Australia's National
Science Agency

Green CREST Award

Science: Indigenous Research Methodology – Groundwater

Created in collaboration with the Narran Lakes Aboriginal Joint Management Committee and CSIRO's Drought Resilience Research.

Image: Grawin Creek, May 2025

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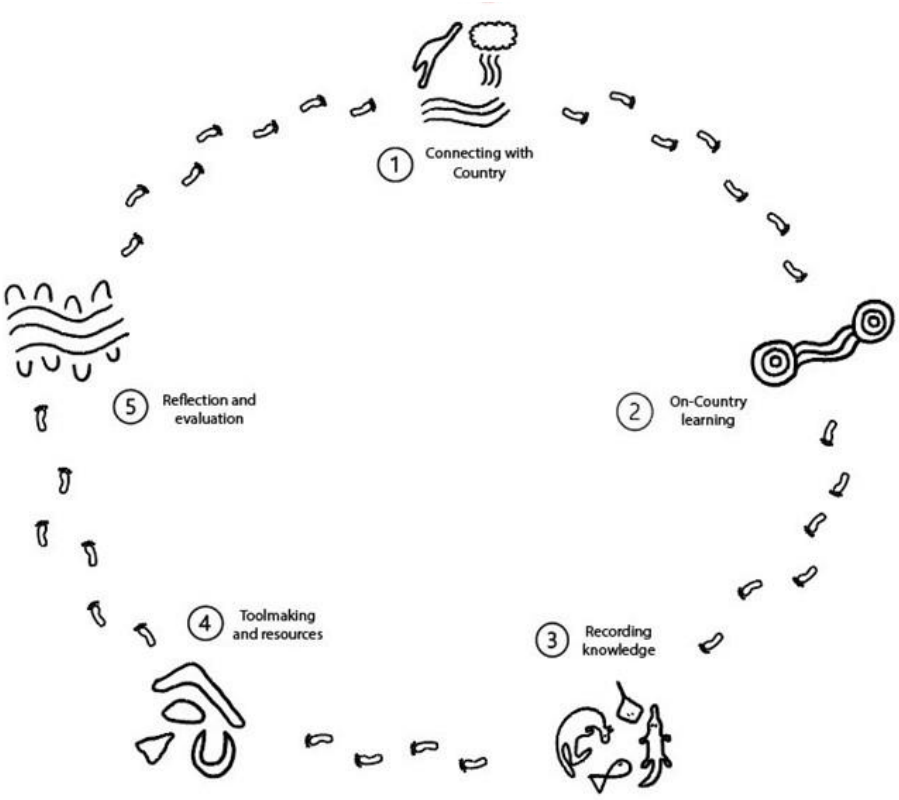
Science: Indigenous Research Methodology – Groundwater

Background information: Indigenous Research Methodology



Indigenous Research Methodology[1]

CSIRO researchers and Indigenous Scholars are looking at how to decrease the effects of drought in Australia as they become more frequent and more severe. A key part of this research project is recognising Aboriginal and Torres Strait Islander People's deep understanding of Country to collaboratively collect and share Indigenous knowledges in a way that both respects Indigenous Cultural Intellectual Property and is recognised by the western scientific community. CSIRO researchers and a Kamilaroi Scholar have worked closely with the Narran Lakes Joint Management Committee to apply an Indigenous Research Methodology (IRM) that captures their understanding of drought resilience.

[1] Fabila M, Moggridge B, Braedon P, Akeroyd M, Connolly M, Court Z, Gilbey S (2025). Indigenous research methodology for drought resilience, CSIRO, Australia.

The IRM is based on Moggridge et al. (2022)[2]. In this activity, it will scaffold an investigation exploring how ground cover affects how much rainwater can reach underground water supplies, embedded in Indigenous ways of knowing, being and doing. Students will consider their perspectives and positionality with reference to science, and conduct an investigation based around Indigenous Australian's deep connection to and understanding of Country.

"Country encompasses land, waterways, seas and skies, as well as the energy and space in between. It also encompasses relationships. Relationships with plants, relationships with animals and relationships with Ancestors (to name a few)."[3]

Aboriginal and Torres Strait Islander (Indigenous) People's cultures are diverse, with more than 250 language groups, however, one commonality is connection to Country, seeing people as part of Country and enduring cultural practices of observing and understanding Country. "Indigenous Peoples have been observing Country since time immemorial. They comprehensively understand all elements of Country, including Land, Water and sky Country."

Consider your own connection to and perspective of Country, and how your culture has influenced how you see the world around you.

"We don't own the land, we all belong to the land, it is part of us as much of us being part of it. In a family setting, it's like mother with her child, she will nurture its growth by being responsible for providing the care and this will continue on generation after generation. It's a cycle of respect, look after one another, look after our trees and waterways, our animals, we all have a place in this, we all have a responsibility with our mother, as she will always look after us and in return, we look after our mother. Take what you need, not what you want, as greed is a form of selfishness, you take, you give back, it's that simple!"

- Rhonda Ashby, Yuwaalaraay and Gamillaraay

Background Information: Groundwater

Safety note: Peat moss can irritate airways. Keep it moist and wear gloves, safety glasses and masks. Wash hands after use. Scissor use - cut trays carefully.

Aboriginal and Torres Strait Islander People's deep knowledge of groundwater and ecosystem resilience complements the western scientific research currently being undertaken by CSIRO to improve Australia's resilience to drought. Keeping water on Country, hydrating the earth and recharging the water table are essential elements of ecosystem resilience to extreme weather events. The Great Artesian basin, which spans 1.7 million square kilometers across the Northern

[2] Moggridge, BJ, Thompson, RM, & Radoll, P (2022) 'Indigenous research methodologies in water management: learning from Australia and New Zealand for application on Kamilaroi country,' Wetlands Ecology and Management, 30(4): 853–868, doi: 10.1007/s11273-022-09866-4

[3] Common Ground First Nations (n.d.) What Is Country? | Common Ground [website], accessed 5 June 2025.

Territory, Queensland, New South Wales and South Australia is one of the world's largest underground water sources. Water emerges through cracks to create spring, creeks and rivers and maintains permanent water sources.

The Yuwaalaraay People of Dharriwaa (Narran Lakes) have a deep understanding of the Gali Gurunha, the underground water sources and springs that make up part of the Great Artesian Basin and we can hear that knowledge in Dreaming Stories (see Appendix 1). Today, we know that in this part of the world the Great Artesian Basin ranges from 500 to 1000 metres below the surface and bores have been drilled to access the ancient water source. Yet through Yuwaalaraay Dreaming, it was Garriya the crocodile who took water underground from the surface and brought it up again to create springs and soaks.

The Yuwaalaraay people's understandings of Country are helping inform CSIRO's Drought Resilience Research, and they have been instrumental in collaboratively applying an Indigenous Research Methodology (IRM) to describe cultural indicators of drought. The methodology is grounded in deep reciprocal relationships, honours Aboriginal and Torres Strait Islander Peoples' extensive knowledge of Country, and recognises that scientific knowledge can be stored in numerous ways, including stories and memories and can be shared through yarning, storytelling and observing Country.

In this inquiry, you will use the IRM based on Moggridge et al. (2022)[2] to investigate how plant life impacts the way water is held on Country and consider the value and importance of an ecosystem rich in plant life that includes plant's role in mitigating the effects of drought by slowing the flow of water and keeping water on Country.

Coocoron Lake, a field of native grasses, February 2024

Coocoron Lake, bare and dry, May 2025

Activity guide

Connecting with Country

- Acknowledgement of Country – find out Traditional Owner and Language groups of the Country you are living and learning on
- Class Discussion – What does 'Country' mean to Aboriginal and Torres Strait Islander Peoples?
  - Record key words, e.g. land, water, sky, spirit, family, language, care, belonging.
  - See Appendix 2 for activity ideas and links
- Discuss Dreaming Stories students have heard/know of – consider what they tell us about Country.
  - Read the Gali Gurunha and Narran Lake Creation Dreaming Story (Appendix 1) – what can that tell us about the groundwater at Dharriwaa (Narran Lakes)?
- Direct conversation to the Country you are on:
  - Share stories of major storm/drought events where water has shaped or changed the land.
  - What do you know about groundwater?
  - What do you know about bores, wells or springs?
  - Discuss groundwater as seen in media.

On-Country learning

In this activity, students will test how ground cover influences the way water moves through or is held in the environment. They will conduct an investigation comparing the way water erodes and runs off soil, or seeps into groundwater stores in samples that are bare, covered with leaf litter/pebbles and planted with grass.

Consider completing this experiment outside to minimize cleanup.

Recording Knowledge

Students collect knowledge in the forms of taking notes, collecting data in a table, taking photographs, video or sketches, learning Indigenous Languages.

Toolmaking and resources

Students can create a photo story/video of experiment.

Reflection and evaluation

Students reflect on their inquiry and make recommendations on how water can be slowed down and encouraged into groundwater stores. They recommend changes or next steps.

- How did the ground cover change the way the water moved through the soil samples?
- How can knowing how water works with soil and plants help us understand and manage Country?
- What other values do plants bring to an ecosystem?

Equipment (per student/group)

- Safety gear: mask, safety glasses, gloves.
- 2 Plastic or aluminium trays
  - 16cm x 22cm x 5cm aluminium BBQ trays were used in this test
  - Aluminium trays were easiest and safest to cut and pierce
- Scissors
- Peat moss
- Propagating sand
- Watering can
- Grass seed
- Greenhouse/large clear container to act as greenhouse
- Pre-prepared grass trays (as per Preparation)
- Pebbles/leaf litter
- Large tray
- Measuring cup/cylinder
- 1L Beaker or medium sized container

Preparation: Propagate and grow the grass samples to 3-5 cm

This can take 2 – 4 weeks depending on weather conditions. Consider using turf for the planted sample if there is not sufficient time to propagate the wheat grass. Keep in mind when doing this that the soil will not be the same.

Equipment (per student/group)

- 1 Plastic or aluminium trays
- Scissors
- Peat moss
- Propagating sand
- Watering can
- Grass seed
- Greenhouse/large clear container to act as greenhouse

1. Provide one tray per group.
2. Prepare each tray:
    a. Cut a hole (approx. half the length and quarter of the height) in the short side of the tray, near the top edge. This will allow excess water to run off.
    b. Puncture three holes in the centre of the tray's base. These will simulate groundwater collection points.
3. Mix equal amounts of peat moss and propagating sand.
4. Moisten the peat moss and sand mixture.
5. Fill each tray with the mixture to just below the bottom edge of the cut-out hole.
6. Sprinkle a thick, even layer of grass seed across the surface of the peat moss.
7. Cover the seeds with a thin layer of moistened peat moss.
8. Lightly water the tray to settle the layers.
9. Place trays in a sunny, sheltered location and keep the soil damp. A green house (or large, clear container) will provide a more stable growing environment.
10. Allow grass to grow until it reaches a height of 3–5 cm.
11. Remove the greenhouse covering and allow samples to dry for 3 days prior to investigation.

Investigation

Three trays ready for testing: Tray 1 (left) peat moss and sand mix, Tray 2 (middle) peat moss and sand mix covered with leaf litter, Tray 3 (right) peat moss and sand mix with living wheatgrass.

Equipment (per student/group)

- Safety equipment: safety glasses, mask and gloves
- 2 Plastic or aluminium trays
- Scissors
- Peat moss – moistened to reduce dust
- Propagating sand
- Pre-prepared grass trays (as per Preparation)
- Leaf litter
- Large tray
- Measuring cup/cylinder
- Watering can
- Container/beaker (approx 1L capacity)

12.Collect all your equipment.

13. Prepare two plastic or aluminium trays:

    c. Cut a small hole (approx. half the length and quarter of the height) near the top edge on one short side of each tray. This lets extra water, “runoff” drain out.

    d. Poke 3 small holes in the middle of the tray’s base. These will collect “groundwater.”

14. Mix equal amounts of peat moss and propagating sand.

15. Fill each tray with the mixture to just below the bottom edge of the cut-out hole.

16. Set up your test trays:

    e. Tray 1: Uncovered peat moss.

    f. Tray 2: Peat moss covered with a layer of leaf litter.

g. Tray 3: pre-prepared grass tray.

17. Place a beaker inside the large tray.

18. Stand Tray 1 on top of the container/beaker. Make sure the holes in the bottom line up so water can drip into the beaker, and the side hole lets runoff flow into the large tray.

19. Fill the watering can with 500mL water.

20. Slowly pour the water over Tray 1 (uncovered peatmoss/sand mixture) and watch what happens, record your observations.

21. Measure how much water ends up in the beaker (groundwater) and in the large tray (runoff).

22. Repeat steps 5 – 9 for Tray 2 (leaf litter) and then for Tray 3 (pre-grown grass).

Prepared aluminium tray with three puncture holes in the base to allow groundwater to pass through, and a narrow hole along the short side for runoff to flow.

Test Tray 1 set up for testing, with ground water collecting in the smaller container and runoff flowing into the larger, surrounding container.

Additional Resources

- Groundwater | Ngarrngga
- AIS: Safe handling and use of potting mix - Australian Science Teachers Association
- Great Artesian Basin - DCCEEW
- Great Artesian Basin | Geoscience Australia
- Bedtime Stories | Common Ground

Videos

Dharriwaa Living with Climate Change videos

- Part 1 - Dharriwaa Living with Climate Change
- Part 2 - Dharriwaa Living with Climate Change
- Part 3 - Dharriwaa Living with Climate Change

CSIRO Science Links

- Indigenous Research Methodology for drought resilience - CSIRO
- Sharing knowledge of drought resilience on Country - CSIRO
- Cultural indicators for drought resilience - CSIRO

Teacher Professional Learning

- 8 Aboriginal Ways of Learning
- Narragunnawali - Caring for Country
- Professional Development for Educators | Ngarrngga | Ngarrngga
- Narragunnawali - A Matter of Perspective

Risk Assessment

- A risk assessment has been provided for this activity; however it is recommended to hold a class discussion regarding the possible risks and mitigation strategies prior to starting the activity.
- Appropriate PPE should be worn during this activity.
- Caution students should be supervised while collecting data outside and while conducting interviews.

Activity	Inherent risk	Elimination or control measures
Exposure to potting media	Infection or illness	• Moisten potting media before use to minimize dust. • Wear safety glasses, gloves and mask while handling potting media. • Wash hands after handling potting media. • Use lower risk media as suggested –peat moss.
Cutting plastic or aluminium trays	Injury from using scissors	• Teacher to complete beforehand if deemed unsafe. • Supervise scissor use.
Using trays with cut edges	Cuts from sharp edges	• Discuss safe handling of trays before use. • Minimise handling of cut edges.

Appendix 1: Connection to and observation of Country – Activities

Dreaming Story: Gali Gurunha and Narran Lake Creation

There is a massive songline that goes across this Country that connects us, not just to Narran Lake, but all across the landscape. And that is about having water within. There are sandhills, soaks, and gravel-bed springs that are in the landscape, which come from groundwater. In our language that's what Gali Gurunha means. Gali means water, Guru means hole, and the suffix at the end means in. Altogether, it means water in those holes. The little gilgaays (small, shallow waterholes) hold plenty of water. And when there's green grass in certain places, you know there's a water spring. We know that water on the surface, at some point, soaks into the ground, which returns to these holes to provide water for us. The combination of groundwater and surface water is all connected, and it is part of the Gali Gurunha story. These pathways are dotted all throughout the landscape. The [Gali Gurunha] story is about the serpent, or the crocodile in Yuwaalaraay language called Garriya, who took the water from the surface, and has to give it back. So he goes across the landscape and pops out in different places, including the rivers, the soaks and the beautiful springs. He can travel that way because he is mythical and magical… he can change shape. Gali Gurunha was called upon too, in drought time or whenever it was needed for that water to surface.

The Narran Lake creation story begins at one of the Gali Gurunha springs, where Garriya seized Baayami's wives. He [Garriya] kept shaking all the water down while he was tracked. As he took all the water from the waterholes, he created the riverbeds of the Narran River while on his path toward the main Narran Lake. And that's when the big flood happened, when they cut Gurriya open to get Baayami's wives back. The Narran River is a windy river, and in those bends of the river, that's where the deep waterholes are located. And when those waterholes in our rivers start drying up, we know we're in trouble. And that's why those waterholes are very special. Part of the ceremony is that you have to name the waterholes.

- Narran Lake Aboriginal Joint Management Committee

Observe Country

Sit or lie down in an open area and close your eyes. What do you notice? Smells, sounds, light? Create art upon 'waking'.

Make a soundscape, sit in silence with a book/sheet of paper. Position yourself in the centre of the paper and sketch/note the natural sounds you hear, positioning them on the page in the same relative position. If weather does not permit, consider a recording e.g. Sounds of Narran: waterbirds calling at Narran Lakes (Dharriwaa) on the Lower Balonne floodplain - Flow-MER

Choose a feature of the ecosystem to draw – a tree, animal, rock formation. Make rubbings of rough bark, leaves or rock-faces.

Go on a traces hunt. Some animals are hard to find, but you can see their traces – look for scratches in the dirt, chew marks in leaves or gumnuts or scat. Try to work out which animals left them.

Consider

"I grew up around the Walgett district with five brothers and four sisters, we spent a lot of time around the Namoi River with family and friends. I remember the river water being clear and you were able to see the bottom where we used to dive for mussels, fished, played water games and bathed. We collected snotty gobbles and gum sap off the trees nearby. Being on the riverbank was also a form of meditation, listening to the bird life, hearing the water flow and the smell of eucalyptus and gum trees. Rivers and lakes like the Narran provided life for the natural environment and its habitat, most importantly, the wellbeing of the people."

- Rhonda Ashby, Yuwaalaraay and Gamillaraay

- What non-living things did Rhonda pay attention to?
- What living things did she notice?
- What things did she know how to use?
- Consider the Country you grew up on – what did you notice? Are there similarities/differences?

Watch:

Dharriwaa Narran Lakes Living with Climate Change

- What did you notice about how Jason, Allan and Brenda spoke about Country?
- What plants/animals did you notice in the video?

Through Our Eyes - Native Foods At Narran Lake with Brenda McBride (Dharriwaa)

- What living things does Brenda notice?
- Do you see Country the same way as Brenda? What is similar or different to the way you look at Country?

Link:

What Is Country? | Common Ground

Discuss:

Class/small group discussion e.g. Think-Pair-Share

- What do you know about Country?

Are there any indicators of Country that tell you changes are coming – e.g. when season change, leaves fall from trees, the smell before rain, when magpies swoop.