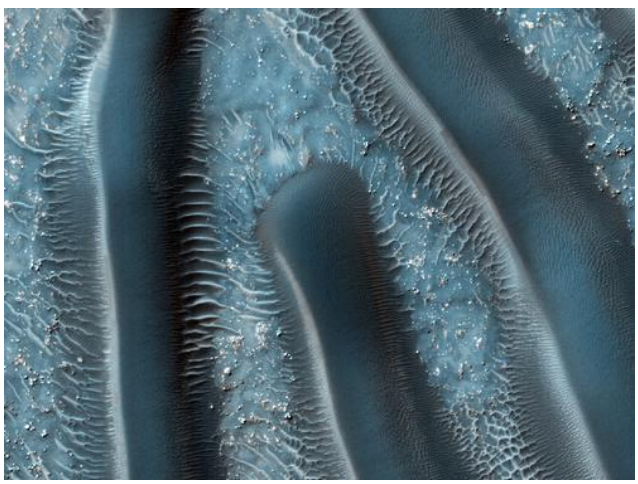
**Picture 12 – Earth**. The iconic Grand Canyon has been carved out by the Colorado River.
*Image credit: Sally Ride EarthKAM (photographed from the International Space Station using a camera controlled by school students on Earth!*

## AEOLIAN LANDFORMS

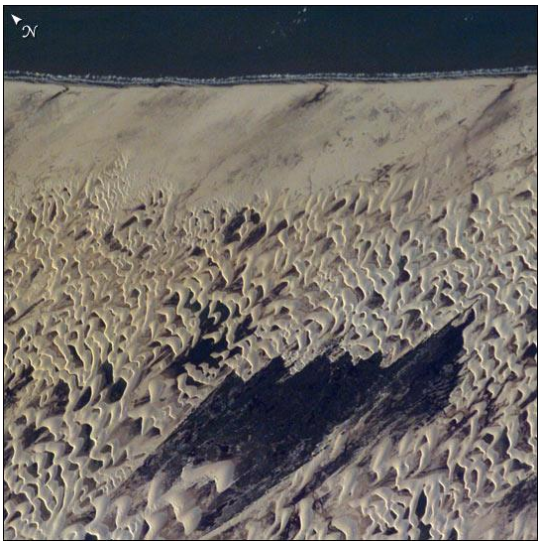
**Picture 13 – Earth**. Sand dunes in Algeria.
Image credit: NASA/JSC Earth Science and Remote Sensing Unit



**Picture 14 – Mars.** Ripples in sands on Mars.
*Image Credit: NASA/JPL-Caltech. This image was taken by Navcam: Right B (NAV_RIGHT_B) onboard NASA's Mars rover Curiosity on Sol 1194 (2015-12-16 01:56:13 UTC).*



**Picture 15 – Mars.** Sand dunes on Mars
*Image credit: NASA/JPL – Caltech/University of Arizona*



**Picture 16 – Earth**. A dune field in the Lencois Maranhenses National Park on the north coast of Brazil.
*Image credit: NASA/JSC Earth Science and Remote Sensing Unit*

Observations that students record may include:

- How would you describe the features you can see?
  - Mountains, rocky, holes, hollows, ripples, like a river, lumpy, squiggly
- What kind of process or action might this be formed by?
  - Something crashing into the surface, pushing up the earth, weathering and erosion
- How long would it take to make these landforms?
  - Thousands to millions of years
- Were they formed naturally or were they man-made?
  - Expect most students to say naturally formed

# How Did That Get There? - Teacher's Notes

Simple descriptions of the processes (also included on the PowerPoint slides found on the PALMS website):

Impact – Objects such as meteorites falling from space and changing the surface when they hit it.

Volcanic – Erupting volcanoes making new landforms from cooling lava and explosive eruptions changing the height and shape of volcanoes.

Fluvial – Flowing water shaping a planet's surface by removing or depositing materials.

Aeolian –The wind moving substances around or shaping hard surfaces by weathering and eroding them away.

Name _____

# How Did That Get There - Student Worksheet

The landscapes we see on the surface of the Earth today have been shaped over millions of years by natural processes. There are four main natural processes. Write a description of each process in the table below:

| Process name | Description |
|---|---|
| Impact | |
| Volcanic | |
| Fluvial | |
| Aeolian | |

Name _____

# How Did That Get There - Student Worksheet

Look at the aerial photographs of different landscapes. Discuss the following questions with your group.

- How would you describe the features you can see?
- What kind of process or action might this be formed by?
- How long would it take to make these landforms?
- Were they formed naturally or were they man-made?

Write down your observations. Think about where they might be located.

| | |
|---|---|
| 1 | 2 |
| 3 | 4 |
| 5 | 6 |

Name _____

# How Did That Get There - Student Worksheet

| | |
|---|---|
| 7 | 8 |
| 9 | 10 |
| 11 | 12 |
| 13 | 14 |
| 15 | 16 |

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# Making Craters - Teacher's Notes

Impact craters are formed when objects fall from height (from space or even from volcanic eruptions) and crash into the surface of a planet. In this activity, students will create and take measurements of impact craters. Since there are different objects that may cause these craters, for this activity, we'll call these objects 'impactors'. There are several options for variables to change in creating the craters – size of impactor, angle of impact, height of drop, etc.

**Materials**

- Large tray or box (a new kitty litter tray, student desk tray or an A3 paper box is ideal) per group
- Clean sand to fill the tray or box and balloons (see below)
- A selection of balloons filled with different amounts of sand or different size balls (eg. golf ball, cricket ball, shot put) to represent different impactors.
  NOTE: Since the balls are all made of different materials, you could discuss with the students whether using these truly represents a fair test.
- Funnel to fill balloons
- A ruler or tape measure per group
- OPTIONAL ADDITIONAL MATERIALS:
  - Plank of wood or metre rule
  - Protractors to measure impact angle
  - Flour or another fine powder (enough to make a thin layer on the surface)
  - A sheet of ice or toffee to fit the size of the tray or box to represent different surfaces
  - Different types of sand to represent different surfaces on Earth
  - Plaster of Paris to make moulds of impact craters

- Camera to photograph or film impacts (slo-mo videos are great!)

**Method**

**To be prepared in advance:**

1. Fill the tray with sand and flatten the surface. It should be firmly packed but not compacted too much. Making the surface of the sand a little damp helps keep the shape of the craters, to allow time for measurement.
2. If using the sand filled balloons, fill four balloons with different amounts of sand and tie them to form roughly spherical shapes that will be your impactors. (Suggest using 80g, 120g, 160g and 200g of sand). To fill the balloons, put the funnel in the neck of the balloon, add a small amount of sand and work it to the bottom of the balloon, stretching it as you go.
3. If using flour, sprinkle a thin, even layer over the surface of the sand in the tray.



4. If using an ice or toffee layer, carefully place on top of sand just before starting the experiment. NOTE: It is probably best to only use these layers when testing hard or heavy impactors as the balloons filled with sand are unlikely to form craters in these substances.

**To be investigated by students:**

Option 1: Changing the size of impactor

1. Select four impactors of different size (sand filled balloons OR balls).
2. Decide on a set height to drop the impactors and record this height on the worksheet (a height greater than 30cm works best).
3. *If videoing your experiment, set up the camera, ready to record.*
4. Drop the smallest impactor and carefully remove it from the tray, trying not to disturb the crater formed.
5. Measure the diameter of the crater it forms. Note any other observations of the craters appearance. Record these values on the worksheet.

*Optional:*

- *Photograph the crater*
- *Create a cast of your crater using Plaster of Paris*



6. Smooth the sand over, filling in the crater.
7. Repeat the test with the different sized impactors, recording all data on the worksheet provided.

**Variables**

In this experiment:

We will **change** the size of the impactor (**independent** variable)

We will **measure** the diameter of the crater formed (**dependent** variable)

The things we will keep the **same** (**controlled** variables) are: impactor drop height, material in tray/box (e.g. sand), the way the diameter is measured and method of dropping impactor.

## Other variables that could be changed

**Changing the height of impact**

Select one size of ball OR a balloon filled with sand (suggest about 120g of sand) that will be your impactor. Drop from different set heights (independent variable) and measure the diameter of the crater (dependent variable) or the depth of the crater.

**Changing the angle of impact**

Select one size of ball OR a balloon filled with sand (suggest about 120g of sand) that will be your impactor. Hold a plank of wood or metre rule at an angle above the surface of your sand. You might need to rest the plank against something or use a clamp to secure it. Measure the angle with the protractor and record it on the worksheet (independent variable). Roll the impactor down the plank/rule then measure the diameter of the crater it forms (dependent variable). Repeat the test, changing the plank angle.

Name _____

# Making Craters - Student Worksheet

Impact craters are formed when impactors fall and crash into a planet's surface. Your task is to create and measure impact craters.

## Materials

- Large tray or box per group
- Clean sand to fill the tray or box
- A selection of different size balls (e.g. golf ball, cricket ball, shot put) or sand filled balloons, to represent different impactors.
- A ruler or tape measure per group
- OPTIONAL: Camera to record impacts (slo-mo videos are great!)

## Method

1. Select four balls or balloons of different size that will be your impactors.
2. Decide on a set height to drop the impactors and record this height.
3. If videoing your experiment, set up the camera, ready to record.
4. Drop the smallest impactor and carefully remove it from the tray, trying not to disturb the crater formed.
5. Measure the diameter of the crater it forms. Note any other observations of the crater's appearance. Record these values on the worksheet.

Name _____

# Making Craters - Student Worksheet

6. Smooth the sand over, filling in the crater.
7. Repeat the test with the different sized impactors, recording all data on this worksheet.

**Hypothesis**

When we increase the size of the impactor, the diameter of the crater will increase/decrease/stay the same (circle one) because_____

_____

_____

**Variables**

In this experiment:

We will **change** _____

(**independent** variable)

We will **measure** _____

(**dependent** variable)

The things we will keep the **same** (**controlled** variables) are:

_____

_____

_____

**Diagram**

Draw a labelled diagram of your experiment

Name _____

# Making Craters - Student Worksheet

## Results

Height of drop (cm) _____

| Size of Impactor | Diameter of crater (cm) | Observations |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

## Evaluation

Was this experiment a fair test? How could you change the experiment to make it better?

_____

_____

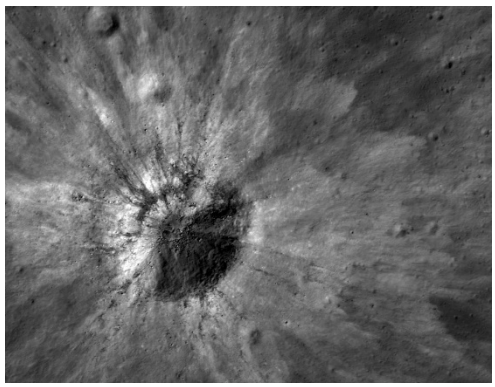
_____

Name _____

# Splash Down - PPP

## Try this outside at home!

In Science we've been looking at things that change the surface of the Earth, such as meteorite impacts. When meteorites hit the Earth they throw a lot of material out from the point of impact – parts of the meteorite that break up and parts of the surface that are broken. This leads to the distinctive craters that we can see scarring the surface of the Earth, Moon and other planets.



In an area outside, try dropping water balloons you've filled with different amounts of water to see if the size of the 'meteor' affects the shape or size of the crater that they make. If you have a sandpit to drop them in, that would be great, otherwise dropping them onto a bare patch of a garden bed would work well too.

You might like to take photos or make sketches of your results so you can compare them.

*Remember to clean up all the parts of balloon*

*e e e a e e a e a a a a e e e ea e*

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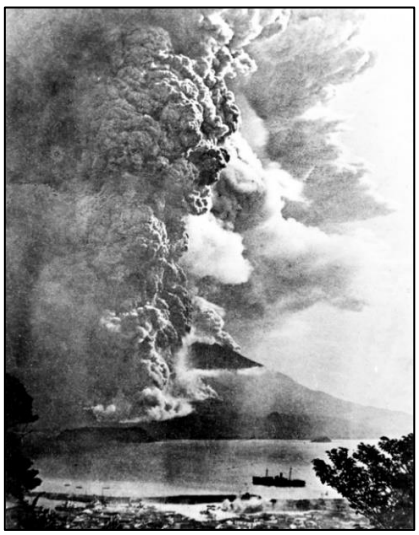
# Having a Blast - Teacher's Notes

As mentioned in the Surface Landforms section, volcanic activity creates and changes surface landforms. It may do this through explosive eruptions, blowing the tops off mountains, or lava flows creating new land and perhaps changing the shape of existing landforms.
The Sakurajima volcano in the southern Japanese prefecture of Kagoshima was once an island but a large and devastating eruption in 1914 filled the narrow strait that had separated it from the mainland, forming a peninsula. Luckily, people were warned of the imminent eruption through strong tremors and were able to evacuate the island. This eruption almost completely buried a tori gate at a shrine which shows the amount of ash ejected and today the tori serves as a tourist attraction.



*Photos from the eruption of Sakurajima in 1914*

*The tori gate buried in ash (left) compared to what a tori gate usually looks like (right)*

# Having a Blast - Teacher's Notes


*An aerial view of Sakurajima today showing where it has joined to the mainland*

Mount St Helens in the US state of Washington erupted spectacularly in 1980. The shape of the volcano was drastically changed when the side was blown out, creating a wide horseshoe-shaped crater. The massive pyroclastic eruption caused a sizeable earthquake and the elevation of the mountain was changed from 2950m to 2549m. Sadly, 57 people were killed and lots of infrastructure in the area was destroyed.

*Photos before (left) and after (right) the 1980 eruption of Mount St Helens*

# Having a Blast - Teacher's Notes

This YouTube video is a timelapse showing the lava dome of Mt St Helens growing rapidly between 2005 and 2008 https://youtu.be/h6B1myUKAS4. This shows how active the volcano still is and it is being monitored closely by scientists who are learning a lot from it.

*This current aerial shot of Mount St Helens shows the scar on the landscape from the 1980 eruption.*

In this activity, students will examine the changes that happen to the shape of a volcano when it erupts using some simple, everyday materials. Depending on time constraints, you may like to build the volcanoes one lesson and test them the next.

**Materials**

- Small foil tray
- Scissors
- Bricks or blocks of wood to stand the foil tray on
- Clean sand
- Strong tape (gaffer or electrical works well)
- Squeezable bottle with narrow top, such as sauce bottle or pop-top drink bottle, and access to water

# Having a Blast - Teacher's Notes

**Method**

1. Cut a hole in the centre of the foil tray that will fit the top half of the squeezable bottle through.
   SAFETY NOTE: **Be careful of the sharp edges of the cut tray!**
2. Tape around the bottle to keep it in place and seal the hole around it.
3. Sit the tray on the bricks or blocks, ensuring you can still reach the bottle to squeeze it.
4. Make the sand damp enough to hold together and put small handfuls around the bottle to sculpt a volcano, ensuring you don't cover the top yet.
5. Open the top of the bottle then carefully build up a peak to cover it.
6. Allow the mixture to dry and harden a little.
7. Take a photo or sketch a diagram of your volcano before testing.
8. Squeeze the bottle in one quick movement to push out a spurt of air which should blow the top off your volcano. You could also try moving the bottle a little to mimic the tremors that occur during eruptions.

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9. Take a photo or sketch a diagram of your volcano after 'eruption' and make observations, comparing before and after photos.

**Extension Activity**

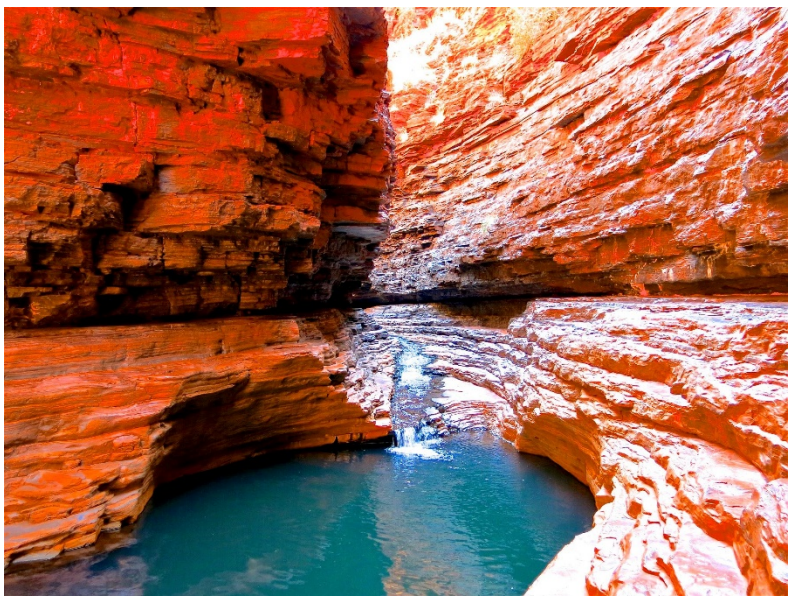
You could put either sauce, oil or other liquids in the bottle to show the effect of lava flows (sauce is roughly the same viscosity as the lava that pours out of the volcanoes in Hawaii). The squeezable bottle would have to be completely full for this to work.

# All the Rivers Run - Teacher's Notes

Just as impactors and volcanoes can change landscapes, water has sculpted many famous locations around the world to form fluvial landscapes. Well known landmarks such as the Grand Canyon in Arizona and the gorges found in Karijini National Park in the Pilbara region of Western Australia were formed through the movement of water (rivers) which weathered and eroded the surrounding rock over long periods of time.

*The Grand Canyon has been carved by the movement of the Colorado River*

*The many gorges in Karijini National Park, such as Hancock Gorge pictured on the right, have had the iron-rich rock of the area eroded away over millions of years*



# All the Rivers Run - Teacher's Notes

In this activity students will build a model landscape then let a 'river' run through it to observe how the landscape changes.
*Note: The student worksheet for this section is for use with the extension activity only.*

**Materials**

- Sand pit or large tray (a foil BBQ tray or new plastic kitty litter tray is ideal)
- Clean sand
- Brick or block of wood to tilt the tray on
- Small rocks
- Water in a bottle or other container
- Optional: small pieces of plants to model vegetation.

**Method**

1. Get students to build a landscape out of sand in the sandpit or tray. The landscape should include some hills and shallow valleys where the river will flow. If building in the sand pit, there should be an overall slope to the landscape to help the 'river' flow.
2. Place the rocks in one or two locations in the landscape. Some should be placed in the path of the river and could be buried also. Add vegetation, if required.
3. If building in a tray, place the brick or block under one end of the tray to slope the landscape.
4. Pour water onto the tray from the elevated end of the tray or upslope end of the sandpit, ensuring the students do not pour it from a great height as this is meant to mimic a river flowing, not a torrential downpour!
5. Students should observe how the sand is washed away (mimicking rocks being weathered and eroded) and note how the water moves

around the rocks (mimicking harder more resistant rocks), taking the path of least resistance.

# All the Rivers Run - Teacher's Notes

*Extension Activity*

To make this activity into an experiment, get students in groups to build landscapes of the same design, in trays, with the landscapes lowest point being level with the sides of the tray. You should provide each group with the design (either as a photo or diagram). Students could change the flow of water from the 'river' by using different sized holes in the tops of bottles. You could then capture the sand that is eroded away from the landscape in a container and measure the amount of sand moved for each of the different water flows.

**Variables**

In this experiment:

We will **change** the size of the holes in the bottle (amount of water flow) (**independent** variable)

We will **measure** the amount of sand moved (**dependent** variable)

The things we will keep the **same** (**controlled** variables) are: landscape design, material in tray (sand), height water flows from, volume of water used, volume of bottle used, shape of bottle used, placement of rocks in landscape, size of rocks, slope of landscape (size of brick or block of wood).

Name _____

# All the Rivers Run - Student Worksheet

Rivers flowing through landscapes weather and erode away rock, forming features such as valleys, gorges and canyons.

**Aim**

In this experiment, you will examine how water flow affects the amount of erosion in a landscape.

**Materials (per group)**

- Large tray
- Second tray or container to collect sand
- Clean sand
- Landscape design photo or diagram
- Brick or block of wood to tilt tray
- Small rocks of roughly same size
- Water in bottle with holed drilled in the lid (each group has different sized holes in their bottles)

**Method**

1. Build a landscape out of sand in the tray according to the design provided by your teacher. Each group's landscape must be the same.
2. Place the rocks at the locations shown on the design.
3. Place the brick or block under one end of the tray to slope the landscape and position the second tray or container at the bottom end of the landscape to collect any sand that will run off.

Name _____

# All the Rivers Run - Student Worksheet

4. Pour water onto the landscape from the raised end of the tray at a set height (each group must use the same height). You may need to squeeze the bottle.
5. Observe how the sand is washed away (mimicking rocks being weathered and eroded) and collected in the tray or container at the end.
6. Measure the amount of sand that was collected (e.g. weigh it once dry or measure spoonfuls of wet sand) and share your results with the class.

**Hypothesis**

When we increase the size of the holes in the bottle (increase flow), the amount of sand eroded will increase/decrease/stay the same (circle one) because

_____

_____

_____

**Variables**

In this experiment:

We will **change** _____

(independent variable)

We will **measure** _____

(dependent variable)

The things we will keep the **same** (controlled variables) are:

_____

_____

Name _____

# All the Rivers Run - Student Worksheet

## Diagram

Draw a labelled diagram of your experiment

## Results

Record the results for the whole class below.

| Size of holes in bottle | Amount of sand collected |
|---|---|
| | |

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Name _____

# All the Rivers Run - Student Worksheet

**Discussion**

1. How does the amount of sand eroded in your experiment compare to other groups?

_____

_____

2. From the class results, what did you observe happening to the amount of sand eroded as the size of the holes (amount of water flow) increased?

_____

_____

3. What happened when the water met rocks in your landscape? Did the water go over, under or around the rocks? Why do you think the water did this?

_____

_____

**Evaluation**

Was this experiment a fair test? How could you change it to make it better?

_____

_____

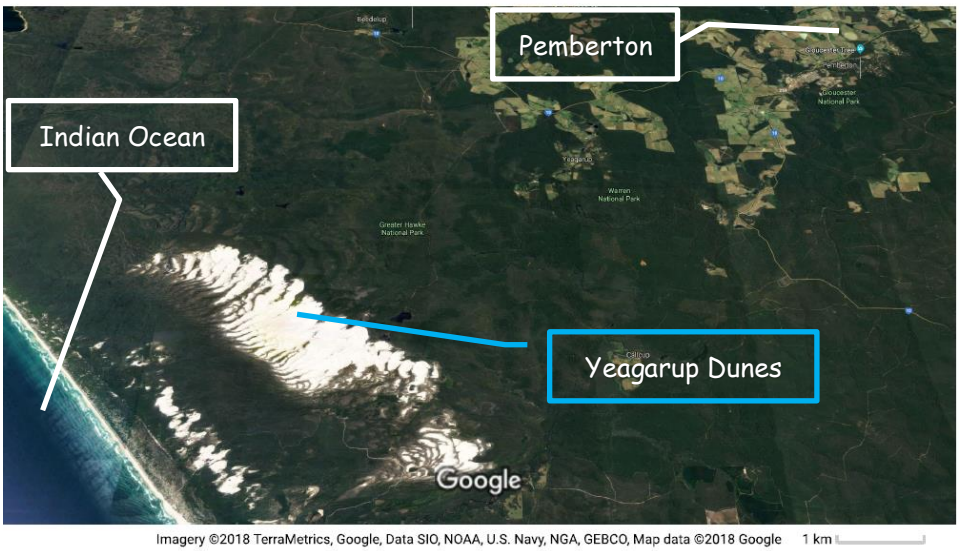
_____

# Sculpting Sand Dunes - Teacher's Notes

Sand dunes are one landscape feature made through aeolian processes, being moved and shaped by the wind. As mentioned previously, Yeagarup dunes near Pemberton are an interesting example of this as they are travelling inland as they are being moved by the prevailing winds.

*Photo credit:* http://neilmallo.reislogger.nl/foto/western-australia/yeagarup-sand.486174

Google Maps Google Maps satellite image of Yeagarup Dunes

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# Sculpting Sand Dunes - Teacher's Notes

In this activity, students can sculpt their own sand dunes by using their breath or other gentle winds.

**Materials**

- Sandpit or outdoor area with a large amount of sand
- If a sandpit is not available, a large tray or box (a student desk tray or an A3 paper box is ideal) may be used
- Clean, dry sand
- Paper fans, straws, a hairdryer or gentle fan

*SAFETY NOTE! As sand will be blown around in this activity, it is advised that students wear safety glasses. Students should be encouraged to blow gently and also to ensure they stand behind or far away from the person/object blowing the sand.

**Method**

Students can build low mounds of sand with their hands at first then, using straws, they should blow towards the mounds and observe how the shape and height of the 'sand dunes' changes. They could then try using the paper fans to see the effect of a less directed wind source. If possible, the teacher may like to demonstrate this on a larger scale by using the low setting on a hair dryer or a gentle fan.

Name _____

# Sculpting Sand Dunes - Student Worksheet

*Sand dunes are made through aeolian processes, being moved and shaped by the wind. You are going to make some sand dunes of your own then observe how they change when affected by the wind (you!).*
*Draw a diagram of your sand dunes before and after blowing on them.*

***BEFORE***

***AFTER***

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# Shifts and Changes - Teacher's Notes

Some water bodies in Australia experience large changes in both water level and quality. They are often influenced by changing seasons and weather events, such as floods or cyclones. Lake Eyre (Kati Thanda) in South Australia is an example of this.

The Lake Eyre basin in which the lake itself is situated is quite interesting as it drains approximately one sixth of the continent and is the lowest part of Australia, sitting at 15m below sea level. When it fills, it becomes the largest lake in Australia; however, this only occurs roughly four times every hundred years. The Lake Eyre basin spans 1.2 million square kilometres across Queensland, New South Wales and the Northern Territory. The majority of the time Lake Eyre is a large, dry salt lake so dry in fact it was used as the track to set a land speed record back in 1964.
The basin is *endorheic* which means that it has a closed drainage system, only losing water through evaporation as it does not drain into rivers or the ocean. This is why there can be such a huge change in the lake's water levels. The lake may be filled by floods that occur in the massive basin, such as those that occurred in Queensland in 2009 when a huge volume of floodwaters took approximately four months to arrive and fill the lake. This lead to a huge explosion in life in and around Lake Eyre, including a vast

increase in the population of migratory birds, such as pelicans and banded stilts.
This ABC TV Behind the News episode on the 2009 flood that filled Lake Eyre may be of interest and students could perhaps conduct further research on the changes that occur during flood events.
http://www.abc.net.au/btn/story/s2578003.htm

This article and video shows the lake flooding in 2018.
http://www.abc.net.au/news/rural/programs/sa-country-hour/2018-05-24/lake-eyre-fills-water-tourists-feral-animals/9792352

This website also gives lots of information on the Lake Eyre Basin including some teacher and student resources.
http://www.lakeeyrebasin.gov.au/resources/student-and-teacher-resources

# Salt Lake Puddles- Teacher's Notes

The salt concentration in salt lakes can vary greatly depending on their location and surrounding geology, sometimes they can even be saltier than the ocean. Seawater has an average of 35g/L dissolved salt whereas salt lakes can range from 3-270g/L dissolved salt concentration. The Dead Sea in the Middle East has a salt concentration of approximately 340g/L.
The salt concentration will also change depending on water levels. Heavy rain or flooding will dilute the salt levels whereas high evaporation rates will increase the salt level, often leaving a crust on the edges and surface of the lake.
In this activity, students will investigate the effect of floods on salt concentration. This may be done in groups or as a whole class activity.

**Materials**

- Table salt
- Measuring spoon or scales to measure salt
- Tap water
- Funnel
- 3 plastic bottles (at least 600mL) with lid
- Marking pen to label bottle and trays
- Measuring jug or cylinder
- 3 plastic containers or trays (rectangular plastic takeaway containers or their lids are ideal)

**Method**

1. Make a salt solution of around 20g/L concentration by mixing salt and water in one of the plastic bottles. A higher concentration will give you more salt to collect at the end of the activity but may be harder to dissolve and does not accurately model real salt lakes.
   **HINT:** Only three quarters fill the bottle with water at first, then put the lid on and shake well to help dissolve the salt, then fill the

bottle to the top and shake again. If you are not using scales, record the number of spoonfuls of salt added. Label this bottle 'Solution 1'.


2. Measure out one half of Solution 1 and pour into a second plastic bottle. Fill the rest of the bottle with fresh water, put the lid on and shake well. Label this bottle 'Solution 2'.
3. Measure out one half of Solution 2 and pour into a third plastic bottle. Fill the rest of the bottle with fresh water, put the lid on and shake well. Label this bottle 'Solution 3'.

# Salt Lake Puddles- Teacher's Notes

4. Prepare the three containers, or lids, by labelling them Solution 1, Solution 2 and Solution 3.
5. Shake each bottle then pour out approx. 50-100mL of each solution into the appropriate container/lid. Make sure you pour out the same amount of each solution, to ensure a fair test. Ideally you don't want to completely fill the container as it will spill more easily.
6. Place the containers in a warm place, such as on a windowsill or outside, and leave until all of the water has evaporated (that may take several days depending on the weather), leaving the dry salt on the bottom of the container. If it is windy, you may need to weight the containers down.
7. Observe and measure the amount of salt left in each container, either by scraping out and weighing the salt or measuring how many spoons of salt remain.



## Extension activity

**Growing plants with salty water**

Make larger batches of the three concentrations of salt and use them to water plants, such as tomato seedlings, over a few weeks to observe the effect of salinity on plant growth and health. You might like to photograph the plants every few days or measure plant height to record your observations. With tomato plants, you may even be able to observe an effect on the amount of fruit produced.

Name _____

# Salt Lake Puddles - Student Worksheet

The salt concentration in salt lakes will change depending on water levels.

*Your task is to investigate the effect of floods on salt concentration in salt lakes.*

**Materials**

- Table salt
- Measuring spoon or scales to measure salt
- Tap water
- Funnel
- 3 plastic bottles (at least 600mL) with lid
- Marking pen to label bottle and trays
- Measuring jug or cylinder
- 3 plastic containers or trays

Name _____

# Salt Lake Puddles - Student Worksheet

**Method**

1. Make a salt solution of approximately 20g/L concentration (HINT: 1,000mL = 1L) by mixing salt and water in one of the plastic bottles. Record how much salt you added in the table (1 tsp = approx. 5g). Label the bottle 'Solution 1'.
2. Measure out one half of Solution 1 and pour it into a second plastic bottle. Fill the rest of the bottle with fresh water, put the lid on and shake well. Label this bottle 'Solution 2'.
3. Measure out one half of Solution 2 and pour it into a third plastic bottle. Fill the rest of the bottle with fresh water, put the lid on and shake well. Label this bottle 'Solution 3'.

Name _____

# Salt Lake Puddles - Student Worksheet

4. Prepare the three containers by labelling them Solution 1, Solution 2 and Solution 3.
5. Shake each bottle then pour out approx. 50-100mL of each solution into the appropriate container/lid. Make sure you pour out the same amount of each solution to ensure a fair test.
6. Carefully put the containers in a warm place and leave until all of the water has evaporated, leaving the dry salt in the tray.
7. Observe and measure the amount of salt left in each container, either by scraping out and weighing the salt or measuring how many spoons of salt remain.

Name _____

# Salt Lake Puddles - Student Worksheet

**Results**

| | Amount of salt added (g) (A) | Size of bottle (L) (B) | Concentration of solution (A ÷ B) | Amount of salt left after evaporation (g) |
|---|---|---|---|---|
| Solution 1 | | | | |
| Solution 2 | | | | |
| Solution 3 | | | | |

**Discussion**

1. Which solution had the most salt left after evaporation? Was it the least or most concentrated solution?

_____

2. What natural event does this experiment model?

_____

3. Is the dissolving of salt in water a reversible or irreversible change?

_____

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# Change Caused by Humans - Teacher's Notes

Sometimes changes to environments are natural – caused by changing seasons or weather patterns. More often, changes are caused through human impact.
You might like to discuss what we mean when we talk about human impact on the environment. Impact is defined as "a powerful effect that something, especially something new, has on a situation or person".
(https://dictionary.cambridge.org/dictionary/english/impact)

In small groups, students can complete a brainstorm on human impacts that can change natural environments. You could then have a class discussion to share the results of the group brainstorms. Some examples could include: introduction of feral animals, land clearing, pollution, tourism and farming practices.

Name _____

# Change Caused by Humans - Student Worksheet

**Brainstorm! What impacts can humans have on natural environments?**

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# Eco-Tourism Poster - Teacher's Notes

People love to visit beautiful natural attractions but unfortunately we often end up damaging that environment, sometimes just through the sheer number of visitors tramping around. In our more enlightened, modern times, there are often regulations governing the use of these attractions and management strategies in place, including regulations to ensure local Indigenous culture is respected.

In this activity, students are asked to research a popular natural attraction in Australia, answering some guiding questions about the place and the applicable regulations and management strategies there.

Some examples of places students may like to research are: Rottnest Island, Ningaloo Reef, Monkey Mia, Kakadu National Park, Great Barrier Reef, Uluru-Kata Tjuta National Park. There may even be an attraction close to your school that the students may have visited or could visit on an excursion.

- What is it that makes people want to visit this place?
- How many people visit per year? Is the number of visitors controlled?
- What activities do people do there? e.g. Hiking or diving.
- Name any unique species of flora and fauna in the area.
- Has there been any effect on these flora and fauna from people visiting?
- What is being done to protect them?
- Is the area special to local Aboriginal people and are there rules for visitors relating to respecting their culture?

Students can then make a poster promoting an environmentally-friendly tourism activity in the area they have researched.

Name _____

# Eco-Tourism Poster - Student Worksheet

**Your task:** Choose a popular natural tourist attraction that people like to visit.
I have chosen

_____

Do some research to answer the following questions about the place you have chosen:

- What is it that makes people want to visit this place?
- How many people visit per year? Is the number of visitors controlled?
- What activities do people do there? e.g. Hiking or diving.
- Name any unique species of flora and fauna in the area.
- Has there been any effect on these flora and fauna from people visiting?
- What is being done to protect these species?
- Is the area special to local Aboriginal people and are there rules for visitors relating to respecting their culture?

Name _____

# Eco-Tourism Poster - Student Worksheet

Make a poster promoting an environmentally-friendly tourism activity

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# Literature Landscapes - Teacher's Notes

Australia is such a large country that it contains a vast array of landscapes, environments and weather patterns. Sometimes these weather patterns lead to natural disasters, like droughts and floods, that have a huge impact on our way of life.
Australian writers and poets have written about these differences since colonial times with one of the most famous examples being the poem My Country by Dorothea Mackellar, first published in 1908. A well-known excerpt from this poem is:

*I love a sunburnt country,*
*A land of sweeping plains,*
*Of ragged mountain ranges,*
*Of droughts and flooding rains.*
*I love her far horizons,*
*I love her jewel sea,*
*Her beauty and her terror –*
*The wide brown land for me!*

Students might like to find some other poetry or stories relating to droughts and floods, or even create their own.

# Community Meeting - Teacher's Notes

## Drought

Drought is generally defined as an acute rainfall or water shortage and has been a common part of life for most Australian farmers since European settlement. Australian farmers have had to become experts in interpreting and predicting rainfall patterns to have any success in their business.
The Bureau of Meteorology has a lot of statistical data relating to drought including an interactive map on rainfall deficiency that can be found here: http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=drought&period=daily&area=nat

Of course the definition and effect of drought is relative to the area in question as the relative amount of expected rainfall in the Amazon, for example, is totally different to expected rainfall in the Wheatbelt of Western Australia.

Areas of Queensland have not had a decent amount of rain for more than five years, which is having a huge impact on the farming communities there, and many areas in WA are in the same situation. Cape Town in South Africa was also recently in the news as they were potentially going to run out of water after experiencing drought conditions since 2015.

# Community Meeting - Teacher's Notes

## Community Meeting

Farming communities will often hold meetings if there is a crisis in their area such as bushfires, flood or drought. These meetings are held to assess the situation and hopefully come up with an action plan to help everyone in the community through the crisis.

In this activity, students will role play some of the members of a farming community and participate in a mock community meeting about a drought situation. Below are some suggested roles for students; however, it will depend on class size as to how this meeting will run (you may like to run it in small groups instead). The idea is that the students get to see the situation from the point of view of all stakeholders in a community. They should take some time to think about how their 'character' would react to the scenario and what their point of view would be.

**Scenario**: You are living in the small rural town of Palms whose main business is wheat and sheep farming. The area has had minimal rainfall for the last five years and has been declared a drought zone. The local community has come together to discuss the following point:

*The possibility of developing an irrigation scheme by drilling into a newly discovered freshwater aquifer. This aquifer is located close to the town and is not too deep so it will be easy to drill down to access it. It is a completely confined aquifer meaning that it does not usually interact directly with surface water. The area that the drilling would take place in is very close to a local salt lake which has quite a fragile ecosystem, including a rare species of fish. The water coming up from the aquifer is likely to be quite warm so if this water enters the salt lake, it would impact on the ecosystem, potentially killing the fish.*

# Community Meeting - Teacher's Notes

Some suggested roles:

- Karen McRae – the Shire President and Chair of this meeting. Karen was born and raised in the area and she runs the local petrol station with her husband. They have seen a big downturn in business for fuel as the farmers have not been running their heavy machinery at harvest time. She loves Palms and is dedicated to the people of the district.
- Bob Hughes – a fourth generation farmer with one of the biggest wheat and sheep farms in the district. He has been able to grow crops for two out of the last five years but the grain yields were low. Bob is quite wealthy as his family were quite successful at farming before the drought. He is buying in feed for his sheep and also buying in water for them. He is very keen to start an irrigation scheme.
- Sarah Williamson – a fifth generation farmer who has had to sell off some of her land due to debts so now has one of the smaller properties in the district. She decided three years ago to stop planting wheat and is concentrating on raising sheep. She is also having to buy feed and water for her sheep.
- Peter Jones – a representative of the government department dealing with water supply. His department discovered the new aquifer and have estimated it will cost $30 million to drill down to access it. It will then cost another $15 million to install all the pipelines for an irrigation scheme. They would expect some of this cost to be borne by the farmers.
- Mark Brown – is a Bureau of Meteorology long range weather forecaster who advises farmers on likelihood of rainfall within the next few months and how much rain is likely to fall. There is little prospect of any rainfall in the few months after this meeting, according to the computer model run by the Bureau.

# Community Meeting - Teacher's Notes

- Silvia Wood – is a local business owner whose family has been in the district for several generations. Her farming supplies store has around $300,000 owing from farmers and she is having to refuse credit to some until their debt is paid. She has had to downsize her staff and let two part-time workers go.
- Tom Fielding – president of the local environmental group who also is a resident in the district, working as a teacher at the local district high school. He has seen how the drought is effecting local families through his students. Tom is against drilling into the aquifer as he believes it will affect the lake and therefore may harm the rare fish species.

You may like to print these roles out for the students and even add some of your own.

Some other topics you might like to discuss in this role play are:

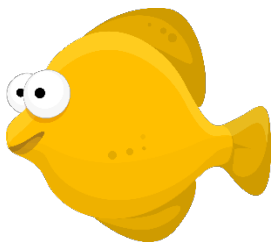
- Long term weather forecast and whether a wheat crop should be planted this season.
- How the government is going to help the local community.
- What other species may be affected if the lake ecosystem changes.

Name _____

# Community Meeting - Student Worksheet

**Scenario**: You are living in the small rural town of Palms whose main business is wheat and sheep farming. The area has had minimal rainfall for the last five years and has been declared a drought zone. The local community has come together to discuss the following point:

The possibility of developing an irrigation scheme by drilling into a newly discovered freshwater aquifer. This aquifer is located close to the town and is not too deep so it will be easy to drill down to access it. It is a completely confined aquifer meaning that it does not usually interact directly with surface water. The area that the drilling would take place in is very close to a local salt lake which has quite a fragile ecosystem, including a rare species of fish. The water coming up from the aquifer is likely to be quite warm so if this water enters to salt lake, it would impact on the ecosystem, potentially killing the fish.



Your teacher will assign you a role of one of the people involved in the community of Palms. You need to think about how your character will respond to the scenario (use your imagination to make some parts up, based on the description your teacher gives you). Your class group will then role play the community meeting, with everyone assigned roles of different community members.

Name _____

# Community Meeting - Student Worksheet

My role is: _____

Some questions you might like to consider from the point of view of your character:

- How have I been affected by the drought?
- Do I think I would agree with drilling into the aquifer?
- If there was an irrigation scheme started, would I be willing (and able) to help pay for it?
- How would I feel about the local lake ecosystem and the potential impact on the rare fish species?

## Floods

When an area receives too much rain, it can be disastrous. The underlying geology of an area can contribute to how runoff from rainfall behaves, such as whether it will soak in quickly or stay on the surface. Areas with high rainfall and soil high in clay will tend to be prone to floods, much more than low rainfall areas or those with sandy, free-draining soils. Areas such as Broome in Western Australia can be prone to flooding, especially during cyclone season due to the high clay content of the soils.

Some further information and resources on floods and droughts can be found at the following websites:
https://www.csiro.au/en/Research/Environment/Extreme-Events
https://www.mdba.gov.au/education/teachers/lesson-plans


## Teacher demonstration

**Materials**

- Two or more soil samples – one with a high clay content. Alternatively, you could use a piece of modelling clay
- Clear containers, such as plastic cups
- Water

**Method**

1. Place each soil sample into a different cup.
2. Pour water into each cup and observe how long water takes to soak in.
3. Once the initial pour has wet the soil, add more water and again observe how long it takes to soak in.

# Flooded Landscape Model - Teacher's Notes

As well as the geology and soil type in an area, its topography will also play a role in flooding. Topography is the shape and features of a landscape and includes aspects like the height above sea level.
In this activity, students will create their own landscape, sculpting the topography, such as hills and valleys.

**Materials**

- Aluminium baking tray or large plastic container with sides of at least 5cm (eg. new kitty litter tray)
- Newspaper or scrap paper (a large amount of plasticine will also work well)
- Tape or glue
- White plastic bag (shopping bag or bin liner) cut open to make a single layer
- Water, coloured with blue food colouring
- Spray bottle
- Watering can or plastic bottle with holes drilled in the lid

**Method**

1. Screw paper up into lumps and secure them to the tray to form hills. You might like to place some close together to form a narrow valley or canyon.

2. Drape the white plastic bag over the tray, lightly pressing it into the lower levels of your artificial landscape. You may need to use tape or glue to secure it at some points.

# Flooded Landscape Model - Teacher's Notes

3. Add blue food colouring to some water in a spray bottle and spray the water over your landscape. Observe and record how and where the water runs off and flows. Observations may be recorded with words or labelled diagrams.

4. Put some blue coloured water in the watering can, or bottle with perforated lid. Use this to simulate heavy rain by pouring over your landscape.

5. Observe and record the water flow and points where the water collects using words or labelled diagrams.

# Flooded Landscape Model - Teacher's Notes

## Extension activities

- Students that tested this activity were keen to add houses, trees, animals and other objects to the landscape model to observe the effect of flooding on these.
- A settlement could be placed in a valley and students will have to consider and design a way to protect this settlement from flood waters. They could then build and test their protection designs.
- More time could be spend building the landscape, combining it with an art project, and perhaps even sculpting the landscape from clay or papier-mâché
- If you have access to a sandpit, you may like to sculpt a larger landscape as a class, adding vegetation, buildings and animals then seeing the effect of floods, including erosion.

Name _____

# Flooded Landscape Model - Student Worksheet

Your task is to create a landscape, sculpting the topography, such as hills and valleys, then observe how rainfall would flow and collect.

**Materials**

- Large container
- Newspaper or scrap paper
- Blu-tac, tape or glue
- Sheet of white plastic
- Water coloured with blue food colouring
- Spray bottle
- Watering can or plastic bottle with holes drilling in the lid

**Method**

1. Screw paper up into lumps and secure them to the tray to form hills. You might like to place some close together to form a narrow valley or canyon.
2. Drape the white plastic sheet over the tray, lightly pressing it into the lower levels of your artificial landscape. You may need to secure it at some points with blu-tac.
3. Add blue food colouring to some water in a spray bottle and spray the water over your landscape. This represents *light rain*. Observe and record how and where the water runs off and flows.

Name _____

# Flooded Landscape Model - Student Worksheet

4. Put some blue coloured water in the watering can or bottle with perforated lid. Use this to simulate *heavy rain* by pouring over your landscape.
5. Observe and record the water flow and points where the water collects

**Results**

Record your observations in the table below with words or diagrams

| |
|---|
| *Light rain* |
| *Heavy rain* |

Name _____

# Flooded Landscape Model - Student Worksheet

**Discussion**

1. Which part of your landscape did the water run off the most quickly?

_____

_____

2. Which areas (high or low) did you notice the water collected the most?

_____

_____

3. What were the main differences you observed between the light rain and heavy rain trials?

_____

_____

4. How do you think you could help an area with this landscape to minimise damage through flooding if they experienced heavy rain?

_____

_____

_____

_____

_____

_____

# Measure a Quake Shake - Teacher's Notes

## Geohazards

Geohazards are changes in the geological structure of the Earth that may lead to damage or even a risk to health. They can involve short-term or long-term geological processes and vary in their impact greatly. Events such as earthquakes, volcanic eruptions, landslides and tsunamis are all considered geohazards.

Geoscience Australia has many excellent resources on geohazards in their education resources found at http://www.ga.gov.au/education/classroom-resources

They also have a map showing earthquakes around the Australia in the last seven days http://www.ga.gov.au/earthquakes/ and the United States Geological Society (USGS) also has some excellent resources https://earthquake.usgs.gov/

## Earthquakes

The Earth's crust is broken up into large pieces, named tectonic plates, which are constantly but very slowly moving in different directions. These tectonic plates also have cracks and fault lines within them which can build up stress as the plates move. When this stress is released, an earthquake is generated, which may cause whatever is on the surface to shake. Earthquakes most commonly occur where two or more tectonic plates meet; however, they can also occur at fault lines within a plate. They can also occur underwater which sometimes results in a tsunami forming.

This You Tube video shows the earthquakes that occurred around the world between 2004 and 2014 https://www.youtube.com/watch?v=Ls3T5Of690I and this one is a visualisation of all of the earthquakes in Japan in 2011 including the series of very large ones in March that resulted in the devastating tsunami in the Tohoku area. This shows how frequently Japan experiences earthquakes https://www.youtube.com/watch?v=NSBjEvPH2j4

# Measure a Quake Shake - Teacher's Notes

The continent of Australia sits completely on one of these tectonic plates so we have relatively few large earthquakes compared to somewhere like New Zealand which has the boundary of two plates running through it. You may be surprised to know that small earthquakes still occur quite frequently here, and occasionally larger ones also.
Meckering in the WA wheatbelt, about 130km east of Perth, experienced an earthquake in 1968 of magnitude 6.5 which was felt in Perth city. In 1989, Newcastle in NSW sustained a 5.6 magnitude earthquake, claiming thirteen lives and causing significant damage to infrastructure.

## Measure a Quake Shake

Earthquakes can be measured using a seismometer, which records seismic waves. A simple version of this can be done with a pen on a roll of paper. This paper recording is called a seismograph. Whilst seismometers are more often computer based now, giving an electronic seismograph, the principle is still the same.
Students can make their own simple seismometers using some basic equipment. This idea comes from Cindy Blobaum's 'Geology Rocks' book.

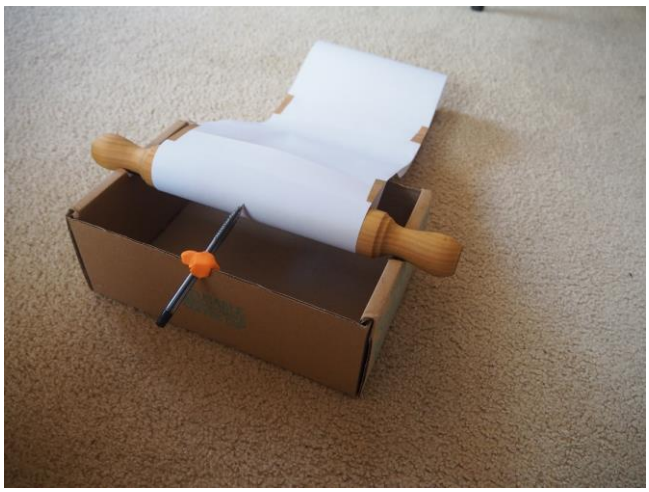
**Materials**

- Shoe box
- Rolling pin (or wooden dowel)
- Four sheets of blank paper taped together to form a continuous loop
- Pen
- Tape or plasticine
- Scissors
- Table or other moveable flat surface
- At least two students

# Measure a Quake Shake - Teacher's Notes

**Materials**

1. Cut a u-shape groove out of each of the short sides of the shoe box, so it forms a holder for the rolling pin.
2. Place the loop of paper over the rolling pin then rest the rolling pin in the cut out grooves.
3. On one of the long sides of the shoe box, cut a small groove to hold the pen. Secure the pen in place with the plasticine, with the writing end facing in to the box. The pen should be positioned so it will touch the rolling pin.
4. Position one person on the table edge so they can shake the table. The other person should hold the loop of paper taut and pull it slowly as the table is shaken, to make a seismograph. If you have a third person, they may like to hold the pen steady.



5. Vary the force with which the table is shaken to show the change in seismic waves.

## Variation

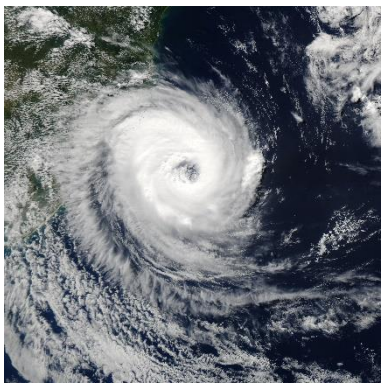
You could make a similar style of seismograph using a roll of paper with a dowel or tautly held rope through the centre. Students holding either end of the dowel or rope could provide the 'earthquake' (as long as they only make horizontal movements) and another student could hold the pen onto the paper. A fourth student could then slowly pull on the end of the paper to unroll it as the movement is recorded.

# PET Bottle Cyclone - Teacher's Notes

Tropical cyclones are extreme weather systems that mainly affect the northern part of Australia, most often during 'cyclone season' which runs from approximately November to April. They are massive storms that form around low pressure cells over warm water, rotating rapidly around a central 'eye' and involve strong winds and heavy rain.

Some interesting fact about cyclones:

- They spin counter clockwise in the northern hemisphere and clockwise in the southern hemisphere, due to the Coriolis effect.
- Cyclones can also be found on Mars and Neptune.
- There are no cyclones at the equator – they only form at least 5° north or south of the equator.
- Hurricanes, typhoons and tropical cyclones are all the same thing, the name depends on where they form. Hurricanes form in the North Atlantic/Central & North Eastern Pacific oceans, typhoons form in the Western Pacific ocean and tropical cyclones form in the South Pacific and Indian oceans.
- The Bureau of Meteorology names cyclones by following a set list of names alphabetically.



The Bureau of Meteorology's website has some excellent explanations and diagrams about cyclones http://www.bom.gov.au/cyclone/about/ They also have a series of weather related activities including one on plotting the path of Cyclone John on a map http://www.bom.gov.au/info/ftweather/page_39.shtml
Cyclones can have devastating effects, destroying buildings and other infrastructure and ruining crops. Severe tropical cyclone Yasi hit the

# PET Bottle Cyclone - Teacher's Notes

Queensland coast in 2011 causing widespread damage, estimated to have cost $3.5 billion.

## PET Bottle Cyclone

Students can get an idea of how the air moves in a tropical cyclone by making and observing a simple PET bottle cyclone. Whilst it is difficult to observe air movements, the same movements occur in water, which is what this model uses.

**Materials**

- 2 x PET bottles with lids of the same size. Ones with a classic funnel shaped top work best.
- Strong glue
- Drill or hammer and large nail
- Water
- Food colouring (optional)

**Method**

1. Remove the lids of the two bottles and glue them together, top to top.
2. Allow the glue to dry then drill a hole through both lids (approx. 60mm in diameter) or use the hammer and nail to make a hole.
3. Fill one of the bottles about three-quarters full and add a few drops of food colouring, if you like.
4. Keeping the bottle standing upright, screw the joined lids onto the filled bottle then screw the empty bottle on top (it will be upside down).

# PET Bottle Cyclone - Teacher's Notes

5. Ensure the lids are secure then turn the bottles over so the empty bottle is on the bottom. You will have to support the bottles so they don't tip over.
6. Observe the way the water moves, rotating around the bottle as it drains through the hole. This is how the air moves in a cyclone.

You may like to experiment with different sized holes, timing how long the bottle takes to empty (using the same volume of water to keep a fair test) or seeing the effect of using different shaped or volume bottles.

# Blow a Cyclone - Teacher's Notes

Wind is one of the most destructive elements of a cyclone. Winds as fast as 300km/hr have been recorded in very intense cyclones with cyclone Yasi in February 2011 recording gusts of 285km/hr.
The following activity demonstrating how cyclones form is adapted from Lisa Magloff's article on the following website
https://sciencing.com/school-projects-cyclones-7904786.html

**Materials**

- Rectangular tray (student desk tray or aluminium BBQ tray)
- Flexible straw
- Water
- Ruler
- Tape

**Method**

1. Bend the straw so it makes an L-shape.
2. Tape the straw in the middle of one of the short sides of the rectangular tray, approximately 1.5cm from the base of the tray. The shorter part of the straw is facing up and the longer part is parallel with the long sides of the tray.
3. Pour water into the tray to a level just below the long part of the straw.
4. For hygiene reasons, only one student should be allowed to blow into the straw. This student should blow gently into the straw at first to create a wave whilst other students can use the ruler to measure the height of the wave.

5. The same student should then blow a little harder to create a larger wave which is measured. The student should continue to blow incrementally harder until they are blowing as hard as they can!
6. The experiment is then repeated with more or less water in the tray (ensuring the straw is not submerged) which represents deeper and shallower water in the ocean.

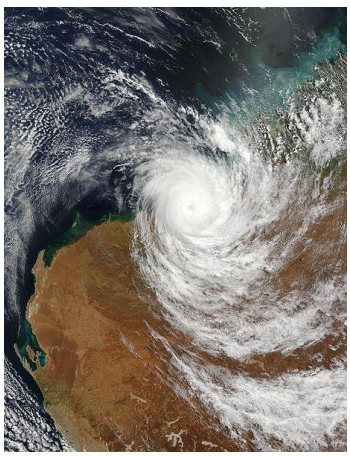
**What is happening?**

As students blow increasingly harder through the straw, they are modelling higher wind speeds blowing across the ocean. As the speed of the wind increases, the height of the waves will also increase. Students will also discover that high winds blowing across shallow water will create larger waves.

By blowing across the surface of the water, students are creating a low pressure cell at the surface. When this occurs in warm tropical waters, a cyclone may form (according to the Bureau of Meteorology, sea-surface temperature needs to be above 26.5).

This video has some more detail about how cyclones form:
https://youtu.be/xXs0FNwlXXo

Please note, this is an American video so it talks about hurricanes (same as cyclones – they just form in a different area) and it also talks about temperatures in the Fahrenheit scale.



Name _____

# Air Pressure and Cyclones - PPP

Go on to the Bureau of Meteorology website (http://www.bom.gov.au/cyclone/about/names.shtml) and find out what the name of the next tropical cyclone in Australia will be. Are any of the names on the list the same as members of your family?

Cyclones form around areas of low pressure. You can create a low pressure environment in a bottle with some simple equipment you'll find at home. You'll need an adult to help you with this activity – they may have seen this done before – no spoilers!

**Materials**

- Boiled egg, peeled
- Glass bottle with a wide neck
- Matches
- Strip of paper (about 10cm)

**Method**

1. Ask an adult to light the strip of paper then put it in the bottle.
2. Quickly put the boiled egg on top of the bottle, sealing the bottle and observe what happens.

**What's going on?**

The paper burning is using up the oxygen in the bottle which creates an area of low air pressure. Because the egg is sealing the neck, this creates a vacuum which sucks the egg into the bottle. Did you notice that the burning paper went out before the egg dropped in? This is due to all of the oxygen being used up – fire needs oxygen to burn.

# Disaster Response - Teacher's Notes

**This section of the resource is designed to provide teachers with some ideas for projects or open-ended investigations for students. As with all PALMS resources teachers should pick and adapt activities to suit their situation and students.**

In a natural disaster situation such as cyclones, earthquakes, floods or bushfires, people may have to evacuate their homes without much notice. As a result of these disasters, they may not be able to return to their homes for a long period of time or their home and belongings may be destroyed. Local councils and governments will have policies and procedures in place and have one or more buildings nominated as evacuation centres where people who have had to evacuate could stay.

## Project Idea 1 – Disasters around the world

One idea for a research project is for students to consider how prepared people in some countries would be for natural disasters. For example, would Australians be prepared for a strong earthquake or tsunami in the same way that Japanese people would?

## Project Idea 2 – What should be in an emergency kit?

Students could come up with a list of essential items for a kit that people in disaster prone areas should have available at all times. This could be tailored to specific threats or just kept very general.
Students should be encouraged to consider factors such as shelf-life of food and other items, the volume, weight and transportability of the kit (this could be done as a maths activity, calculating volumes of different shapes). They should also consider how long the kit will assist people for.
The Queensland government website is a good resource for suggestions for emergency kit contents: https://www.qld.gov.au/emergency/dealing-disasters/emergency-kit
Students may also want to look at emergency plans for their school or a

bushfire plan for their home. There is some good information available on the Department of Fire and Emergency Services website: https://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/Pages/allpublications.aspx
This project will assist students in making judgements about what they consider essential items for survival.


### Project Idea 3 – Emergency shelter design

The design of a shelter to be used in an emergency situation is dependent on many factors such as:

- Climate and weather of the area affected
- Terrain of the area the shelter will be put, including soil stability
- Accessibility of the area

# Disaster Response - Teacher's Notes

- Skills and tools available for delivery and/or construction
- Cost of materials used
- Expected lifespan of shelter
- Number of shelters needed and whether they can be joined together
- Protection from continuing threat of natural disaster (e.g. aftershocks or floods)
- Size that the shelter is when not in use (storage requirements)

Students could be given a completely unscaffolded project brief or be asked to design for one particular country or disaster type.
If your school has a 3D printer available, you could get students to design models of their shelters using a computer then print them. There is broad scope to make models (including full scale ones!) from many other materials also.

# Disaster Response - Teacher's Notes

## Project Idea 4 – Disaster response donations

If you were to put together a kit to donate to a person who has been affected by a natural disaster, what should it include? This project could include considering the following questions:

- What will people actually need in the week after a disaster if they have been evacuated and unable to return home? What will they need a month later?
- Is there different kits for adults and children / families and single people / young and old people / females and males?
- Could the kits be prepared and stored for a long time? (e.g. shelf life of food)
- Do any of the items in the kit need special preparation?
- How would this kit be packaged?
- How will the kit be transported to the people in need? (e.g. could it be air-dropped into a flooded area cut off from transport by road or rail)
- Do any of the items have instructions required that may need to be translated?

Issues that can affect areas struck by natural disasters that students may like to consider include:

- Being isolated for extended periods of time - roads, railways and airports may flooded or damaged (how will the kits be delivered?)
- Communication such as phone lines damaged (mobile or satellite phones could be included)
- Access to clean water for drinking and sanitation (water purification equipment could be included)
- Disease outbreak (disease prevention equipment such as masks and gloves could be included)

# Disaster Response - Teacher's Notes

- Dealing with people injured in the disaster (medical supplies could be included)
- Lack of electricity and cooking facilities (any food included should require little preparation and ideally no cooking)

Increasingly, charity organisations ask for donations of money rather than goods and the reasons for this may be something you could discuss with your class (see this article on this subject https://www.devex.com/news/thanks-but-no-thanks-unwanted-goods-flood-disaster-struck-developing-countries-89458)

# International Space Farm - Teacher's Notes

Lack of food security has been identified as an increasing problem in the modern world. Food security is defined by the Food and Agriculture Organisation of the United Nations as:
*"… when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life."*
Source: http://www.fao.org/economic/ess/ess-fs/en/

A decrease in food security can often be caused by natural disasters either destroying food sources or stopping people gaining access to these sources.

A project that is likely to spark a lot of interest and creative ideas in students is one based on the idea of an international collaborative space farm (ISF). This idea was formed when working with a teacher from a



school in WA's northwest who was lamenting the lack of availability of fresh vegetables when their town was cut off due to flooding from cyclones. This lead to an expanded discussion on international food security in areas suffering drought, flood or famine or those struck by disasters such as earthquakes, volcanic eruptions, landslides and tsunamis. This discussion resulted in what at first seemed like a pretty far-fetched idea to start a farm on an international space station or even on another planet.

There are several reasons why this idea is perhaps not so far-fetched:

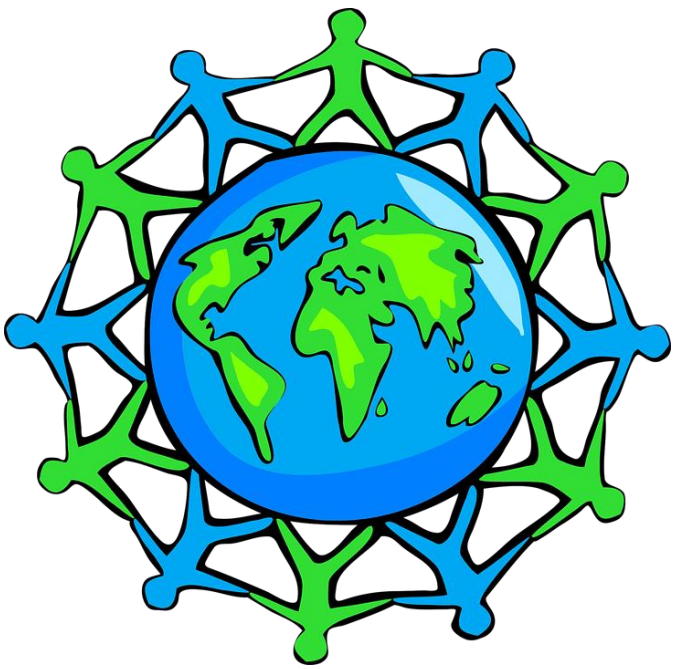
- Natural disasters often wipe out crops and these can take months or even years to recover and people still need to be fed in the meantime.
- Global warming and climate change are leading to reduced crop yields in some areas and a change in the ability to grow crops in others.
- Soil quality is in decline due to past activities, like over-farming and grazing, and this leads to a decrease in farmable land.
- As well as destroying food crops, natural disasters may cut access to areas by road so usual deliveries of fresh supplies are not possible.
- In underdeveloped countries, people may already not have access to sufficient fresh food and natural disasters can compound this issue.

There are some interesting teaching resources available on the Global Education website on the issue of food security.
http://www.globaleducation.edu.au/global-issues/gi-food-security.html
If your school is part of the Sustainable Schools program, this project may even expand on and tie together some of the concepts you already cover.
There are also some good resources on the NASA website about experiments to grow vegetables on the International Space Station currently being undertaken.
https://www.nasa.gov/feature/how-does-your-space-garden-grow
https://www.nasa.gov/mission_pages/station/research/news/flowers

# International Space Farm - Teacher's Notes

The idea of a global cooperative farm in space has many advantages. Here are a few:

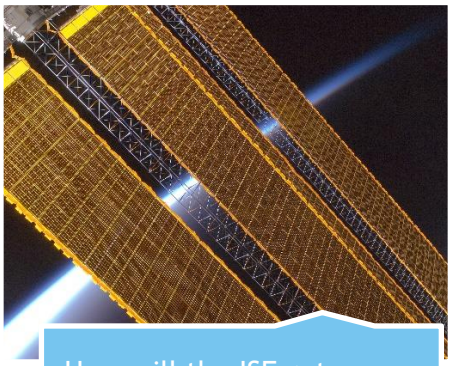
- Crops can be grown in carefully managed conditions to ensure optimal yields.
- Disease and pest control would not be needed with strict quarantine procedures leading to lower costs and the use of less chemicals.
- Crops are not affected by weather conditions or natural disasters.
- The crops grown at the farm could be distributed according to the most urgent area of need globally.
- Cooperative research can be done on crops – most effective growing conditions, soils, high yield species, nutritional content etc.



There are many directions you might like to take this project on, here are some suggested prompting questions and statements and some activity ideas to get you started:

# International Space Farm - Teacher's Notes


How big should the ISF be?

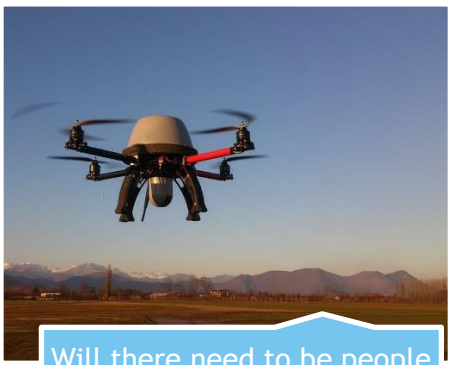


How will the ISF get power and water?

Should the ISF be a satellite of Earth or be made on the moon/another planet?

Which crop types will grow best?

How will the crop products be transported back to Earth?



Will there need to be people there or can it be run by robots?

PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

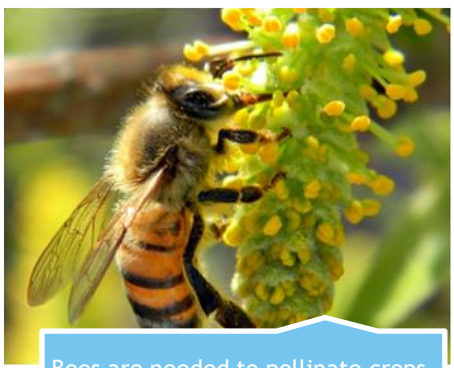
# International Space Farm - Teacher's Notes

What conditions will be needed to grow crops/veggies in space?

Which crops will provide the most nutrition for the least area taken up?

Would plants be grown from seed or would seedlings be transported from Earth?


What quarantine conditions would ensure the ISF remains pest and disease free?

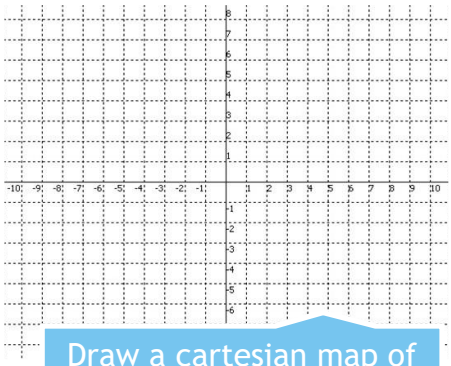


Bees are needed to pollinate crops. Would they survive on the ISF? How else could crops be pollinated?

Will the crops be grown in soil, water (hydroponics) or some other method?

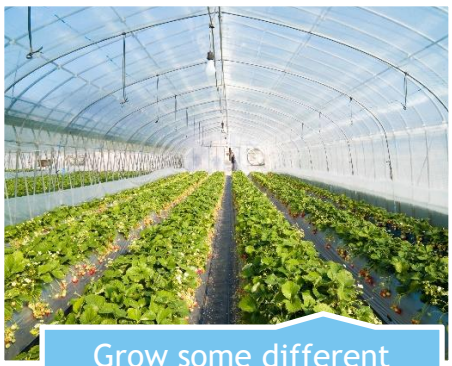
PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

# International Space Farm - Teacher's Notes



Draw a cartesian map of the layout of the farm to maximise space

Build a model of the ISF from your plan



Grow some different crops in a greenhouse to test growing conditions

Creative writing task – persuasive text on why we need/don't need an ISF

Who will govern who receives what amount of food?

PALMS
PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

# How Would Your Area be Impacted? - Teacher's Notes

Another project idea is to find out what plants and animals have been recorded living in your local area using the Atlas of Living Australia (ALA) https://www.ala.org.au/

This online resource is a wealth of information collated from sightings by scientists working in the field and also schools and the general public all over Australia. You may even like to contribute some sightings to the database yourselves. There are many curriculum-linked educational resources available on the ALA website also.

Once you have found out about flora and fauna in your local area, you could present the students with scenarios about changes that may occur due to surface changes and natural disasters. The students should then think about which species would survive, which would adapt and which ones may leave the area forever.

# PALMS

## PRIMARY AUSTRALIAN LITERACY MATHEMATICS AND SCIENCE

Santos & ESWA supporting earth science education

EARTH SCIENCE WESTERN AUSTRALIA

Santos