

THE DEADLYSCIENCE GUIDE TO
INNOVATION

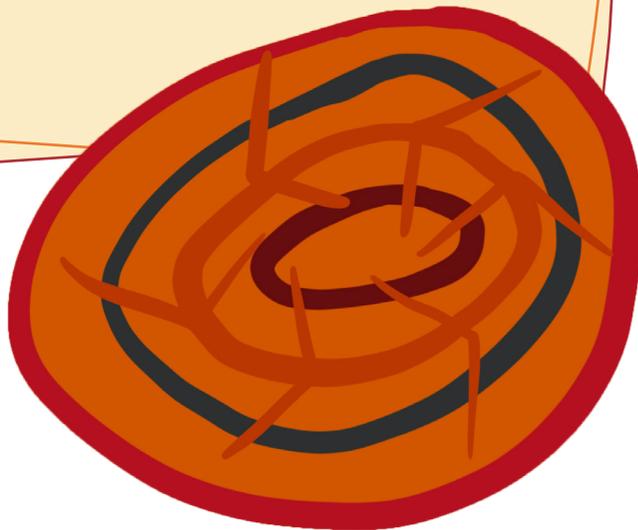
TEACHER GUIDE
Foundation - Year 6

DEADLY
SCIENCE

 Australia Post

ACKNOWLEDGMENT OF COUNTRY

DeadlyScience, Australia Post and Wingaru Education pay respect to the Traditional Custodians of the land, to all Elders past and present, and to First Nations people everywhere. First Nations people have used science for over 65,000 years, making their culture the oldest in the world. The first scientists passed on the lessons of the land, sea and sky to the future scientists of today, through stories, song and dance. We call this caring for Country. If you care for Country, the Country will care for you.



MESSAGE FROM AUSTRALIA POST



As proud partner of DeadlyScience, we are excited to share this Teacher's Guide with you to bring First Nations science, wisdom, cultures and knowledge into your classroom.

From stocking Corey Tutt's DeadlyScience book titles in our Post Offices, to delivering more than 2000 packages of STEM books and materials to more than 750 schools and communities nationally, we support DeadlyScience to help ensure that all schools and students have access to STEM resources, and to the stories and achievements of the first scientists of Australia – Aboriginal and Torres Strait Islander people.

The best way we can share and learn from First Nations science is to experience it ourselves. Gather your classmates, friends and family and try these exciting experiments and activities this National Science Week.

Nicky Tracey
General Manager of Community and Stakeholder Engagement
Australia Post

INTRODUCTION



Yaama! My name is Corey Tutt. I am a proud Kamilaroi man, Founder and CEO of DeadlyScience.

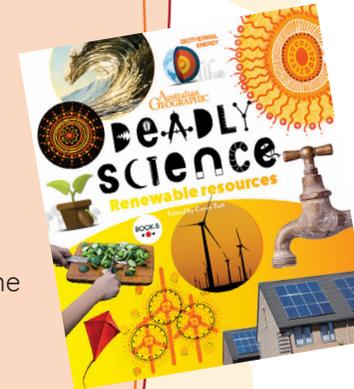
In partnership with Australia Post we have developed this resource to help bring First Nations science into your classroom. It is based on the [Australian Geographic DeadlyScience Book 8: Renewable Resources](#) and features the designs of Mim Cole, a Larrakia, Wardaman and Karajarri visual artist from Darwin. We also want to thank Wingaru Education who worked with us on this year's resource development.

When Aboriginal and Torres Strait Islander kids can see that our people practice science and have done for thousands of years it inspires them and opens their minds to what is possible. For non-Indigenous people it is important they learn the true history of the amazing innovations and scientific knowledge developed and used by Aboriginal and Torres Strait Islander people.

The innovations of the past will help inform the answers for the future. The 2023 National Science Week theme encourages educators, learners and families to explore Aboriginal and Torres Strait Islander innovations. So, in this year's resource we focus on the innovations of the past and demonstrate their relevance to today. We explore wind, sun and water energy encouraging people to think about what has been and what can be.

Yaluu

Corey Tutt OAM
CEO, Founder of DeadlyScience



ABOUT THIS GUIDE

As the first scientists of Australia, First Nations people throughout this land have practised and continue to develop scientific innovation. The lessons in this guide are designed to inspire students to learn more about First Nations people and their connection to Country, as well as their sustainable practices, to engage with scientific experimentation in the knowledge that this drives innovation, and to examine the need for sustainable approaches to future technology. Country provides everything we need; if we look after her, she will continue to do so for future generations.

It is anticipated classes will **build connections with local First Nations communities** and learn about the connections between traditional Aboriginal and Torres Strait Islander scientific innovation and the science of today. Connect with local Aboriginal and Torres Strait Islander people and organisations who can help your class develop a deeper understanding of First Nations science by enquiring at local Aboriginal and Torres Strait Islander organisations.

TEACHER NOTES

Use a map, such as the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Map of Indigenous Australia, to teach students about the Traditional Custodians of the land on which they live, learn and play. Explain there are over 500 distinct First Nations cultural and language groups across Australia.

Introduce students to the concept of a ‘yarning circle’, which is something used in many First Nations communities as a way to share knowledge, ideas and points of view. It is an engaging, fun and safe place for students and teachers to be heard and to have opinions.

Begin each lesson with an Acknowledgment of Country to respectfully recognise the Traditional Custodians of the land, sea, waterways and sky of your area. Discuss the meaning an Acknowledgment of Country provides as an opportunity to introduce the themes of the lessons, including custodianship, respect and connection to Country.



HAVE A YARN!

A good yarn is the perfect way to share knowledge, ideas and points of view. It's engaging and fun, and gives us the chance to explore concepts, to challenge ideas and consider how we think.

Yarning circles are an enriching way for students to engage with First Nations knowledge. It is a practice that has been an effective teaching method for thousands of years, providing a safe place to be heard and to offer an opinion, as well as naturally building connectedness.

You may like to invite an Aunty or Uncle to join you.

FIVE TIPS FOR A YARNING CIRCLE

1 SIT IN A CIRCLE

Sitting in a circle means everyone gets to be a part of the conversation, listening, talking and thinking. You may also like to use a talking stick to pass between students so that everyone knows whose turn it is to speak.

2 SET SOME EXPECTATIONS

Yarning circles are a safe space where everyone should feel comfortable contributing. Setting some expectations around listening, using respectful language, and not judging what others say can help ensure your circle is a positive space.

3 PROVIDE FOCUS QUESTIONS

Sometimes lots of voices can take you off track. Introducing focus questions so that everyone knows what they are discussing can really help, and follow-up questions will keep you on track.

4 ENCOURAGE SHARING OF IDEAS

Encouraging students to take turns to talk gives everyone the chance to share, but never force them. The yarning experience is always better if students are given time and space to feel comfortable sharing.

5 MAKE TIME FOR REFLECTION

Reflecting on what you have talked about will help instil any ideas or actions decided on by the group.

SUGGESTED YARNING TOPICS AND QUESTIONS

THESE QUESTIONS CAN BE MODIFIED FOR ANY GROUP YARNING CIRCLE

WATER

- How do people use water?
- How did Aboriginal and Torres Strait Islander people collect water?
- Do you know how First Nations people caught fish to eat?
- What did Aboriginal and Torres Strait Islander people use to make boats?
- How did First Nations people make boats waterproof?

SUN

- What kind of things can the sun tell us?
- How important is the sun to everyday life?
- How do Aboriginal and Torres Strait Islander people living traditionally on Country use the sun?
- Do you know how First Nations people harness the sun's power? What is an earth oven?
- How can bushfires be useful? How do First Nations people use bushfires?

WIND

- What does 'caring for Country' mean to you?
- What are some of the ways we use wind? What can wind tell us?
- How does knowledge of wind patterns help First Nations people care for Country?
- How is the wind powerful? In what ways can it be used?
- How do First Nations people harness wind power?
- How can wind be used to help collect food? How do you think Aboriginal and Torres Strait Islander people use the wind for this purpose?

INNOVATION | POWERING FUTURE INDUSTRIES... FROM THE PAST

HOW DOES INNOVATION POWER FUTURE INDUSTRY?

Innovation is the process behind generating ideas for new tech, products, and production processes for future industries that include AI, robotics and driverless cars, as well as renewable energy solutions that help sustain the current world.

Innovation is also about thinking of ways that we can power industries well into the future while looking after the planet. Earth can provide everything we need and will continue to do so for future generations if we care for her.

A cleaner and more resilient future with net-zero emissions will require a wide range of innovation, because renewable energy sources are not secure – the sun does not always shine; the wind drops; and water flow fluctuates. So, we rely on innovators to find solutions to our current problems to power our future, and within that, we need an inherent knowledge exchange. First Nations people have always been innovators, so it is vital that their knowledge and expertise at caring for Country forms the basis of this exchange.

WHY THIS THEME?

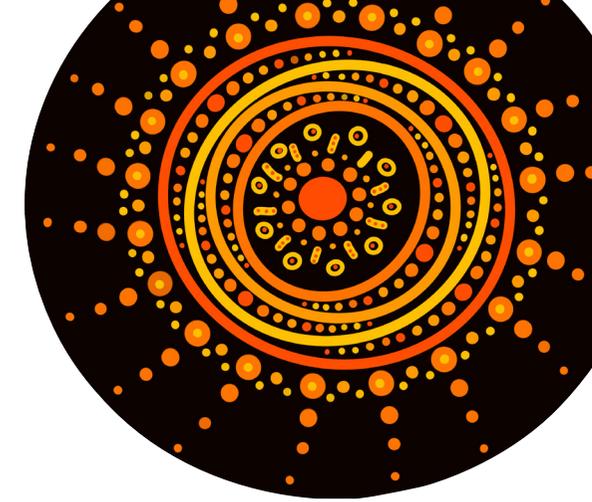
Each year the United Nations (UN) dedicates an entire calendar year to a particular topic or theme. The purpose is to raise awareness of how the topic is important to life, society and progression. This year, the theme is Innovation: Powering Future Industries, and incorporates advancement in technology in all industries. With recent advancements in renewable energy solutions, data science and environmental monitoring, the natural world expertise of Australia's First Nations people is a vital piece of the puzzle.

HOW IS IT RELEVANT TO MY STUDENTS?

This guide is designed to provide all Australian students with fun and engaging opportunities for scientific inquiry, and an important insight into the vital contributions of First Nations knowledge and innovation to renewable energy and future industry.

DOES IT LINK TO THE CURRICULUM?

Yes! All the lessons in this guide link directly to the Australian Curriculum, with relevant codes noted. Each lesson provides learning intentions, guiding questions and vocabulary lists, and is underpinned by the Bloom's Taxonomy pedagogy.



AUSTRALIA'S FIRST SCIENTISTS AND INNOVATORS

ABORIGINAL AND TORRES STRAIT ISLANDER PERSPECTIVES

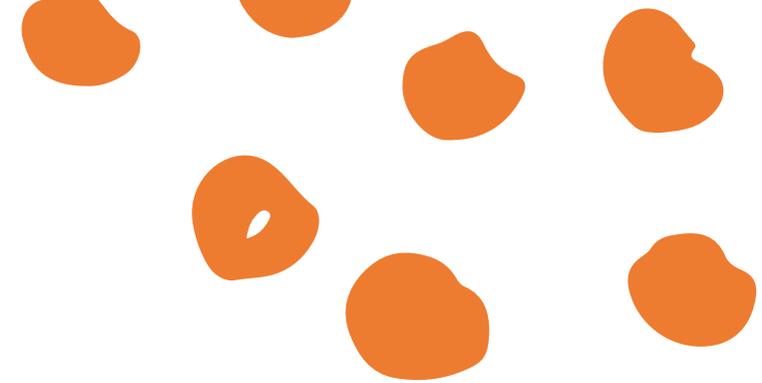
Aboriginal and Torres Strait Islander people have a highly sophisticated understanding of Country – the land, sea and sky that supports them and the flora and fauna around them. They also have a long history of innovative approaches to sustainability and resource management, and have an innate understanding of local ecosystems, including weather patterns, plant and animal behaviour, and natural resources cycles, as well as the interconnectedness between them.

Firestick farming is used to clear away undergrowth and encourage new vegetation in a sustainable way while preventing large-scale bushfires, for example, while seasonal harvesting and fishing involves observing seasonal cycles and breeding patterns, and the rule of three – taking only what is needed – which avoids overexploitation and ensures ecosystems are capable of regeneration. Sustainable hunting, which involves targeting specific animals while the rest are undisturbed, and avoiding hunting during breeding seasons, allows fauna populations to replenish naturally.

First Nations people also have a complex system of resource sharing, which means everyone has a fair share, resources are not overexploited, and there is a sustainable balance between humans and their environment. Recent understanding shows extensive evidence of First Nations farming, too, with an emphasis on allowing for the natural regeneration of plants, and sharing of the cultivated land with local animal populations.

Today many communities are located in remote areas that are not connected to a centralised power grid, so innovative off-grid renewable energy solutions have been developed to meet their energy needs, including standalone solar power systems, microgrids, and hybrid systems that combine solar, wind, and storage technologies.

It is important to recognise the traditional custodianship of First Nations people over their land and resources, and the deep cultural knowledge they hold, which is built on respect, responsibility and a natural balance between all things. Combining this powerful understanding of Country with modern renewable energy technology will create innovative and context-specific solutions for the future.



RENEWABLE RESOURCES

[Renewable resources](#) have been used for more than 65,000 years by First Nations people. These resources have been and are still used in sophisticated and innovative ways to harness energy. Renewable resources are an integral part of the future. Today these resources are classified into five main categories:

WIND POWER	Wind is harnessed using wind turbines, which are towers with two or three blades at the top. The wind turns the blades, the blades turn a generator (inside the tower), and the generator converts wind into electrical power.
SOLAR POWER	Direct from the sun, solar power is captured by photovoltaic panels on the roofs of buildings (or in giant solar farms) that convert sunlight into electrical energy.
HYDRO-ELECTRIC POWER	Energy is generated from moving or flowing water, so most hydro-electric plants are next to dams. A controlled amount of water is released under pressure through tunnels in the dam, turning huge turbines and generating power.
GEOTHERMAL POWER	Geothermal power uses the heat deep within the earth – like reservoirs of hot water, and the high temperature and pressure in the earth’s core – to convert heat into electrical energy.
MARINE ENERGY	Marine or ‘tidal’ energy is harnessed from the natural rise and fall of ocean tides, currents and waves, as well as river currents in some places. Power can also be captured from temperature differences in water.

Safety note: Use discretion when experimenting with renewable power conversion in the classroom. Teacher supervision should be applied at all times

SCIENCE CHECKLIST

As the first scientists of Australia, First Nations people throughout this land have practised and continue to use specialist scientific knowledge and innovation to live sustainably on Country.

ENVIRONMENTAL/ PHYSICAL SCIENCE	First Nations people have sophisticated knowledge of the environment, the weather and astronomy, including sustainable land management systems, seasonal calendars, celestial navigation, and scientific prediction.
ECOLOGICAL SCIENCE	Aboriginal and Torres Strait Islander people have innate traditional ecological knowledge of native flora and fauna, soil fertility, ecological succession, land rehabilitation, revegetation, erosion control and habitat restoration.
GEOLOGICAL SCIENCE	First Nations people have long used the geological structure and heat of the earth in daily life, for example cooking in earth ovens and reading the land to find water.
BIOLOGICAL SCIENCE	The deep connection to Country of Australia's Traditional Owners includes extensive knowledge of medicinal plants and traditional healing practices, including practices that ensure flora and fauna populations are protected.
CHEMICAL SCIENCE	Aboriginal and Torres Strait Islander communities have a deep understanding of fire ecology and employ cultural burning practices, as well as using the chemical transition of materials to their advantage.
AGRICULTURAL SCIENCE	First Nations people employ land management practices, controlled burning, rotational harvesting and regenerative agriculture to ensure ecosystem health, biodiversity conservation and renewable resource management.
CLIMATE CHANGE SCIENCE	Adaptive strategies such as adjusting seasonal practices, migration patterns and sustainable land use employed by Aboriginal and Torres Strait Islander people are used for scientific modelling and planning for climate change resilience.

SCIENTIFIC TEACHING STRATEGY

The Predict-Observe-Explain (POE) teaching strategy, developed by White and Gunstone (1992) helps to ensure Indigenous perspectives are included in the STEM classroom. This strategy supports students through the basics of the investigation process in a way that is independent of cultural background and knowledge. It offers teachers information about how much and what type of knowledge students hold already, generates discussion, and inspires students to ask questions and think more deeply so they can further investigate the topic.

The POE strategy is a collaborative process: the teacher investigates students' understanding by asking them to carry out the predict, observe and explain steps. This encourages students to use their prior knowledge and understanding and supports developing an agreed meaning of specific words as used and understood by the classroom. It is especially important for Aboriginal and Torres Strait Islander students who may have access to culturally specific knowledge that they might be able to share with the class. This demonstrates acknowledgment and inclusion of Indigenous perspectives through engagement with the student and potentially the wider First Nations community.

PREDICT

This is the process of using what we already know in order to ask questions that will help us learn something and create a strong foundation to build upon. This predication is often referred to as an hypothesis, or a testable question. We create hypotheses based on our accumulated knowledge, available tests and investigations.

OBSERVE

This is the process where students use experimentation to test their hypothesis. They can do this by watching someone else solve the problem or they can work to solve the problem themselves. During this process students review their hypothesis through iterations as they progress through the problem-solving phase to discover new information.

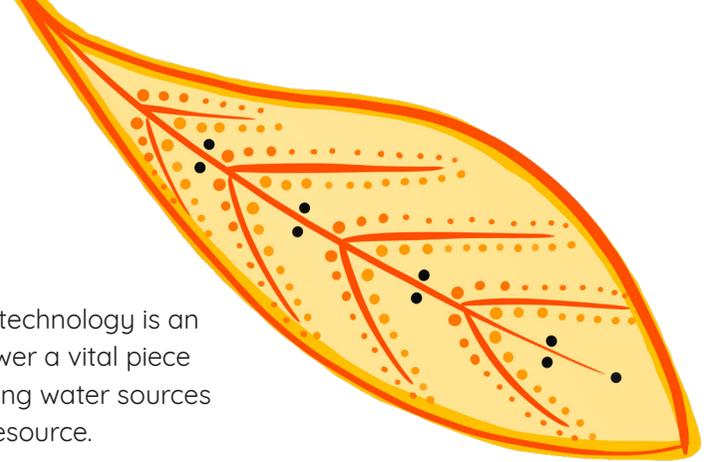
EXPLAIN

This is the process of analysing, synthesising and communicating what the problem-solving phase has uncovered according to what we see. We try to answer our question in this step. Sometimes we see the results differently and sometimes the results move us to ask more questions.



FOUNDATION – YEAR 2

Water Power



FOUNDATION – YEAR 2 | WATER POWER

LESSON OVERVIEW

This lesson introduces students to the most important renewable resource in Australia, water. Innovation in water technology is an ancient practice in First Nations communities, with traditional river and tide traps built to catch fish, and water power a vital piece of a sustainable future. Students will discuss all the uses we have for water and how it is renewable, before exploring water sources outside. They will then be encouraged to construct a rock well or a dam to see how water can be collected as a resource.

Learning intention

- Understand the importance of water for sustaining life and identify its uses.
- Learn about the ways First Nations people used water and harnessed the power of water.
- Describe some ways to capture and store water
- Experiment with designing rock wells to understand the power of water and complexities in capturing and storing water.

Guiding questions

- Explore** – What is water and why is it important? How is water used in our daily lives?
- Analyse** – What can we learn from the way First Nations people used water to help us harness the power of water?
- Create** – Why is collecting and storing water important? Do you think your rock well was effective? Can you create some innovations to make your design better?
- Extend** – How can the science of First Nations innovations, such as rock wells using hydro-energy, be used for future technology and innovations?

Resources

- Images of First Nations environments
- Dreamtime stories
- Natural materials (rocks, twigs, leaves, bark)
- Images/videos of rock wells and Aboriginal water collection methods
- Trays/containers
- LEGO

Vocabulary

- Water
- Habitat
- Basic needs
- First Nations
- Culture
- Natural materials
- Renewable resource

You might also like to investigate related words in the local language/s of your area.

FOUNDATION – YEAR 2 | WATER POWER

STEP 1: EXPLORE – LEARN

- Engage students in a discussion about water.

Guiding Question: What is water and why is it important?

How is water used in our daily lives?

- Explain to the students that water is a renewable resource, which means it is, or can be, replaced faster than it can be used. Discuss briefly what ‘renewable’ means and provide examples of other renewable resources (sun, wind etc.) If available, refer to pages 20-23 of [Australian Geographic DeadlyScience Book 8: Renewable Resources](#).
- Introduce a First Nations focus by explaining that Aboriginal and Torres Strait Islander people have a deep connection to water and consider it a valuable resource. Share a brief overview of how water is significant in Indigenous culture, such as its role in stories and sustaining life.
- Read aloud or show pictures from books that depict Aboriginal culture and their relationship with water. (Recommendation: [Big Rain Coming](#) by Katrina Germein, the story of [how the water got to the plains](#), and [The Rainbow Serpent story](#))
- After reading, engage students in a discussion of First Nations perspectives of water. Encourage students to ask questions and share their thoughts about the importance of water in Indigenous communities.

STEP 2: ANALYSE – THINK

- Ask students to observe and collect various natural materials, such as rocks, twigs, leaves, and bark, while considering their potential use in Aboriginal water collection practices.
 - Encourage students to explore outside and see if they can find natural sources of water such as rock holes, tree trunks, dew.
- Guiding Question: What can we learn from the way First Nations people used water to help us harness the power of water?**
- Explain to students that Aboriginal and Torres Strait Islander people used the land and all its resources in a sustainable way to ensure their needs were met, collecting water in soaks, for example, catching fish in traps and making canoes from the bark of trees.
 - Introduce the concept of a rock well as a way to collect and store water using natural materials, highlighting its connection to Aboriginal water collection techniques.
 - Show students images or videos of rock wells and Aboriginal water collection methods (e.g., coolamons (carved wooden carriers), bush tanks, billabongs).
 - Explain how rocks can be arranged to create a well and how water can be collected and stored based on Aboriginal knowledge.
 - A well is hand dug in soil or sand, and rocks are placed around the sides of the hole, stacked on top of each other to make walls. Different sizes and shapes are arranged to create integrity, with twigs, leaves and pebbles used to fill in the spaces between the rocks.
 - First Nations people used many different methods for collecting water, depending on the resources available to them. A common method was a coolamon – a shallow wooden bowl – as well as bark containers or natural hollows in rocks or tree trunks to store the water.

STEP 3: CREATE - DO

Guiding Question: Why is collecting and storing water important? Do you think your rock well was effective? Can you create some innovations to make your design better?

PREDICT – What will happen? Will the well hold water? Which well will hold the most water? If the water leaks out, consider why?

- Divide students into two groups. One group is provided with natural building materials collected earlier, and encouraged to design and construct a rock well design.
- The second group is provided with LEGO (or similar) and asked to complete the same task.
- Encourage students to consider the designs and practices they learned about and incorporate them into their construction.
- Once the rock wells are built, provide a small amount of water for each group to collect and observe, discussing the connection between their design and First Nations knowledge.

OBSERVE – What happens when the water is added to the well? Does it stay there? Does it escape?

- Using natural materials, encourage students to try and scoop/ collect water from their well, using bark, plants etc, in the knowledge that Aboriginal people used coolamons (carved wooden carriers), and bags made from the skins of kangaroos, wallabies, possums and other small mammals, because their skin is waterproof. Near the sea, kelp and large shells were also used.
- Students share their success and challenges and compare the different rock wells.

EXPLAIN – Reflect on what you have seen and explain why it has happened. How has the rock well contained the water?

DID YOU KNOW?

In the Crocodile Islands off the coast of the Northern Territory, fish traps made from twined pandanus palm leaves are still being used today!



EXTEND THE LEARNING

Water tunnels

Dew collection

Soaks/
rock holes

Fish Traps

- Introduce the concept of future technology and the importance of water
- Explore the ways scientists and engineers are exploring ways to use water to create sustainable tech
- Show or describe examples of future tech that involves water:
 - Hydroelectric power
 - Water filtration systems providing clean drinking water
 - Harnessing wave power and tidal energy to generate electricity
 - Desalination processes to turn seawater into freshwater

There are hundreds of words for water in Aboriginal and Torres Strait Islander languages. You might like to investigate related words in the local language/s of your area.

In Australia there are more than 100 operating hydro-electric power stations, and the power of the tide can be captured as marine energy. First Nations people along the coastline of Australia used boulders to construct stone-walled intertidal fish traps – similar to weirs – to regularly harvest fish. At high tide, the walls of the fish traps are submerged, which allows the fish to move into the area to feed. As the tide recedes, the fish are stranded in the trap and can be easily caught.

Aboriginal and Torres Strait Islander people have used fishing to build a livelihood for themselves and their communities for thousands of years. As well as fishtraps made from rock, First Nations fishermen use woven basket fish trap, placed into creeks during king tides, and handheld nets that could be used at any time. Dugout boats and bark canoes were used as transport, and spears and hooks made from animal bone were used to catch the fish.

DID YOU KNOW?

To First Nations people, water is seen as a gift from Mother Earth or Country, and it must be respected and cared for. Aboriginal and Torres Strait Islander people have always known how to manage water. Maybe some of these amazing ideas could be extrapolated for further uses in the future.

Guiding Question:

Extend – Class discussion, yarning circle

How can the science of First Nations innovations, such as rock wells using hydro-energy, be used for future technology and innovations?

MORE

DEADLY SCIENCE

TO EXPLORE THE POWER OF WATER FURTHER,
TRY ONE OF THESE DEADLY EXPERIMENTS AT HOME

MAKE A SOAK

A water soakage – or soak – is a source of water in very dry areas of Australia, particularly in the desert. In these hot places, First Nations people know where to find water, and their stories tell of the places where it is stored, like wells, just beneath the surface. They would dig out the sand or mud at the soak using a coolamon (a vessel to carry things) or woomera (a spear thrower), often over a metre deep, until clean water gathered in the base of the hole.

Head out into your garden and have a look around: is there a spot that you think might have water? Aboriginal people look for birds and animals to see where they drink – maybe that will help? Then build a well to catch water using rocks, stones and modelling clay to see if you can collect water. If you are near the beach, it is easy to see how a soak works: just dig a hole near the water's edge and watch it seep into the well you have made. Remember this water at the beach is salt water, so do not to drink it.

First Nations people would collect water from their soak using clay bowls and animal skins: how are you going to collect the water? And how do you think water could be collected sustainably from the ground in the future?

Traditional Aboriginal water collection and storage practices have evolved for many centuries and continue today. The deep knowledge of First Nations people means an understanding of where water can be found is always available.

How could scientists use this information in the future?

HERE ARE SOME YOUTUBE VIDEOS
THAT SHOW TRADITIONAL WAYS
OF FINDING WATER:

[Finding water in an arid environment](#)

[Finding water in a dry creekbed](#)

[Finding Water in the Desert - BBC](#)

[Finding Water in the Desert - Nat Geo TV](#)

DID YOU KNOW?

In the desert, sheoak trees have a cavity where the branches join the trunk, so water trickles down the branches and collects in the hole. The small opening means this water source can not be reached by birds or animals, so it is the perfect outback water cooler for people living in the desert, and in some places, larger cavities were hollowed out so even more water could be stored!

MORE

DEADLY SCIENCE

MAKE A FISH TRAP

Just like in class, use some modelling clay to build a structure that can hold water – it can get messy, so maybe do this outside – with a funnel at one end for the water to flow into it. Then, find some things that float (these will be your ‘fish’) and add them to the water: paper, leaves, sticks – whatever you think!

Then fill the dam with water and watch the ‘fish’ float. Keep watching, and you will see that as the water drains out, the ‘fish’ are trapped in the dam, ready to be caught and eaten.

COLLECT RAIN FROM DEW

Did you know that First Nations people collected water from dew that forms over night as the land cools down. You can try it too: head out into the garden or park and find some large green leaves. Shape them into a bowl and leave them out overnight to collect water! Aboriginal people would then transfer dew into coolamons to store it until it was needed during the day.

WATCH WATER WALK

First Nations people understand that water can move freely, and this understanding helps them know where to always find water. This experiment shows how water moves via capillary action: between plants, under the ground, and between billabongs and creeks.

You will need:

- 5 plastic cups
- 3 different coloured food colours (red, yellow and blue are best)
- Water
- Paper towel

First up, line up five plastic cups in a row and number them 1-5. Fill cups 1, 3 and 5 with the same amount of water (about $\frac{3}{4}$ full). Add a few drops of red food colouring to the first cup in the line – cup 1. Add a drop of yellow food colouring to cup 3, and a few drops of blue food colouring to cup 5. Stir in the food colouring in each cup, but make sure you wipe the stirrer clean between each colour.

Fold a piece of paper towel lengthways on the vertical axis, and then in half horizontally so that it makes a V shape that is just taller than the cups. If it is much taller than the cups, rip a bit off the end. Add an end into cups 1 and 2. Fold three more pieces of paper towel the same way, and add them into cups 2 and 3, 3 and 4 and 4 and 5.

Now, sit back and watch as the water travels between the cups, changing colour as it goes! Be aware, it can take up to 20 minutes for the colours to start changing. Leave the experiment over night, and see what happens in the morning.



YEAR 3 - 4

Solar Power

YEAR 3 - 4 | SOLAR POWER

LESSON OVERVIEW

This lesson explores heat and how it impacts physical properties, using the sun as a source of renewable energy. The power of the sun has been harnessed for millennia, to cook, to create materials to build with, and as a source of both solar and geothermal energy. It will talk about solar power and how it can be used to prepare food, and introduce First Nations techniques such as cooking over hot coals, baking food in ashes, and using latent heat stored in hot clay to steam food in 'earth ovens'. Students are introduced to solar ovens, designing and constructing their own, and after reviewing the results, make 'damper', to monitor how the dough transforms in a solar oven.

You might also like to investigate related words in the local language/s of your area.

Learning intention

- Learn about the significance of the sun to First Nations people, some ways they harnessed the power of the sun and its connection to sustainable living.
- Understand the concept of solar energy, physical properties of materials and their application in solar ovens.
- Describe how a change of state between solid and liquid can be caused by adding or removing heat.
- Design and build a simple solar oven and use it to bake bread.

Guiding questions

Explore – How is the sun important to living things? How does the sun generate energy? How can we harness this energy?

Analyse – How did First Nations people harness the power of the sun? What can we learn from the way First Nations people cooked their food? Is this a renewable method?

Create – How does the heat from the sun change the state of physical materials? How long will the damper take to cook? What temperature will your oven reach?

Extend – How can the science of First Nations innovations, such as earthen ovens using geothermal energy, be used for future technology and innovations?

Resources

- Aboriginal cultural resources (books, videos, websites)
- Materials for constructing a solar oven
 - cardboard (pizza box),
 - foil,
 - plastic wrap,
 - black paper,
 - thermometer,
 - glue,
 - scissors,
 - pen
- Ingredients for damper
- [When the Snake Bites the Sun](#) by David Mowaljarlai.

Vocabulary

- Change of state
- Harness
- Solid
- Liquid
- Heat
- Damper
- Natural materials
- Physical properties
- Aboriginal culture
- Sustainable
- Renewable resources
- Solar
- Geothermal

YEAR 3 - 4 | SOLAR POWER

STEP 1: EXPLORE - LEARN

- Engage students in a discussion about the sun.

Guiding Question: How is the sun important to living things? How does the sun generate energy? How can we harness this energy?

- Explain to the students that solar energy is a renewable resource, which means it can be replenished naturally. Discuss briefly what 'renewable' means and provide examples of other renewable resources (water, wind etc.). If available, refer to pages 12-15 of [Australian Geographic DeadlyScience Book 8: Renewable Resources](#).
- Introduce a First Nations focus by explaining that Aboriginal and Torres Strait Islander people have a deep connection to the sun and consider it a valuable resource. Share a brief overview of how the power of the sun is significant in Indigenous culture, such as its role in stories and sustaining life.
- Ask students if they know what is depicted on the Aboriginal Australian flag. The black part at the top of the flag symbolises the Aboriginal people, while the red at the bottom represents the earth and the colour of ochre used in Aboriginal ceremonies. The circle of yellow in the middle of the flag, dissecting both other colours, represents the sun, the constant renewer of life.
- Read [When the Snake Bites the Sun](#) by David Mowaljarlai.
- Explain that First Nations people have a deep understanding of the solar system, and this celestial knowledge has been passed down for hundreds of generations. Did you know that the path of the sun, the moon and the planets is seen as a pathway for the spirits, and that Aboriginal and Torres Strait Islander people used the night skies like a map? Find out more [here](#), and [here](#).

STEP 2: ANALYSE - THINK

Guiding Question: How did First Nations people harness the power of the sun? What can we learn from the way First Nations people cooked their food? Is this a renewable method?

- First Nations people harnessed the sun's power in many ways, including earth ovens that use geothermal energy, and solar ovens, which use the power of the sun.
- Introduce students to the concept of a solar oven and explain how it utilises the sun's energy to cook food. Talk about changing states of matter when heat is applied using [this video](#) if required.
- Encourage students to discuss materials that could be used to make a solar oven in the classroom, as well as how these properties work together to make the oven work.
- Divide students into small groups and provide them with cardboard boxes, foil, black paper and clear plastic wrap.
- Ask students to think about things that could be put in the oven. Examples could include damper, grasses to be dried, and resins which were used to fix tools and implements, as well as for torch fuel.
- Talk about how First Nations people would dry grasses and reeds to make string and weaving materials.
- Ask students to consider other ways First Nations people cooked food. Are these methods renewable?

STEP 3: CREATE - DO

Guiding Question: How does the heat from the sun change the state of physical materials? How long will the damper take to cook? What temperature will your oven reach?

- Students are encouraged to follow a [recipe](#) to make a damper dough and place it in solar ovens outside on a sunny day.
- [Watch this video](#) on solar ovens, or other videos you feel are appropriate.
- Students are asked to monitor and record the temperature inside their ovens using thermometers.

PREDICT – What will happen? At what temperature will the dough change form? What would happen if the temperature got too hot?

Ask student groups to design and construct solar ovens following this guide:

You will need:

- 1 pizza box
- Black paper
- Glue and sticky tape
- Pen
- Aluminium foil
- Cling wrap
- Scissors
- [Damper dough](#)

Make a flap in the lid of the pizza box by drawing a square 2cm from the edges of the lid. Cut along the front edge and the sides. Do not cut the back edge! Fold the flap open. This flap will be used to reflect light into your pizza box.

Cover the inside of the flap with aluminium foil. Sticky tape cling wrap over the open square in the lid: this will help the heat stay in the oven. Cut a square piece of black paper and glue it to the inside base of the box, making sure all the joins are sealed properly – you want the heat to build up inside the box to be able to cook your damper.

Take your solar oven outside to a sunny spot. Position the reflective flap so it reflects the sunlight into the oven (you may need to move it around as you cook to accommodate the moving sun). You will need to prop the lid open with a stick – you should be able to see the ray of sunlight being reflected by the foil into the oven.

Now you are ready to cook! Place the damper dough in the oven, put the lid down, and position the reflective lid so it catches the sun. And remember, the oven and food can get very hot even on a cool day.

Depending on the conditions, cooking times can vary. We suggest making smaller damper rolls, and checking on them throughout the day, or substitute marshmallows for the damper and watch as they soften and ooze in the heat of the oven!

OBSERVE and record what happens while the damper is cooking. What is the temperature of the oven? How is the movement of the sun affecting the heat in the oven? At what point does the damper start to rise?

EXPLAIN the process of solar cooking and compare it to geothermal cooking. After reviewing the observations, how could you change the cooker or what you did to make it more efficient?

Students try the cooked damper, with butter and bush honey, if available, and discuss how First Nations people used grains in their cooking. Did you know First Nations people are the world's oldest bakers? Acacia seeds and various grasses were ground between stones to make flour, from which bread was made. Deadly!

EXTEND THE LEARNING

Geothermal cooking

Hot water bathing

Drying grasses

Dehydrating food

- Introduce the concept of future technology and the importance of solar power.
- Explore the ways scientists and engineers are exploring ways to use the sun to create sustainable technology.
- [New solar tech](#) includes pyramid lenses to focus sunlight as it hits the solar panel, getting the same amount of light to hit an area a third of the size, as well as:
 - solar balloons
 - solar windows
 - solar paint

There are hundreds of words for the sun in Aboriginal and Torres Strait Islander languages. You might like to investigate related words in the local language/s of your area.

In Australia, more and more remote communities are turning to solar power to bring electricity to their communities. Due to their location far away from power stations, running power lines for thousands of kilometres is not feasible. Using solar power helps communities to create jobs, protects the environment and reduces the cost of living for communities so they can stay on Country.

Aboriginal and Torres Strait Islander people have used the power of the sun to cook, navigate and build tools for themselves and their communities for thousands of years. As well as earthen ovens, First Nations people used solar power to dehydrate food to make it last longer, to dry grasses to build baskets and tools such as fish traps and bathed in hot water springs for personal hygiene and healing purposes.

DID YOU KNOW?

Aboriginal and Torres Strait Islander people marked the rising and setting position of the sun throughout the year, noting solstices and equinoxes as part of a seasonal calendar. They did this by observing the sun's position using landscape features or stone arrangements. That's deadly science!

The sun's rays have to travel 150,000kms to reach earth – that takes 8 minutes and 20 seconds!

First Nations people can navigate using the position of the sun and the other planets in the sky.

Guiding Question: Extend – How can the science of First Nations innovations, such as earth ovens and solar cookers, be used for future technology and innovations?

MORE

DEADLY SCIENCE

**TO EXPLORE THE POWER OF THE SUN FURTHER,
TRY ONE OF THESE DEADLY EXPERIMENTS AT HOME**

MAKE A HUMAN SUNDIAL

First Nations people tracked the position of the sun in the sky. It helped them to understand seasons and equinoxes and plan their lives around these. They used patterns of stones and mapped the shadow the sun created in the pattern, but you can create a sundial... using you!

First, choose a sunny day! Then, mark a spot outside with a cross, and stand in the sunlight. Look at where your shadow is, and trace a line around it with chalk, or take a picture on a parent's phone.

Head back out each hour and repeat the same process, you may need to set an alarm to remind you to go outside. After a few hours, you will have begun to map how the sun moves through the sky. If you want to see how this changes throughout the year, try it each month on the same day, even at the same time, and look at the differences.

MAKE A SUN PRINT ARTWORK

The sun is an important symbol in First Nations art, and is often drawn as a circle, or rays. It is symbolic of life and energy.

Cyanotype is printing using the sun. You will need:

- Dark paper
- Gum leaves or other native flowers
- Sticky tape

Stick your leaves in a pattern on the paper – you could even try and make a sun circle or rays – then stick the paper to a window that catches lots of light, with the leaves closest to the glass. Leave the cyanotype in the sun for a few hours, then take it down, peel off the leaves and check out the sun pattern beneath!

MAKE A SOLAR-POWERED GARDEN

Design and build a solar-powered garden in your community, using solar panels to provide energy for lighting, water systems and heat, if the garden needs it. Can you design a daily watering system powered by the panel? Do you need to consider any other needs for the garden? What if it gets too hot or cold? What are the best things to plant in each season? Perhaps you could plant Indigenous plants, and incorporate First Nations knowledge of growing food into your garden? At every point, think about how important the sun is.

Did you know that Aboriginal and Torres Strait Islander people cultivated yam daisies as a crop to eat? The tuber part of the plant is eaten like a root vegetable. The cultivation process involved finding the right spot with the right amount of sun, clearing the land, tending to the crops and then harvesting and storing the food. The Noongar people in southern WA would sow kangaroo grass and wattleseed in the rainy season and then harvest it and store it as an important food source.



YEAR 5 - 6

Wind Power

YEAR 5 – 6 | WIND POWER

LESSON OVERVIEW

This lesson introduces students to wind power and its increasingly important role as a renewable resource in Australia, as well as its inherent part of weather patterns and the significance of this in First Nations culture. Students will consider how wind energy stacks up compared to other renewable resources, and investigate the capacity of wind to power a motor using reed propellers.

For First Nations people, a deep connection to their environment, and detailed knowledge of wind and weather patterns allows prediction of [changing seasons](#), of animal migration and plant cycles – and therefore when and where there will be food – even when to escape danger.

This ability to link events in the natural world to a cycle that predicts seasonal change is perhaps the most innovative knowledge there is. This is what has ensured the survival of the oldest continuing living civilisation on earth.

You might also like to investigate related words in the local language/s of your area.

Learning intention

- Learn about the relationship between wind and weather in First Nations culture.
- Understand how wind can be harnessed as a [renewable resource](#) for every generation.
- Recognise David Unaipon and the significance of his innovations.
- Design propellers using different shapes and test their properties.
- Describe ways First Nations people have used wind.

Guiding questions

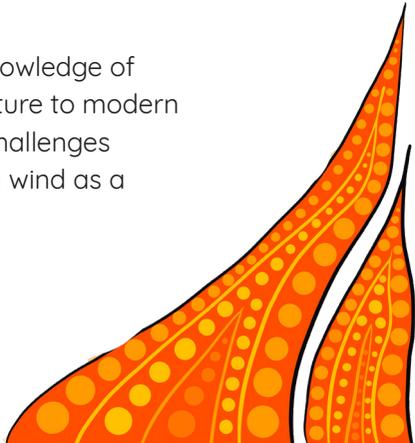
- Explore** – How is wind important to living things? What do we use wind to do? How does wind energy generate energy? How can we harness this energy?
- Analyse** – How did First Nations people harness the power of the wind? What can we learn from the way First Nations people used and worked with the wind?
- Create** – Thinking about the shapes of propellers and boomerangs, how can wind influence a propeller?
- Extend** – How can we apply the knowledge of wind energy from First Nations culture to modern practices? What are some of the challenges or limitations associated with using wind as a renewable resource?

Resources

- [Walking With the Seasons in Kakadu](#) by Diane Lucas
- Images or videos depicting wind patterns
- Reeds (or similar firm leaves or cardboard)
- Scissors, hot glue

Vocabulary

- Wind power
- Harness
- Capture
- Renewable resources
- Weather patterns
- Watercraft
- Seasons
- Animal migration
- Headwind
- Tailwind
- Power generation
- Propeller
- Papanus toy
- LED
- Anemometer



YEAR 5 – 6 | WIND POWER

STEP 1: EXPLORE – LEARN

Guiding Question: How is wind important to living things? What do we use wind to do? How does wind generate energy? How can we harness this?

Engage students in a discussion about the influence of wind on weather patterns and its impact on daily life.

- Ask students if they can think of any connections between wind and weather changes.
- Explain to the students that wind is a renewable resource, which means it can be harvested for power without it all being used up – the wind will keep blowing! Discuss briefly what ‘renewable’ means and provide examples of other renewable resources (water, solar etc.) If available, refer to pages 18-19 of [Australian Geographic DeadlyScience Book 8: Renewable Resources](#).
- Introduce First Nations perspective of wind by explaining its significance in predicting seasonal change, animal migration, plant cycles and cloud formations.
- Read [Walking With the Seasons in Kakadu](#) by Diane Lucas, which explores an Indigenous perspective of the changing seasons in Kakadu National Park in the Northern Territory. It explains how Aboriginal and Torres Strait Islander people observe and interact with their environment throughout the year, and provides insights into the deep connection between First Nations culture, Country, and cyclical weather patterns.



TEACHER NOTES

Here is a [resource from Worimi Country](#), which explores seasons, animals, months, wind and air temperature.

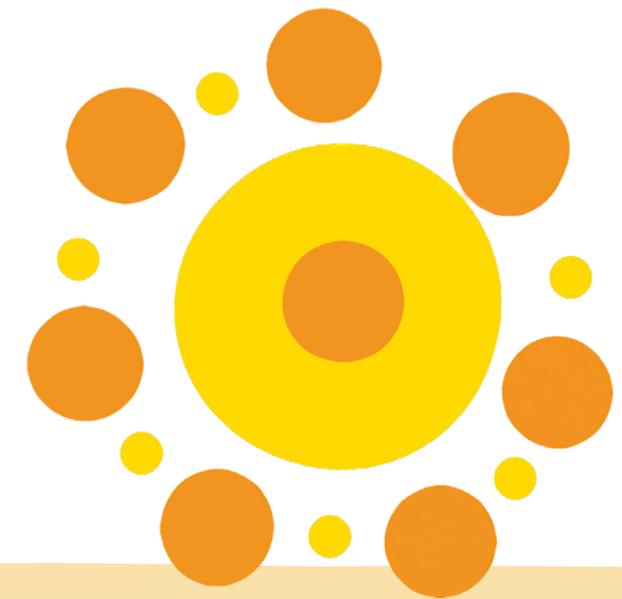


STEP 2: ANALYSE - THINK

- Share images or videos that depict wind patterns and ask students to observe and describe the characteristics of wind in different weather conditions.
- From a light breeze to a hurricane, ask students to consider how wind is formed and what influences it. Many First Nations people have sacred stories about [wind dreaming](#) and ceremonies to celebrate and honour wind.

Guiding Question: How did First Nations people harness the power of the wind? What can we learn from the way First Nations people used the wind?

- Discuss different ways in which wind influenced the daily lives of Aboriginal and Torres Strait Islander people. First Nations people harnessed the power of the wind in many ways. They used the wind to move across bodies of water in watercraft, they used wind to their advantage when hunting and they ‘read’ the wind for seasonal changes that determine changes on Country.
- Encourage students to consider different seasonal changes that they see each year and compare these results with weather patterns linked to Indigenous seasonal change.
- Today, wind speed is measured by an anemometer but First Nations people were able to ‘read’ the wind. The famous Indigenous inventor [David Unaipon \(1872-1967\)](#) is well known for his engineering designs. He knew so much about wind he adapted the design of the boomerang to develop a propeller system shown in a pre-WWII drawing of a helicopter – 22 years before the first operational helicopter. That’s deadly!



DID YOU KNOW?

In the Kimberley in northern WA, the bark of the helicopter tree is used to make coolamons and shields (it’s also called a coolamon tree). The other deadly thing about this tree is that the seeds have wings! Shaped like helicopters, the seeds are designed to catch the wind as they fall away from the tree and fly away. This helps each seed move away from the parent tree so that it is not competing for food, water and sunlight.

STEP 3: CREATE - DO

Guiding Question: Thinking about the shapes of propellers and boomerangs, how can wind influence your propellers?

- Provide students with a pattern for a traditional [pandanus toy propeller](#).
- Provide students with paper and reeds (or similar) to experiment with creating propellers.

PREDICT – How far will the propeller toy travel? How fast will it get there?

OBSERVE – What happens in a tailwind opposed to a headwind? What happens when you change the length of the blades? What happens when you change the materials?

EXPLAIN

- Reveal that Aboriginal and Torres Strait Islander people used these toys to prepare children for adulthood, teaching them to throw the propellers as a boomerang would be thrown to hunt for food, and as a form of defence.
- Have students share their success and any challenges they faced.
- Changing the shape changes the properties, changing the materials changes the properties and therefore the result.

EXTEND

Prepare a larger-scale reed propeller in class. Students get to experiment with generating power from the wind generating device, using a fan to move the propeller which powers a small motor to light up an LED.

You will need:

- 1 small motor
- 1 LED
- 6 Paddle pop stick
- 1 large paper cup
- 1 small paper cup
- Scissors, hot glue

First, attach the LED to the terminals on the motor. Test it is working by spinning the shaft on the back of the motor by hand; the LED should flicker on. Then, glue two paddle-pop sticks together so that they make a cross, and drill a small hole in the centre of the crossed sticks that is the same size as the shaft of the motor.

To make the blades for the propeller, cut the smaller paper cup lengthwise in half, and then again into four, discarding the base of the cup. Hot glue each blade to the top edge of each stick to make a windmill structure. One edge of each propeller should be aligned to the edge of the stick. This slightly offset pattern should be followed for all four blades.

To make the base of the propeller, turn the larger paper cup upside down, and glue 2 sticks so that they stick up into the air from the base.

This is to hold the motor assembly above the cup and provide height to capture the wind.

Place the motor's shaft into the back of the fan; it should be a tight fit so that the blades spin independently of the motor. Place the motor (attached to the fan) between the two sticks that are attached to the upside-down cup, and angle it to ensure the blades do not touch the cup. Spin the fan assembly to make sure it is working. Once the motor is in the correct position, hot glue it to the sticks it is placed between.

Then, head outside on a windy day, or place a fan in front of the wind machine to source the energy to power the LED. If the LED is not working, it could be because it is attached the wrong way around. Simply detach the LED and reattach it the other way around. Use PREDICT, OBSERVE, EXPLAIN as you go.

Anemometers are used to measure wind speed. [This link will show you how to make an anemometer](#). You could colour one propeller a different colour to more easily measure wind speed.

EXTEND THE LEARNING

Winnowing

Sailing

Fire Control

- Explore existing and future wind farms in Australia, including a [remote Aboriginal community](#) in the Northern Territory where a 25m wind turbine now produces all the power; and the Gugu Badhun people in Queensland who are partners in a [giant wind farm](#) that will provide renewable energy to around 300,000 Australian homes.
- [Australia has the potential](#) to generate up to 5,000 gigawatts (GW) of electricity from offshore wind turbines, and its total wind energy capacity will quickly outstrip fossil fuel production.
- Find out which seasonal calendar is used for the Country at your location, using this [resource](#).

There are hundreds of words for wind in Aboriginal and Torres Strait Islander languages. You might like to investigate related words in the local language/s of your area.

In Australia, some remote communities are embracing the power of wind energy, including Gawa on the northern tip of Elcho Island in the Northern Territory where a 25-metre wind turbine now produces all the power they require and replaces costly diesel generators with green sustainable energy.

Aboriginal and Torres Strait Islander people have used the power of the wind to help them live sustainably on the land for thousands of years. They use the wind to hunt, to tell when the seasons are changing, and what this means, and to sail the seas and navigate waterways to fish, explore and manage Country.

First Nations people also used the wind to winnow seed, too. Gathered seeds were placed in a coolamon, then thrown lightly into the air allowing the wind to remove the lighter husk particles while the heavier seeds fall safely back into the coolamon. After this, the seeds are milled by hand, and cooked in earthen ovens or over hot coals into a bread-like food. The wind is still used by First Nations people as a tool for fire control, and it is an important factor in sustainable land-management practice. If you have time, explore [cultural burning practices](#) and understanding the wind to see how Aboriginal and Torres Strait Islander scientific knowledge is being used to protect Country today and into the future.

DID YOU KNOW?

- In the Kurna seasonal calendar, 'waitpi' means windy. This is a time when there are fish in the estuaries, when wattle gum is cut to make canoes and shelters, skins are made into cloaks for winter, and it's nearly time to move inland.
- The flowering of the boo'kerrikin (*Acacia decurrens*) is an indication for the D'harawal people, of an end to the cold, windy weather, and the beginning of the gentle spring rains.

Guiding Question:

Extend - How can we apply the knowledge of wind energy from First Nations culture to modern practices? What are some of the challenges or limitations associated with using wind as a renewable resource?

MORE

DEADLY SCIENCE

**TO EXPLORE THE POWER OF WIND FURTHER,
TRY ONE OF THESE DEADLY EXPERIMENTS AT HOME**

MAKE AN EMU CALLER

Like the didge, an emu caller uses wind and sound to 'call' a male emu away from its nest so that the eggs can be collected to be eaten. Did you know the male emu is the one who looks after the eggs?

Check out this video to make an emu caller
<https://www.youtube.com/watch?v=NPrPs-wTg5c>

MAKE A DIDGERIDOO

Making your own didge using a cardboard tube will help you understand how First Nations people harnessed the power of wind to make sound. Experiment with different lengths of tube to see what sounds it can make!

What other things could you make a 'didge' out of? How would this affect the sound? What else could affect the sound that comes out?

Watch this video to find out more
<https://www.youtube.com/watch?v=2IBZ6yPW9WU>

MAKE AN ANEMOMETER

First Nations people could 'read' the wind (and other weather) and know what to do next: to move somewhere warmer when the weather indicated it was going to get cold, for example. You can make your own wind speed machine (anemometer) to find out how fast the wind is blowing, and to recognise when it is changing. What could different wind speeds mean in your life?

This resource shows how to make an anemometer
<https://www.youtube.com/watch?v=DqeYuRKWpL8>

POWER YOUR OWN WATERCRAFT

First Nations boats vary across the country. In northern Australia, dug-out canoes are used to travel across open water. Carved from a single log, they are propelled by a square, pandanus sail. Can you find things to make your own wind-powered raft? You could use paddle-pop sticks glued into a raft shape, or plastic bottles, cut in half into a canoe shape. Then, find a mast, and something to capture the wind to make your vessel move. Test it out in the bath, using your breath to make the wind.

LINKS AND SOURCES

RESOURCES

[Australian Geographic DeadlyScience Book 8: Renewable Resources](#)

[Yarning circles](#)

[Brewarrina fish traps](#)

[Fishing the old way: Indigenous fish traps of Western Australia, Guardian Australia](#)

[How did Aboriginal peoples manage their water resources, Waterwise Queensland](#)

[Aboriginal and Torres Strait Islander Histories and Cultures, Australian Curriculum](#)

[Big Rain Coming by Katrina Germein](#)

[Solar Cooking by National Geographic](#)

[New Solar Tech, Metropolis Magazine](#)

[Traditional Aboriginal and Torres Strait Islander crafts, design and technologies,](#)

[Indigenous Knowledge Institute, University of Melbourne](#)

[Solstice and solar position observations in Australian Aboriginal and Torres Strait Islander traditions, Journal of Astronomical History and Heritage](#)

[Making Damper, Wingaru Kids](#)

[Walking With the Seasons in Kakadu by Diane Lucas](#)

[Aboriginal community gets wind power, ABC](#)

[New Indigenous partnership for Upper Burdekin Wind Farm](#)

[Australia poised to be a world leader in offshore wind, The Conversation](#)

[Indigenous seasonal calendars, CSIRO](#)

[Indigenous weather knowledge, Bureau of Meteorology](#)

[Changing weather: Understanding Australia through ancient Indigenous knowledge of seasons](#)

[A dance for the winds, Australian Geographic](#)

[Indigenous seasons, ABC, BTN](#)

[Pandanus toy propellers, Australian Museum](#)



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