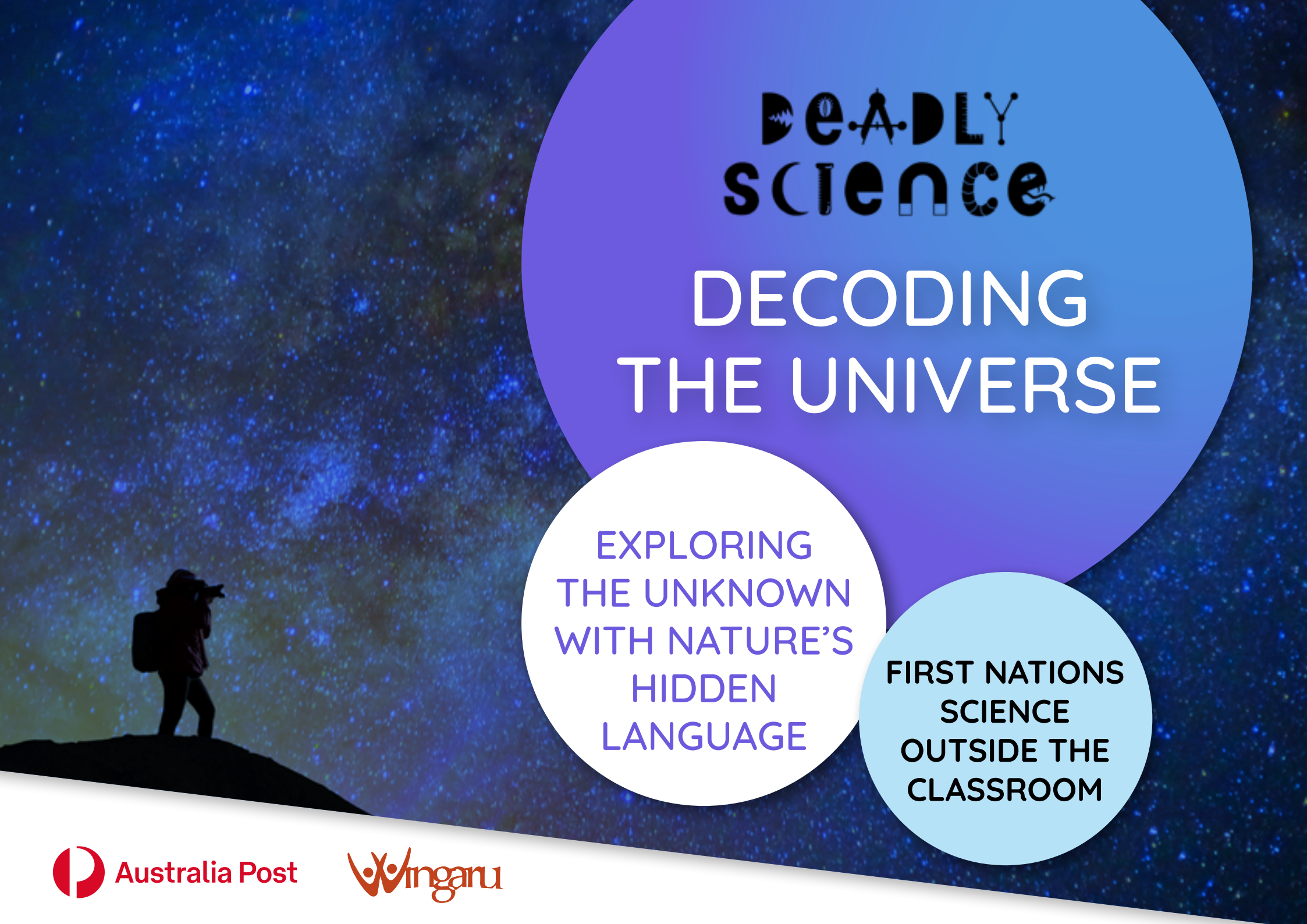

DEADLY SCIENCE

DECODING THE UNIVERSE

EXPLORING THE UNKNOWN WITH NATURE'S HIDDEN LANGUAGE

FIRST NATIONS SCIENCE OUTSIDE THE CLASSROOM

Australia Post

Wingaru

MORE DEADLY SCIENCE

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DEADLY SCIENCE

PATTERNS IN NATURE

FINDING PATTERNS IN THE NATURAL WORLD

There are so many patterns in nature! From animal tracks and insect markings to repeating patterns in plants, constellations in the sky and more! And these patterns can tell us lots about the Country we are on. Head outside and see what patterns you can see!

Here are some helpful questions to keep in mind:

- Check out where the ants are moving: is there a pattern there?
- Are there any snails around? Can you see where they have been?
- Can you see any feathers?
- Where do birds and animals drink?
- What is happening with the weather?
- Where is it sunny/shady?
- Is there any wind? What direction is it coming from?
- Where is there water? How can you tell?

ACTIVITIES

Materials

- Paper
- Coloured textas/pencils/crayons
- Camera or device to take photos (optional)

HAVE A YARN:

How might patterns be interpreted by First Nations Australians to find water, food and shelter?

What patterns share information about weather or changing seasons?

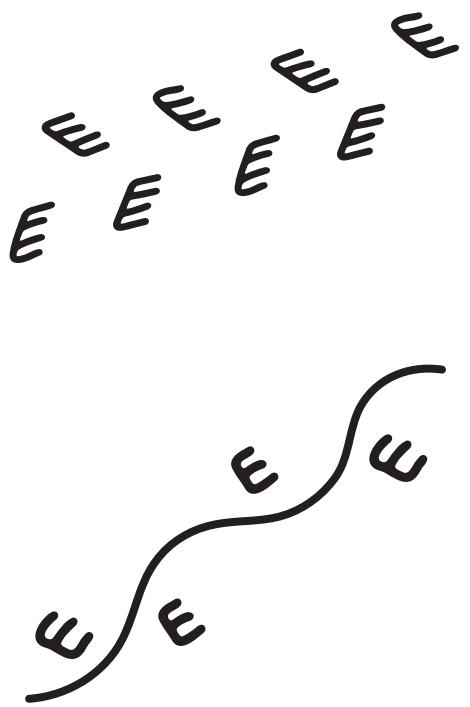
Why would knowing where an animal drinks everyday be useful information?

What can patterns tell us about migration and seasonal change?

DID YOU KNOW?

Aboriginal and Torres Strait Islander people can 'read' animal tracks like a book! They can understand subtle marks made by hundreds of different species, from which they can tell the animal's age, size and even gender. Plus, they can use track patterns to predict the animal's behaviour, or pathways that show which way they are moving. They can even tell how long ago the animal was there, which is deadly information if you are hunting something to eat!

That's Deadly!



MORE

PATTERNS IN NATURE

EXPLORE | PATTERN SCAVENGER HUNT

Head outside to the bush, the beach, a local park, or your backyard and find as many of these materials as you can!

- A feather with stripes
- A leaf with dots
- Animal tracks or trails
- Imprint left by a fallen leaf/branch
- A pattern created by shadows
- A flower with patterns
- Bark with ridges
- An insect with body markings
- Patterns made by the weather
- A spider web – not with a spider in it!
- A shell, if you are near the beach

EXPLORE | COLLECT

Collect leaves, sticks, bark, rocks, flowers, shells (if empty) and seed pods, and look for repeating patterns, spirals and symmetry. Make an artwork using the materials you have collected. Try not to collect any living creatures. Let them live where you spot them. Maybe you can take some photos of patterns if you want to leave something where it belongs?

DIG DEEPER | PATTERNS IN NATURE

Explore the patterns found in nature and draw the patterns you've observed, such as spirals in shells, lines on leaves, or repeating animal markings. Make a map of where you discovered each pattern – was it in the garden, a nearby park, or while out on Country? Think about how these patterns might be used by First Nations people. How do these patterns help people or animals navigate their environment? Record what you find and reflect on how recognising these patterns could help you better understand nature.

MORE

PATTERNS IN NATURE

CHALLENGE YOURSELF | NATURE'S SYMMETRY SCAVENGER HUNT

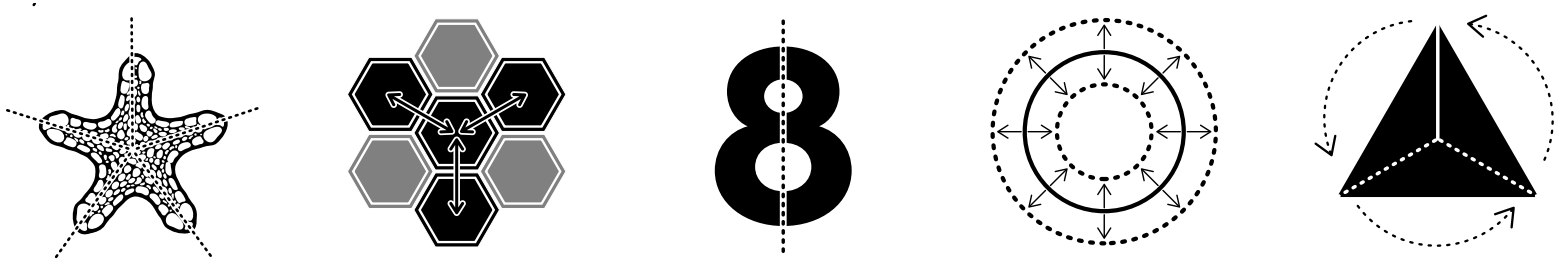
Symmetry relates to the correspondence of size, form and arrangement of parts on opposite sides of a plane, line or point, and the regularity of form or arrangement when referring to corresponding parts. A starfish has radial symmetry; a beehive hexagon has translational symmetry, as in it can be moved sideways without changing its shape; the number 8 has mirror symmetry; a circle has scale symmetry [it doesn't change its shape when expanded or contracted]; and an equilateral triangle has rotational symmetry – it can be rotated around a fixed point and still look the same.

Head outside and find an example of each form of symmetry displayed in nature (if you can!)

- Radial Symmetry
- Translational Symmetry
- Mirror Symmetry
- Scale Symmetry
- Rotational Symmetry

RESOURCES

Djanbun writer Bronwyn Bancroft's *Patterns of Australia* and *Shapes of Australia*.



Radial Symmetry | Translational Symmetry | Mirror Symmetry | Scale Symmetry | Rotational Symmetry

MORE DEADLY SCIENCE

COUNTING + GROUPING

Aboriginal and Torres Strait Islander people have sophisticated mathematical understanding, all devised and passed down over millennia without the use of pens and paper. Body tallying, for example, is one of the oldest calculation systems, a clever and effective way of counting and communicating numbers using the human body. You can literally do a sum using your body! That's deadly!

EXPLORE | COUNTING WITH YOUR BODY!

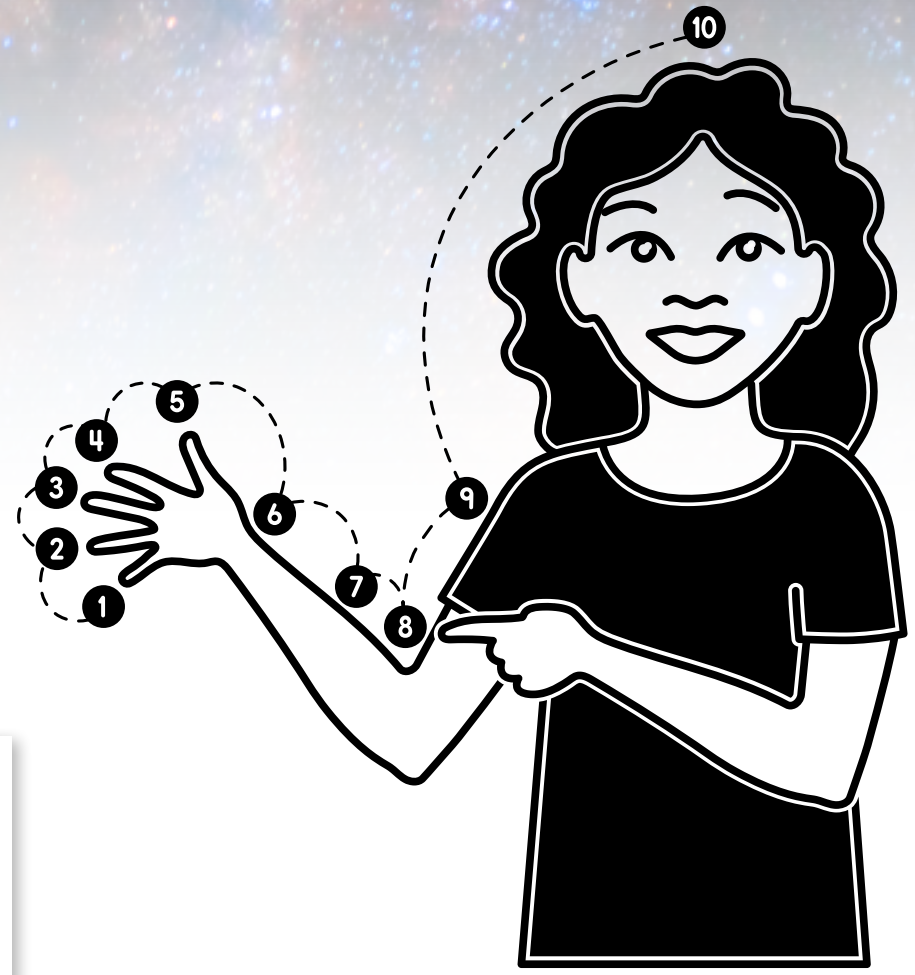
Discover how First Nations people counted without using the numbers that we read and write with at school!

Materials

- Open space to move around
- Collection of small materials from the natural environment: shells, stones, leaves, gumnuts

Mobs in Australia and the Torres Strait used lots of different body tallying practices, each specific to their own community. So, we've created a sample body tallying map to help with this activity:

Little finger	1
Ring finger	2
Middle finger	3
Index finger	4
Thumb	5
Wrist	6
Forearm	7
Elbow	8
Shoulder	9
Head	10



Practice counting up to 10 using your body. Spread out your natural items in different-sized piles around the space. Count each pile using your body tallying method. Can someone else guess how many by watching you point to the part of your body?

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DIG DEEPER | GROUP IT, COUNT IT!

Use what you learned in the Explore activity to take your counting further!

Now that you've practised body tallying, it's time to think about how grouping can help make counting easier and faster.

Using the same natural items from the Explore activity, start by grouping your items before you count. Try different group sizes and see what works best. For example:

- Group items into 2s
- Group items into 5s (like the fingers on one hand)
- Group items into 10s (like both hands or both feet)

For each pile of grouped items, use your body tallying method to show how many items there are in total. Think about which group sizes helped you count more quickly or more accurately.

CHALLENGE YOURSELF | DEVELOP YOUR OWN BODY TALLYING SYSTEM

Take your body tallying skills further by developing a system to count beyond 10 and up to 100 using your body. Start with the fingers and body parts you've learned in the previous activity, and think about how you can extend the tallying system to reach higher numbers. For example, you could use your legs, knees, or feet to represent numbers beyond 10.

Once you've created your system, use it to count objects in your environment – like stones, leaves, or other natural items. Share your tallying system with someone else and challenge them to use it too. How does this system help with counting in a more physical, hands-on way?

DID YOU KNOW?

Many First Nations people used different counting systems depending on their Country. Some used notches on sticks, others used string, sand or body parts. These systems helped keep track of important things like trade, time, ceremonies, and even how many fish were caught!

That's Deadly!

HAVE A YARN:

How could counting with your body be helpful if you didn't have paper or pens?

What other ways do you think First Nations people counted or kept track of things?

How might body tallying change depending on where a person lives?

MORE DEADLY SCIENCE

SYMMETRY

First Nations people have used hand-carved tools for millennia, for all sorts of things, from hunting and digging for food, to weapons, ceremonial practices, as toys, and even as friction poles to light fires!

Woomera are spear-throwing devices that work by extending the thrower's arm to generate powerful accuracy and range. Woomera are effective thanks to their bilateral symmetry, which gives the tool a balanced weight distribution, stable trajectory, and optimal force transfer from the thrower to the spear, something Aboriginal people understood long before formal equations existed.

Concepts such as proportion, balance points and leverage were also part of First Nations knowledge and the merging of practical function with mathematical precision. That's deadly!

HAVE A YARN:

Why would symmetry be important in making tools like spears or woomeras?

What would happen if the tool was uneven or unbalanced?

What other tools or objects in nature or made from natural materials can you think of that use symmetry to help them work well?

EXPLORE | SYMMETRY IN NATURE

Take a walk through your backyard or local park and observe natural objects that show symmetry, like leaves, flowers, or animals. Draw a few examples and think about how symmetry may help these living things function, such as helping leaves capture sunlight or enabling animals to move efficiently. Compare these natural examples to tools like the woomera and consider how symmetry in design helps balance and effectiveness.

DIG DEEPER | SYMMETRY IN TRADITIONAL TOOLS

Research and draw a variety of First Nations tools that rely on symmetry, such as the woomera, boomerang, or digging sticks. For each tool, identify and draw the line of symmetry, showing how the tool is balanced. Reflect on how symmetry contributes to the tool's function, such as improving the throw of a boomerang or making a digging stick more efficient.

MORE

CHALLENGE YOURSELF | MAKING A SPEAR THROWER

First up, check out how a woomera works by watching the link below, or any of the links at the end of the activity. Then, team up with an adult and give it a go yourself, testing to see the difference between throwing a 'spear' by hand and throwing a 'spear' using a woomera. Can you design and create your own version of a spear thrower using natural or recycled materials?

Materials

- Long, flat pieces of wood, Sturdy cardboard, foam board, or balsa wood (30-40 cm × 5-7 cm wide)
- Craft knife or scissors (with adult supervision)
- Sandpaper
- String or twine
- Playdough (or tape) for handle grip
- Pencils and paper for design planning
- Measuring tools (ruler, protractor)
- Materials for decoration (charcoal, textas etc.)
- Reference images of woomeras
- 'Spears' made from pool noodles or foam

Design

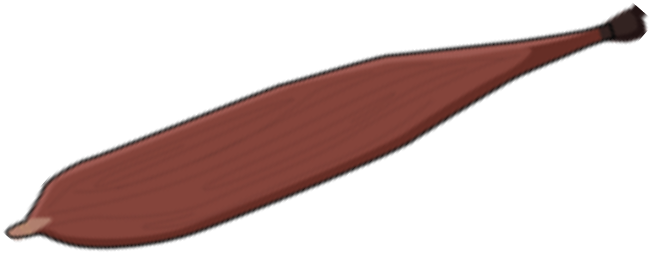
Research woomera from different First Nations groups all over Australia.
How do they differ?
Do the core principles remain the same?

Watch this video about Aboriginal spear throwing: Aboriginal Spear Throwing

Think about how symmetry affects aerodynamics and the trajectory of the spear, the distribution of force, and how accurate the throw will be.

Sketch up a design for your woomera paying special attention to:

- Bilateral symmetry along the length of the tool
- The balance point
- How the handle will feel
- How the hook will work



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Build

Draw a centre line down the material you will be using to make your woomera and mark key measurement points – they have to be symmetrical! Use a protractor to ensure angles match on both sides

Carefully cut out the basic shape and, if using wood, sand the edges. Create a notch or hook at one end for the spear to lock into, and form the handle using playdough or something similar, like layers of tape, perhaps.

Test

- Test the balance by finding the centre point where the woomera balances horizontally.
- Test the rotation by spinning the woomera to see if it spins evenly or wobbles.
- Test the mirror symmetry by folding a piece of paper along the centreline, and tracing half of the woomera. When you unfold the paper, does the outline you have drawn match the other side of the tool?

Using a pool noodle or some foam, create soft-tipped 'spears' and set up targets in an open area. Then, give it a go!

Can you see how symmetry affects how accurately and far you can throw? If you have used cardboard, do you think wood would work better? Which types of wood would perform best?

LINKS

The science of the woomera

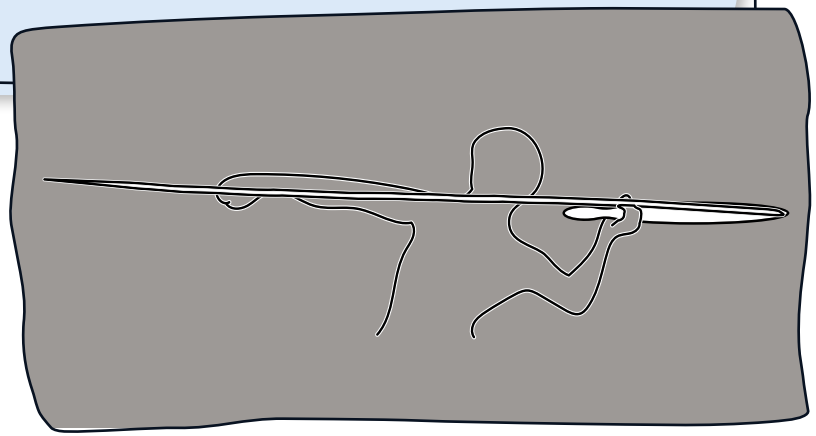
The woomera

Is this the best spear fisherman in the world? | Fishing in the Wild Ep 2

Making a womera | Australian Survival Instructors

DID YOU KNOW?

A woomera is an example of a simple machine called a lever. A lever changes the force on an object, and in this case, it allows a spear to be thrown with more force than by hand. Aboriginal and Torres Strait Islander people designed and perfected these tools over thousands of years, using deep understanding of materials, science, and the environment.



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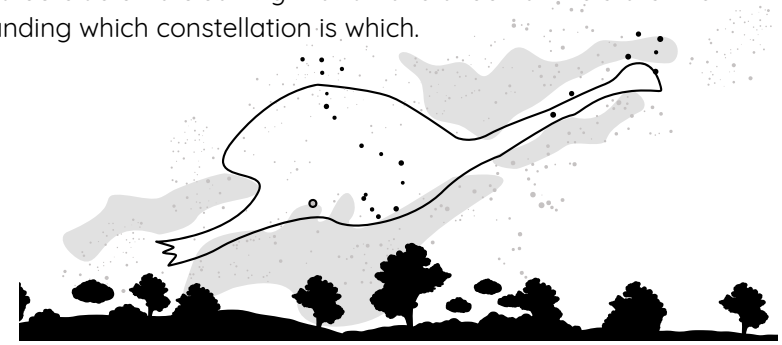
SKY NAVIGATION

READ THE STARS!

Aboriginal and Torres Strait Islander people could read the patterns and symmetry in the stars, and they used this information to help them navigate across Country and at sea, to understand time, and to track the seasons. Head outside on a clear night and have a look at the stars: the Stellarium app is great for understanding which constellation is which.

Materials

- Black or dark blue construction paper
- White pencil, chalk, or silver/white marker
- Cardboard
- String
- Scissors
- Ruler
- Small pebbles or shells
- Optional: star charts or pictures of Southern Cross and other key constellations
- Stellarium app



EXPLORE | STAR PATTERN RECOGNITION

Using dark paper, draw some of the key constellations in the skies above us, particularly the Southern Cross, and take note of the symmetry between the stars. Look at how they are spaced and how they relate to each other. You could also explore the Emu in the Sky and notice how its shape changes with the seasons.

HAVE A YARN:

Why would knowing how to read the stars be helpful when travelling?

What stories have you heard about the stars?

How do you think the stars helped people find their way on Country?

Why might the stars tell us about different seasons?

Do stars stay in the same place all night/every night?

DID YOU KNOW?

The Emu in the Sky is a famous Aboriginal constellation — but it's not made from stars. It's made from the dark spaces in the Milky Way! Aboriginal people read the shadows and gaps between the stars, not just the stars themselves. The Emu stretches from the Southern Cross all the way across the sky, and its shape changes with the seasons. For many mobs, when the Emu appears to be standing upright, it is the right time to collect emu eggs. When it's stretched out flat, the eggs have already hatched, so it's time to stop. This isn't just a story – it's a star calendar that shares important information about the right time to gather food and what's happening on Country.

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DIG DEEPER | STAR PATH MAPPING

Using the Stellarium app or star charts, create a map that tracks the movement of key constellations across the sky over a week or month. Focus on how the positions of the stars change from night to night. Think about how Aboriginal and Torres Strait Islander people might have used these movements to understand time, seasons, and directions. Mark the positions of the Southern Cross, the Emu in the Sky, and any other constellations on your map, noting their changes and what that might tell you about.

CHALLENGE YOURSELF | MAKE A STAR COMPASS

Cut a circular piece of cardboard that is about 20cm in diameter and mark the cardinal directions: North, South, East, West. Using the Stellarium app to identify the Emu in the Sky, the Seven Sisters, the Canoe (in Orion), and the Southern Cross, add the key star constellations, using pebbles or shells to mark the most important stars. Take your compass outside in the early evening. Try to locate the Southern Cross or any other visible constellations, and try to work out how this could help you to travel in a certain direction. Think about how this might change through the night and in different seasons.

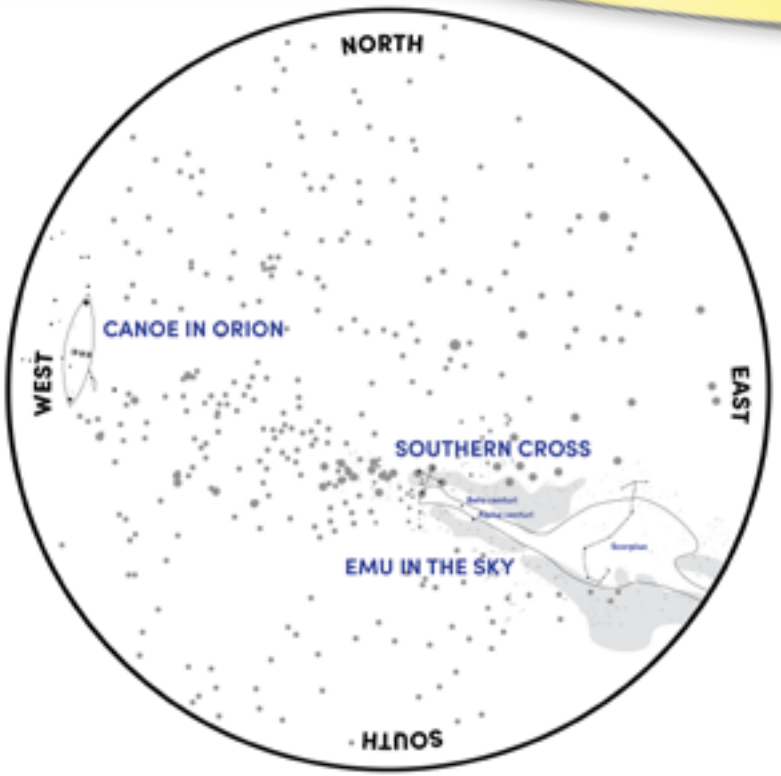
Using this example create a reference chart that shows when key constellations are visible in the evening sky, the changing orientation of the Southern Cross across the seasons, and the appearance of cultural star patterns like the Emu in the Sky. Include notes about how these star patterns tell us about seasonal changes, such as when bush foods are ready or when animals begin to migrate..

LINKS

Star Maps | Australian Indigenous Astronomy

Aboriginal Star Maps | BBC Sky at Night

Australian Geographic DeadlyScience Book 5: The Solar System



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EXPLORING RATIOS

SUSTAINABLE LIVING 'THE RULE OF THREE'

Most of us know that First Nations people are taught to respect and nurture Country from when they are very young, learning to maintain the land to ensure food and materials don't run out – for them, or for future generations. In order to achieve this, Aboriginal and Torres Strait Islander people understood that they could only 'take' [hunt, fish, harvest] what was needed, leaving behind enough of whatever the resource was to ensure it could continue to breed or grow, and that other animals had enough too. This is often referred to as the Rule of Three: you take a third, you leave a third for other predators, and a third to ensure that resource doesn't die out, vital for sustainability.

HAVE A YARN:

Why is it important not to use all of the resources available?

What ways can we be more sustainable in our daily lives?

How can we apply cultural knowledge like the Rule of Three to current environmental challenges?

DID YOU KNOW?

The Rule of Three is about understanding how everything in the environment is connected. First Nations people knew that over-hunting, over-harvesting, or taking too much of any resource would upset the entire ecosystem. By following the Rule of Three, they didn't just protect the land for themselves, but for future generations, ensuring the survival of plants, animals, and the balance of life. This practice mirrors current-day sustainability principles, showing the wisdom of First Nations people!

EXPLORE | BUSH COLLECTION

Head into your garden or a park/bushland nearby, and collect as many natural materials as you can find: rocks, stones, sticks, leaves, gumnuts – anything natural! Put them into piles for each thing, and then separate each pile into three:

Use the gumleaf example, and explain that the Rule of Three helps everyone:

1. A pile for me
2. A pile for the tree
3. A pile for the birds who live in the tree

DIG DEEPER | ECOSYSTEM BALANCE

Look into a local ecosystem on Country, such as a forest, wetland, or coastal area. Research the natural resources found in that area, particularly plants and animals. Think about how people might follow the Rule of Three when harvesting plants and hunting animals. Are you aware of any upsets of balance within certain ecosystems that have been caused by overharvesting or land mismanagement? What was the outcome of this? Research how current farming or agricultural practices compare to the Rule of Three. Do any practices today follow or go against this principle? What can we learn from the Rule of Three to make our future more sustainable?

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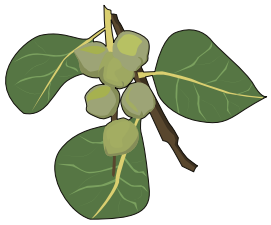
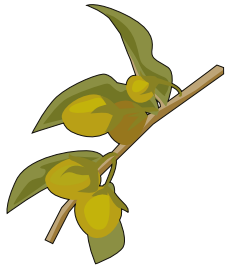
CHALLENGE YOURSELF |
SUSTAINABLE EDIBLE NATIVE GARDEN PROJECT

This activity asks you to apply sustainable land management practices to your home garden over a period of time, and it's especially useful to understand which native edibles grow well – as well as where, and when: things like Lilli Pilli berries, kangaroo apple, quandong, bush tomato, macadamia nuts and many more.
Check out what you can eat here: Australia's Native Edible Plants.

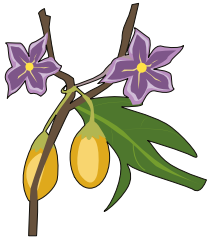
Lilli Pilli berries



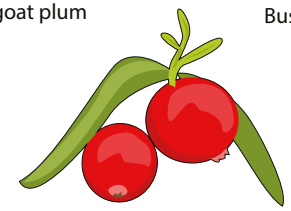
Billy goat plum



Bush tomato



Kangaroo apple



Quandong

Macadamia nuts

LINKS

- National Biodiversity Month | Wingaru Education
- Eight tips for saving water in your garden | Gardening Australia
- Methods for creating water points for wildlife in your garden | Garden Design | Gardening Australia
- Australian Plants Online
- Bush to Bowl
- Indigigrow
- Australia's Native Edible Plants

BEING SAFE IN THE GARDEN

Wear sunscreen and a hat

Keep hydrated

Wear gloves when handling potting mix/soil/ compost and read potting mix instructions well

Never leave tools lying around

Check the area for snakes, spiders, sharp items and other hazards

Cover cuts or scratches on your hands with a dressing and wear gloves

Be aware of poisonous plants

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Materials

- Small garden space/ containers/indoor planters
- Seeds or seedlings: veggies, herbs or edible native plants: native seedlings are readily available from good gardening outlets and online stores such as Australian Plants Online, Bush to Bowl, and Indigigrow, among many.
- Gardening tools
- Journal to document the process

STEPS

Design

Check out the links in the materials section and research plants that grow well in your area, and in the position your garden bed is in.

Design a small garden layout that includes companion planting (plants that help other plants grow well: basil and tomato, for example - can you find native plants that will grow well together?)

Create a sustainable harvesting plan:

- One third for the family to eat
- One third left for the birds, insects and other animals
- One third left to go to seed for the next season

Build + Sow

Prepare the garden space and plant according to your plan

Maintain the garden sustainably using water conservation techniques (Gardening Australia have a great You Tube video)

Document how the garden grows and any observations each week

Harvest + Distribution

When your plants are ready, harvest just one-third of what is available

Observe and document what wildlife visits the patch to feed/drink from it

Reserve the seeds of one-third of the plants for seed collection for the next planting, or simply let them reseed naturally

Reflection

You could create a visual representation of how the Rule of Three was applied to your own garden

You could calculate approximate yields for the edible plants and how they were distributed

Think about how this approach differs from standard gardening practices and mass farming

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SCALES OF THE UNIVERSE

TIPPING THE SCALES!

Understanding mathematical scales in our world can help us understand how everything works together: from an invisible bug on a leaf, to the expanse of the Daintree Rainforest, there are connections throughout nature, a hidden language that is as intriguing as it is fascinating.

EXPLORE | BECOME A SIZE EXPLORER!

Explore all the different sizes and scales of nature in your backyard/park!

Materials

- Paper
- Coloured textas/crayons/pencils
- Scissors
- Glue
- Ruler
- Optional: magnifying glass

Head outside to the local bush, a community park, or simply your backyard, and try to find natural objects in the following sizes:

1. Something tiny that would require a magnifying glass to see
2. Something small that fits in the palm of the hand
3. Something about as long as your finger
4. Something about as tall as you are!
5. Something bigger than your house!
6. Something enormous... maybe that you can only imagine

HAVE A YARN:

How might small creatures in nature, like ants or bees, impact the whole ecosystem?

How do you think different scales in nature work together to create balance in the world?

Can you think of examples where the size of something in nature helps it survive?

How do you think First Nations people would use the scale of nature to manage resources?

DID YOU KNOW?

At 1,200 square kilometres, the Daintree might be Australia's largest rainforest, but it is a great example of scale – starting with the teeny-tiniest microbes in the soil that are found nowhere else on earth. In fact, a single teaspoon holds billions of microbes that break down fallen leaves in a process that hasn't changed in 180 million years! That's deadly.

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DIG DEEPER | THE SCALE OF COUNTRY

Draw a measuring line on your paper with these six points equally spaced:

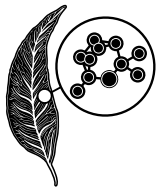
1. Ant sized
2. Finger sized
3. Hand sized
4. Child sized
5. House size
6. Giant sized

For each category, draw a picture of something from nature that fits that size. Then think about comparisons: How many ants would fit across a leaf? How many houses might fit on a mountain? And how do different sizes in nature keep our environment healthy? Consider how tiny insects help a big plant to grow, or birds that spread seeds for giant trees.

CHALLENGE YOURSELF | THE POWER OF 10

Understanding mathematical scale can be a simple investigation into the power of 10. For this activity, you are challenged to create a visual or digital representation tracking a journey through different scales in nature.

Consider this as a guide:

Scale	Metric Unit	Power of Ten	Example	First Nations Connection
Microscopic 	picometres (pm)	10^{-12} m	Carbon atoms in eucalyptus oil	You can't see them, but can smell them!
	nanometres (nm)	10^{-9} m	Soap tree saponin & wattleseed tannin molecules	Used in bush medicine for over 60,000 years
	micrometres (µm)	10^{-6} m	Charcoal dust & fine ochre particles	Used in ceremony, tools, and storytelling
Macroscopic 	millimetres (mm)	10^{-3} m	Witchetty grub, termite, millet grass seed	Important bush foods and ecosystem indicators
	centimetres (cm)	10^{-2} m	Human, koala, emu	Key totems and Dreaming figures in many Nations
	metres (m)	1 m	Eucalyptus tree, whale, termite mound	Used for making tools, storytelling, and ceremony
Megascopic	kilometres (km)	10^{3} m	Uluru, Lutruwita (Tasmania), Great Barrier Reef	Sacred sites with many names and meanings
Cosmic	light years	$\approx 10^{13}$ m	Emu in the Sky, Seven Sisters constellation	Linked to seasonal calendars and deep time stories of creation

Starting at 10^{0} meters (1m - human scale), move down to 10^{-2} meters (1 cm), which is the size of a tiny organism, and then down to atomic scale: 10^{-10}m. Then go up to 10^{1} meters (10 m), which is multi-organism scale, to habitat scale (10^{2} meters (100 m), and finally up to 10^{6}m (continental scale). For each power of ten, identify, label and illustrate one natural structure or organism that exists at that scale.

LINKS

From atom to whole universe: amazon scale video

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