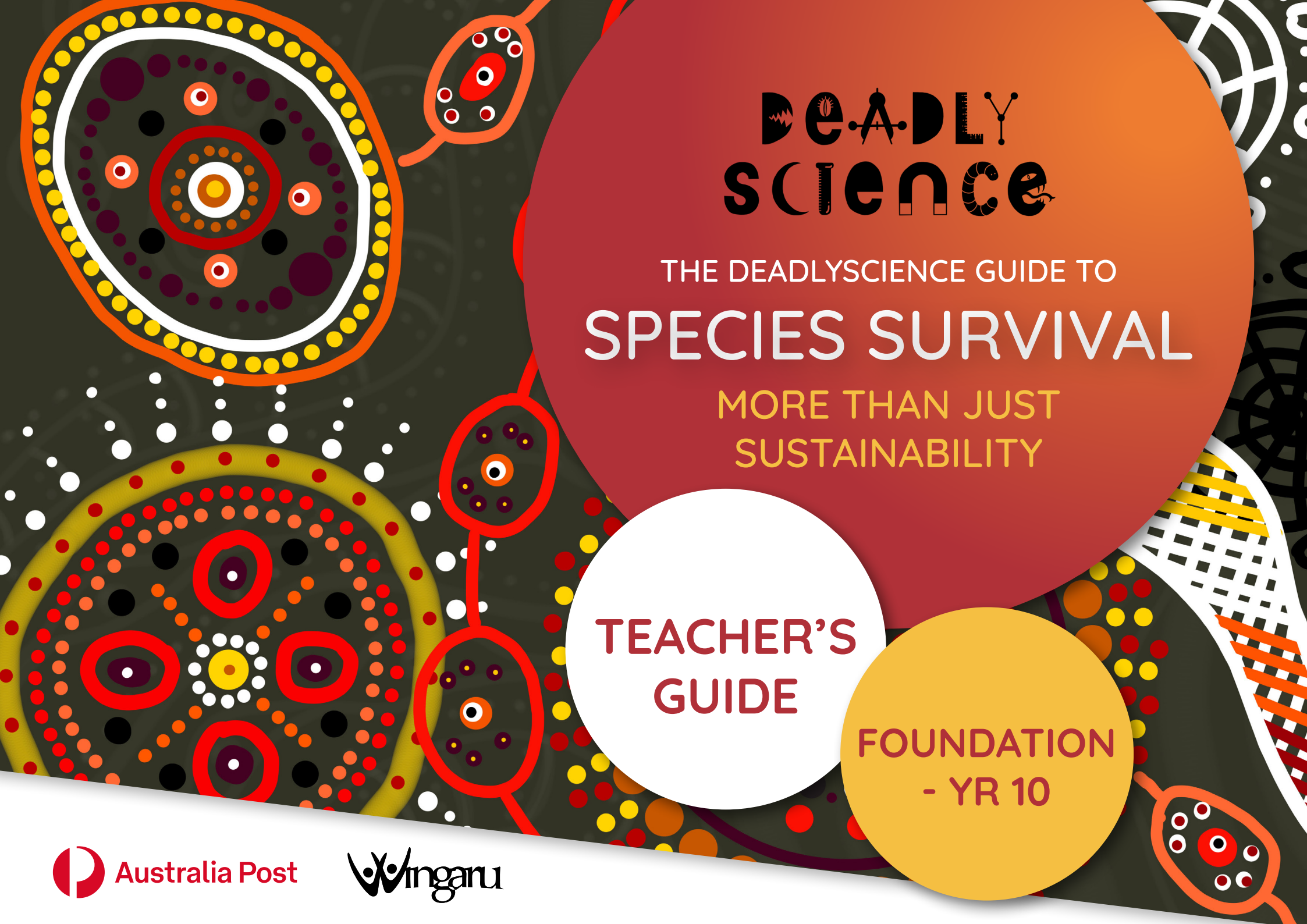
DEADLY SCIENCE
THE DEADLYSCIENCE GUIDE TO
SPECIES SURVIVAL
MORE THAN JUST SUSTAINABILITY
TEACHER'S GUIDE
FOUNDATION - YR 10
Australia Post
Wingaru

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.

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 Indigenous science knowledge into your classroom. This resource is based around this year's Science Week Theme, **Species Survival: More Than Just Sustainability**. We would like to acknowledge the work that Wingaru Education has put into helping us develop this resource. We are working to ensure that every Aboriginal and Torres Strait Islander learner knows that their ancestors were the First Scientists of this Country, and for non-Indigenous people to learn the true history of the scientific knowledge developed and used by Aboriginal and Torres Strait Islander people. The deep connection to Country Indigenous people have had for thousands of years forms the foundation of the sustainability practices that are used today. The 2024 National Science Week theme encourages educators, learners and families to explore the traditional land and animal conservation practices that Aboriginal and Torres Strait Islander people have been practising for over 65,000 years. This resource is designed to bring this knowledge into the classroom through engaging and interactive learning while sharing stories. We hope your students enjoy learning about deadly science!

Corey

Corey Tutt OAM
CEO, Founder of DeadlyScience

ABOUT THIS GUIDE

As the first scientists of Australia, First Nations people throughout this land have an enduring connection to Country. Theirs is an innate understanding of the seasons, weather, animals, plants and ecosystems of this land, collected, remembered and passed down through the generations. It is a rich lore, an embedded understanding of how to help Country not just survive – but thrive.

Australia has over 200,000 animal species, more than any other developed nation, and 24,000 species of native plants, all of which contribute to Australia's rich biodiversity. These incredible species have developed amazing ways to adapt and survive, and First Nations custodianship entails an inherent responsibility to protect them.

It is now widely recognised that Aboriginal and Torres Strait Islander peoples' methods of land care are vital in combating ecological issues, reversing species decline, regenerating habitat, and introducing sustainable harvesting. Seasonal calendars are increasingly used in land care, tracking which species are active and when, and 'cool burning' – the practice of using small fires to clear areas of land while ensuring seed regeneration and delivering nutrients back into the soil – is becoming widespread.

"We are all part of an interconnected web of life. Every creature, from the bees that pollinate fruit trees to the worms that enrich the soil, plays an essential part. So, the survival of every species doesn't just protect nature's beauty, it ensures the health of the ecosystems that provide food, clean water and the air that we as humans breathe..."

First Nations Elder, Australia State of the Environment Report, 2021

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 millennia-rich history of helping to protect species survival beyond sustainability.

It is anticipated classes will build connections with local First Nations communities and connect with local Aboriginal and Torres Strait Islander people and organisations who can help the class develop a deeper understanding of animal survival and adaptation through an Indigenous lens.

Country encompasses all living things and all aspects of the environment, as well as the knowledge, cultural practices and responsibilities connected with this. Aboriginal and Torres Strait Islander people believe that we belong to Country, rather than Country belonging to us.

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's an engaging, fun and safe place for students and teachers to be heard and to have opinions.

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

LESSON OVERVIEW | INTRODUCTION

The Deadly Science Guide to Species Survival: More Than Just Sustainability is a practical and fun resource for teachers of Foundation to Year 10. Alongside the 2024 National Science Week theme of Species Survival, it introduces the importance of science and innovation in ensuring not just the survival but the thriving of countless Australian species, all through the lens of Australia's First Nations people.

Developed in partnership with Australia Post, DeadlyScience and Wingaru Education, this guide is curriculum-aligned and strongly features the cross-curriculum property of Aboriginal and Torres Strait Islander histories and cultures. Each lesson reflects on the sustainable practices of Aboriginal and Torres Strait Islander people as part of caring for Country, and how these ideas are intrinsically part of future solutions.

Australia is one of 17 megadiverse countries globally, with many plants, animals and ecosystems found nowhere else on Earth. Over the 200 years since European colonisation, however, we have suffered the largest decline in biodiversity of any continent, including the highest rate of extinctions in the modern world as a result of climate change, invasive species, and pressure over contested land: farming, land clearing, urban expansion and tourism have a significant impact on habitats and environmental degradation.

Endemic species have learnt to adapt physically and behaviourally to the pressures on their natural populations in order to survive, such as adapting to survive in hot or cold weather, negotiating difficult terrain, finding food, or staying hidden from predators. And increasingly, Indigenous ways of knowing, seeing, reporting and understanding are being recognised as essential for meeting the environmental challenges of today and the future, as well as helping to ensure species survival.

DID YOU KNOW?

Australia's First Nations people have coexisted with their environments for millennia, using cultural practices that sustain rather than exploit.

Their deep and enduring cultural respect for all endemic species – from mudskippers to mallee trees – has allowed for ongoing, sustainable and effective management and care for this precious environment.

STEM + SPECIES SURVIVAL

Science helps us understand ecosystems and unravel the genetic code of different species. Technology creates tools for conservation, such as drones and artificial intelligence (AI) used to map habitats and count animal populations.

Engineering solutions, such as wildlife corridors, and 65,000+ years of cultural practices enable species numbers to be sustained rather than exploited.

Maths and data science allow us to predict and measure changes in species population number to better understand our impact on species survival in Australia.

Year	Lesson Overview	Curriculum Links	
		Science	Aboriginal + Torres Strait Islander Histories + Cultures
F	**FIRST NATIONS FOOD SOURCES**		
	Introduce students to traditional food sources focusing on the Bogong moth. Understand threats to survival of this insect population, current conservation efforts, how the wide ecosystem is affected. Appreciate nature and its enduring capacity for species survival, within the broader context of species decline.	AC9SFU01 AC9SFH01 AC9SFI02	A_TSICP2
1-2	**WILD FOOD**		
	Introduce the idea that humans rely on wild species as part of the food industry and that our diets directly affect the health of these species and their habitats. Investigate how wild species adapt to this drain on their natural populations, and reinforce the interconnectedness of food chains. Consider the ways First Nations Australians used wild food resources, with emphasis on Aboriginal and Torres Strait Islander resource sustainability. Understand what we need to do differently to protect species biodiversity.	AC9S1U01 AC9S1I01 AC9S2I01	A_TSICP2
3-4	**DIGGING THE DATA**		
	Explore the importance of collecting species data to understand diversity and where help is needed. Consider what sort of things scientists need to count to understand species diversity. Explore the concept of citizen science projects related to species diversity, and foster involvement in local conservation projects.	AC9S3H01 AC9S3H02 AC9S3I03 AC9S4H01 AC9S4H02 AC9S4I03	A_TSICP1 A_TSICP2

Year	Lesson Overview	Curriculum Links	
		Science	Aboriginal + Torres Strait Islander Histories + Cultures
5-6	**CULTURAL PRACTICES**		
	Investigate Aboriginal and Torres Strait Islander seasonal calendars. Understand the importance of First Nations cultural ideology and practice in species preservation, land care, and bush regeneration, with a focus on living in harmony with nature. Consider migration patterns and cultural burning practices.	AC9S5H02 AC9S5I01 AC9S6U01 AC9S6H02 AC9S6I01	A_TSICP1 A_TSICP2
7-10	**TECH x SUSTAINABILITY**		
	Investigate the role of technology in conservation efforts, efforts to control feral species and the balance between overpopulation and species culling. Consider how tech solutions could be used to protect Indigenous flora and fauna and investigate the success of Indigenous rangers in saving native species. Identify traditional species monitoring practices.	AC9S7U02 AC9S7H01 AC9S7H02 AC9S7H03 AC9S8H01 AC9S8H02 AC9S8H03	A_TSICP1 A_TSICP3
9-10	**UNDERSTANDING DNA**		
	Investigate how the study of DNA can be used to unlock the mysteries of plants and animals and help protect populations. Understand how species mutation can help survival, and investigate current scientific studies that focus on bringing extinct organisms back to life, including the implications of this. Species sequencing project. Extinction investigation into Australia's megafauna.	AC9S9H02 AC9S9H04 AC9S9I01 AC9S10U01 AC9S10U02 AC9S10H02	A_TSICP1

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 to 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.

Yarning topics

Wild Food

What is the wildest thing you have eaten?

What things do we eat in Australia that people in other countries would find strange?

Why do we eat kangaroos but not koalas?

How could an animal species protect itself from being overeaten?

Cultural Practices

What First Nations cultural practices do you know about?

What can Indigenous knowledge teach us about diversity and species protection?

How did First Nations people know about migration patterns, animal populations and when to harvest food?

What is a cultural burn? Why is it done?

Technology

What are some modern technologies that can be used to understand and protect biodiversity?

How did First Nations Australians monitor and share information about local animal and plant populations?

Is technology better than traditional methods? Why? Why not?

How many feral plants/animals can you think of? What is the best way to deal with them?

Data

How is data used to understand biodiversity?

What different things can form 'data'?

How can we tell if a species is native to Australia?

How many ways can you think of to identify different species?

DNA + genetics

How many species do you know of that have become extinct? Do you know what caused the extinction?

What is an example of a genetic mutation? Are mutations good or bad?

What do you know about DNA?

What are the ethical implications of bringing extinct species back to life?

FIVE TIPS FOR A YARNING CIRCLE

Sit in a circle

Sitting in a circle means everyone gets to be a part of the conversation, listening, talking and thinking.

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.

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.

Encourage sharing of ideas

Encouraging students to take turns to talk gives everyone the chance to share, but don't force them. The yarning experience is always better if students are given time and space to feel comfortable sharing.

Make time for reflection

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

SPECIES SURVIVAL | MORE THAN JUST SUSTAINABILITY

The survival of humanity depends on species survival. The global ecosystem we are a part of is wholly interconnected, a web in which the tiniest of bugs is as important as the leading scientist. The survival of every part of the system is required to ensure we have food, clean water and unpolluted air.

Climate change, habitat loss and degradation – caused by farming, land clearing, urban expansion, tourism and invasive species – and invasive species are key threats to Australia's unique ecosystem. We are seeing changes to seasons, coastlines, flora and fauna; wattle trees have been noted flowering randomly and outside of defined seasonal patterns; dragonflies seem to not know when to arrive during migration, flying ants are hatching too prematurely, and fewer insects are being observed in general.

As the world's oldest living culture, Aboriginal and Torres Strait Islander peoples have dealt with environmental change over millennia. Sustainable environmental practices are embedded in First Nations culture, via traditional hunting, harvesting, and plant and species management. So, it makes sense that this knowledge and experience is incorporated into campaigns that safeguard Australia's biodiversity.

This cultural understanding can be partnered with **scientific innovation, adaptive food chains, data-driven results** that quantify the health of the ecosystem, and **tech-led solutions** to help protect and revitalise our ecology, including **DNA and genetic sequencing.**

Imagine the world without bees?

As crucial pollinators, any significant reduction in the bee population would result in a huge decline of agriculture, resulting in decreased crop yields and potential food shortages. There would be a decline in plant diversity, on soil fertility and nutrient cycling, and the resulting impact on other species could cause a cascading effect on herbivores, omnivores and ultimately the entire food chain, including predators.

There would be many ripple effects across Australia's ecosystem.

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 **Species Survival: More Than Just Sustainability**. It explores some of the critical challenges impacting earth's human, animal and plant habitation. It encompasses the understanding that our survival as humans depends on the survival of our unique ecosystems, and that the natural-world expertise of Australia's First Nations people is a vital piece of the puzzle. And it welcomes technology, scientific innovation, adaptive change, the power of data-driven investigation, and genetic sequencing.

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 ensuring our unique ecosystem not just survives – but thrives.

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.

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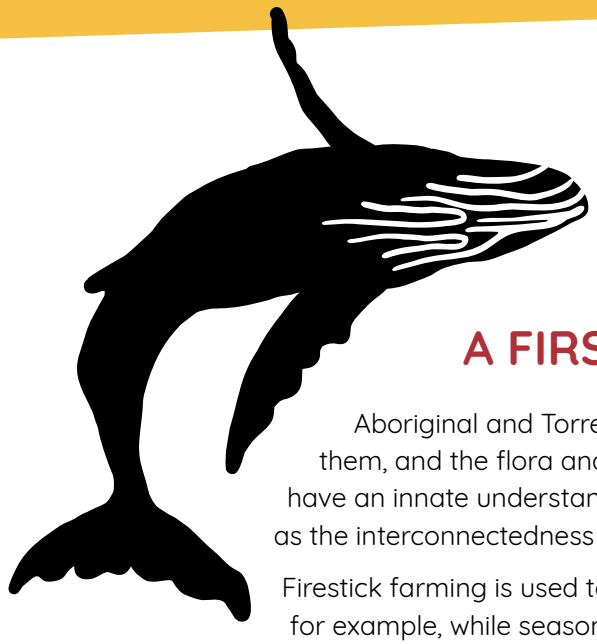


A FIRST NATIONS PERSPECTIVE ON SPECIES SURVIVAL

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 sustainable cultural practice 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. Plus, Aboriginal and Torres Strait Islander peoples' commitments to ensuring resource sustainability – taking only a third of the animal or plant population, leaving a third for other animals to eat, and a third to repopulate the species – 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.

Aboriginal and Torres Strait Islander peoples have complex systems 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. First Nations farming has an emphasis on allowing for the natural regeneration of plants and sharing of the cultivated land with local animal populations.

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 technology such as artificial intelligence, genetic sequencing, and cutting-edge scientific innovation could lead to measurable and context-specific biodiversity protection solutions for the future.

SCIENCE CHECKLIST | STEM + X

The Science Week Sustainability + X formula connects the concept of species survival with other disciplines, interests and goals. Each 'X' is a lens through which we can better understand the complex challenge of species conservation and how we can all play a role in the crucial mission of saving species from extinction. With a First Nations focus, this formula is given greater depth and perspicacity.

SUSTAINABILITY + FOOD

There are social, cultural, and spiritual dimensions to the connections First Nations people have between sustainability and food. Increasingly, wild foods endemic to Australia are being incorporated into society, which has a direct impact on these species and their habitats. Aboriginal and Torres Strait Islander cultures, however, have embedded management practices to ensure a harmonious balance is maintained throughout every part of their environment, and it is this knowledge that plays a vital role in future-proofing our food chain.

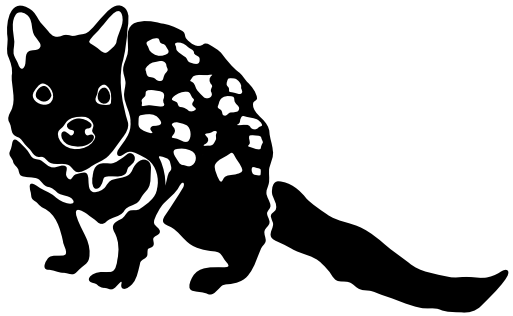
SUSTAINABILITY + MATHS & DATA

First Nations people have gathered data via direct observation, oral histories, and cultural practices for thousands of years. This traditional ecological knowledge (TEK) provides valuable insights into local ecosystems, including species behaviours, migration patterns, habitat requirements, and environmental changes, and defines the responsible use of resources, informs sustainable harvesting practices, and is inherent in balancing local ecologies.

TEK is complemented by modern scientific methods, forming a collaborative approach known as Two-Way Science. This approach recognises the validity of both Indigenous and Western scientific knowledge systems and integrates them to achieve more comprehensive and sustainable outcomes in species management and conservation.

DID YOU KNOW?

Aboriginal and Torres Strait Islander people have always been committed to ensuring the resources of their world are sustained. **The Rule of Three** is one way of doing this. It relates to taking only a third of the food or resources available, leaving a third for other animals to eat, and a third to repopulate the species. This avoids overexploitation and ensures ecosystems are capable of regeneration. That's deadly!



SCIENCE CHECKLIST | STEM + X (CONTINUED)

SUSTAINABILITY + CULTURE

Aboriginal and Torres Strait Islander communities have been living, hunting and farming on Country for almost 70,000 years. The deep and enduring knowledge First Nations communities have in relation to the natural world directly informs the intersection of sustainability and culture. By embracing this wisdom, wider society can learn how to better live in harmony with our environments and help protect them into the future. Cultural fire practice, the Rule of Three, cyclical farming, seasonal harvesting – and so much more – pave the way to greater understanding of our unique ecosystem and how to protect it.

SUSTAINABILITY + TECH

Many First Nations communities have developed tech-led monitoring programs to track changes in wildlife populations, habitat health and environmental degradation. Using GPS, remote sensing, aerial drones and mobile apps to collect data, as well as Geographic Information Systems (GIS) – computerised analysis and spatial display of geographical information – to 'map' traditional ecological knowledge, this information provides valuable insight into species distribution, migration patterns and habitat preferences. Plus, digital storytelling platforms are being used to share First Nations ecological knowledge to a broader audience.

SUSTAINABILITY + BIOLOGY

Our ongoing understanding of the idiosyncrasies of species diversity, adaptability and mutation – and thus survival – is thanks to the study of genetics. First Nations communities often approach genetic science within the framework of cultural protocols and ethical guidelines that prioritise respect for the land, animals, and ancestors, which includes the spiritual significance of certain species and understanding the interconnectedness of all living beings. Genetic manipulation of species resilience to reintroduce extinct species such as the thylacine is underway thanks to collaborative efforts between First Nations and Western genetic scientists, unlocking new approaches to the threat of extinction.

SCIENTIFIC TEACHING STRATEGY | POE

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 because the student may have access to culturally specific knowledge which they may be able to share with the class. This demonstrates acknowledgement and inclusion of Indigenous perspectives through engagement with the student and potentially the wider First Nations community.

PREDICT

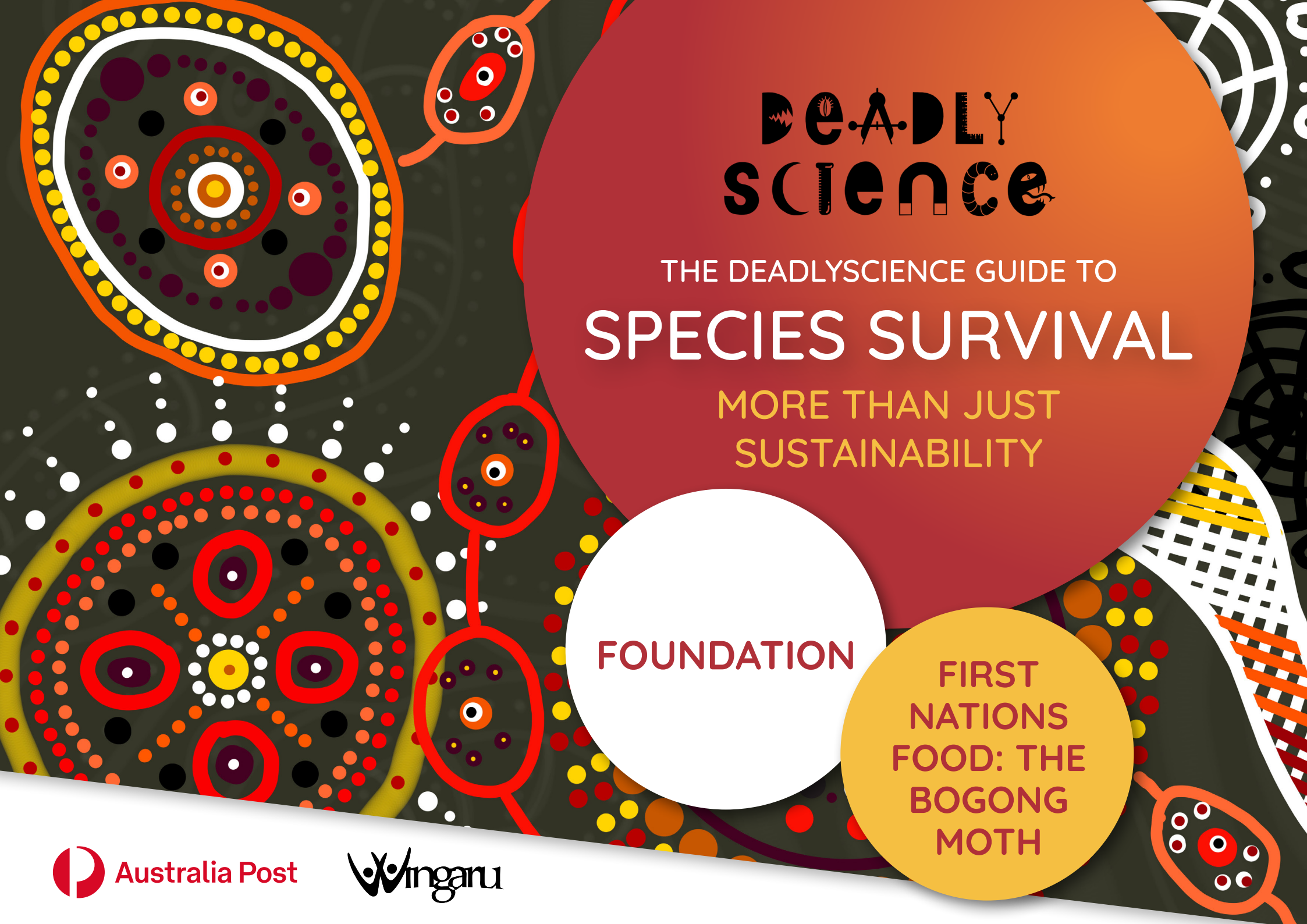
This is the process of using what we already know in order to ask questions that will help us learn something and create a strong foundation to build upon. This predication is often referred to as an hypothesis, or a testable question. We create hypotheses based on our accumulated knowledge, available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

This lesson introduces students to First Nations food sources, with specific emphasis on the Bogong moth. It incorporates an understanding of threats to the survival of this important insect population, current conservation efforts, and the impact degradation of this population has on the wider interconnected ecosystem. There is an investigation of what else eats the moths, and if the moth population declines, how this affects other animals. Students are encouraged to read Taungurung story *Bijil Ba Wudhi Deberra* by Auntie Lorraine Padgham, and colour in paper moth models, using sticks, leaves and other natural materials to make a moth habitat.

Learning intention

- To learn about traditional foods, focusing on the Bogong moth.
- To understand the role of Bogong moths in the ecosystem.
- To engage creatively with natural materials to create a moth habitat.

Guiding questions

- What are Bogong moths and why are they important?
- How do different animals interact with Bogong moths?
- How can we create a habitat for Bogong moths?
- What do you think they taste like?
- Would you eat a moth if you were hungry?
- Do Bogong moths like cold or hot weather?

Resources

- Whiteboard and markers
- Paper and drawing materials
- Images and/or videos of Bogong moths:
  The journey of the Bogong moths
  Mysteries of the Bogong moth
- Taungurung story *Bijil Ba Wudhi Deberra* by Auntie Lorraine Padgham
- Paper, coloured pencils, crayons, markers, sticks, leaves, and other natural materials
- *Australian Geographic Book 6: Animal Survival,* pp 13, pp 30-31

Vocabulary

- Bogong moth
- Habitat
- Ecosystems
- Predators
- Decline
- Conservation

PREDICT, OBSERVE, EXPLAIN

PREDICT	Begin by gathering students in a circle and engaging them in a discussion about Bogong moths. Use the whiteboard to jot down their predictions and thoughts about the taste of Bogong moths and their preferences in terms of weather. Encourage them to share their ideas freely. Provide each student with a piece of paper and ask them to draw what they think a Bogong moth looks like. Once they finish, have them share their drawings with the class and explain their reasoning behind their illustrations.
OBSERVE	Provide images or videos of Bogong moths for students to observe in the classroom. Guide them to notice details such as the moth's colour, size, and movement patterns. Read the Taungurung story *Bijil Ba Wudhi Deberra* by Auntie Lorraine Padgham to the students. As you read, encourage them to pay attention to the cultural significance of Bogong moths. After the story, facilitate a discussion about the role of Bogong moths in Aboriginal culture and their importance in the ecosystem. Use the whiteboard to list key points or ideas shared by the students. Distribute paper to each student and provide materials such as coloured pencils, crayons, or markers. Allow students to draw a Bogong moth in their habitat. Or provide materials such as sticks, leaves, and other natural materials for students to create a moth habitat diorama. Encourage them to work in small groups to design and build their habitats, incorporating elements they observed during the observation activity.
EXPLAIN	Encourage students to share their understanding and discuss any new insights gained about Bogong moths. Prompt them to consider how their drawings or habitats reflect their understanding of the moth's characteristics and its role in the ecosystem. Guide students in exploring the cultural significance of Bogong moths in Aboriginal culture further. Discuss how *Bijil Ba Wudhi Deberra* illustrates the relationship between Bogong moths and First Nations communities. Encourage students to reflect on the lessons and values conveyed in the story, such as respect for nature and sustainable practices. Transition the discussion towards the importance of conservation efforts to protect Bogong moths and their habitats. Discuss the threats facing Bogong moths, such as habitat loss and climate change, and brainstorm possible actions that individuals and communities can take to conserve these important insects.

EXTEND THE LEARNING

FOSTER APPRECIATION FOR NATURE

Provide students with nature journals and encourage them to explore outdoor environments, observing insects, plants, and other elements of nature. Guide them to record their observations through drawings, descriptions, and sensory experiences, fostering a deeper connection to the natural world.

COMMUNITY GARDEN PROJECT

Collaborate with local Indigenous community members to establish a community garden that promotes native plant species and attracts insects like the bogong moth. Involve students in planting, tending, and observing the garden, emphasising the importance of biodiversity and sustainable practices.

DID YOU KNOW?

The decline of Bogong moth populations has a significant impact on other creatures, notably the mountain pygmy possum. This small marsupial is native to the alpine regions the moths migrate to in summer months, and Bogongs are an essential food source for them, as they prepare to hibernate through the winter months. If there are not enough moths to eat, it can affect the possums' breeding patterns, reducing their numbers and impacting the survival of this endemic species, to the point that they are close to extinction.

For thousands of years, Aboriginal people from the south-eastern areas of Australia have relied on the annual migration of the Bogong moth as a seasonal food source. The moths migrate to the Australian alpine regions to escape the hot summer weather, and during this seasonal movement, First Nations clans would collect the moths to roast, grind into a paste and eat.

Bogong moths are rich in fat, protein and other nutrients, which makes them a valuable and sustainable food source – as well as delicious!

Bogong moths hold cultural significance for many Indigenous groups, and are featured in stories, ceremonies and art. The annual moth migration and associated harvest are deeply ingrained in First Nations culture and highlight the intricate relationship between Aboriginal and Torres Strait Islander people and the natural world.

Bogong moth populations are being heavily impacted by climate change, habitat degradation, the use of pesticides and light pollution. Conservation efforts to protect them include addressing all these issues, as well as educating people to better understand the importance of the moths and how they can help them survive, and ongoing research and monitoring of existing populations.

MORE DEADLY SCIENCE

TRADITIONAL FOODS SCAVENGER HUNT!

Do you know how many traditional First Nations foods can be found in the supermarket? Ask your parents or a guardian to help you look for some of the following delicious foods in your local shops:

Note down as many as you can find on this cool scavenger hunt list, and think what each one might taste like... Then, check out what some of these foods look like when they are grown on Country; you could visit the library and ask to see some books with pictures of bush tucker, too. How do you think Aboriginal and Torres Strait Islander people discovered what tasted good and what didn't?

Finally, ask your parents or guardian if you can taste one of these yummy foods: which one will you choose? Is it delicious? What does it taste like?

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YEARS 1-2 | WILD FOOD

LESSON OVERVIEW

This lesson introduces students to the idea that humans rely on a significant number of wild species within the food industry. It considers seeds and where they come from, which foods that we eat contain seeds, and the importance of seed banks. It investigates how wild species adapt to this drain on their natural populations and introduces the concept of diverse ecosystems. It also considers the ways First Nations Australians used wild food resources, with emphasis on sustainability.

Learning intention

- To understand the importance of wild species in the food industry.
- To recognise the connection between human diets and the health of wild species and their habitats.
- To explore how different cultures, including First Nations Australians, utilise wild food resources.

Guiding questions

- Why are wild species important for our food industry?
- How do our diets impact the health of wild species and their habitats?
- How did First Nations Australians use wild food resources, and what can we learn from them about protecting species biodiversity?

Resources

- Pictures or videos of wild food
- Finding witchetty grubs
- Bags or baskets for gathering wild seeds, nuts, fruits etc.
- Magnifying glasses for close-up observation
- Wild food items such as seeds and images for posters
- Poster-making supplies
- Materials for mini seed banks: egg cartons, plastic containers, soil, seeds, watering cans etc.
- *Australian Geographic Book 7: How Plants Thrive*
- *Australian Geographic Book 9: Numbers in Nature*

Vocabulary

- Wild species
- Habitat
- Ecosystems
- Seed bank
- Adaptation
- Rule of Three
- First Nations Australians
- Responsible harvesting
- Food industry
- Food chain

PREDICT, OBSERVE, EXPLAIN

PREDICT	Before engaging in the discussion about wild food, prompt students to make predictions about the importance of wild species in the food industry and the impact of human diets on these species and their habitats. Encourage them to think critically about where their food comes from and how it relates to wild species. Pose questions such as: What do you think 'wild food' means? Why might it be important to learn about wild species in the food industry? How do you think our diets affect wild species and their habitats? Engage students in a discussion about wild food, building on their predictions and prompting them to think about where their food comes from and the variety of foods they eat. Discuss the concept of wild species and their importance for biodiversity and ecosystem health. Introduce the First Nations perspective by explaining the deep connection First Nation peoples have to the land and their sustainable use of wild food resources. Share examples of how First Nations Australians utilised wild food resources, emphasising their sustainable practices, and encouraging students to ask questions and share their thoughts on First Nations interactions with wild species.
OBSERVE	Ask students to observe and collect various seeds, nuts, fruits, and other wild food items (if available, otherwise they can be supplied) from their local environment. Encourage them to explore outside and notice the diversity of wild species and their habitats. Guide students to think about how wild species adapt to human reliance on them for food. Encourage them to consider the challenges wild species face due to habitat loss, overharvesting, and climate change. Explain to students that responsible harvesting and conservation efforts, such as seed banks, are important for preserving wild species and their habitats. Discuss how seed banks work and why they are essential for maintaining biodiversity in the food industry.
EXPLAIN	Divide students into small groups and provide them with a selection of wild food items, seeds, and pictures of different wild species and their habitats. Encourage each group to predict which wild species are commonly used in the food industry and why. Then, guide them to design and create a poster or presentation showcasing the importance of these wild species in the food chain. Provide materials for students to create their own mini seed banks using recycled materials such as egg cartons or plastic containers. Guide them to plant seeds from the wild food items they collected earlier and discuss the importance of preserving genetic diversity. Reflect on the lesson and discuss why wild species are important for the food industry and the health of ecosystems. Encourage students to explain how their actions can impact wild species and what they can do to promote responsible harvesting and conservation efforts. Encourage students to reflect on their predictions and observations during the activity, emphasising the importance of understanding the interconnectedness of all living things in the food chain. Encourage students to continue exploring and learning about wild species and their habitats in their local environment.

EXTEND THE LEARNING

FIRST NATIONS COOKING DEMONSTRATION

Invite a local First Nations community member to demonstrate traditional cooking methods using wild food ingredients. Students can observe how these ingredients are prepared and cooked, gaining insight into First Nations culinary practices and the importance of wild foods in traditional diets.

CREATE A WILD FOOD RECIPE BOOK

Task students with researching and compiling a recipe book featuring dishes made with wild food ingredients, inspired by both First Nations and contemporary culinary traditions. Encourage creativity and exploration of diverse flavours and cultural influences, fostering appreciation for the richness of wild food resources.

COMMUNITY GARDEN PROJECT

Collaborate with local First Nations communities to establish a community garden that incorporates native wild food plants. Involve students in planting, tending, and observing the garden, while learning about First Nations gardening techniques

Bush tucker is an increasingly important part of Australia's food industry, with things like bush tomatoes, wattle seeds, yabbies, kangaroo, emu and various native herbs and spices being used in restaurants and as products you can find on the shelves. They are celebrated for their unique flavours, nutritional value, and significance in Aboriginal and Torres Strait Islander cultures.

The same goes for our oceans, which offer up wild-caught prawns, lobsters, oysters, barramundi, snapper and tuna. Sustainable fishing practices, marine conservation efforts, and seafood certification programs promote the responsible harvesting of wild seafood, which helps to ensure the long-term health of marine ecosystems and supports the livelihoods of coastal communities.

The incredible wild produce that Australia has requires a different approach to protect it and ensure its survival, both as endemic species, and as an important part of the food chain. First Nations land-management practices, habitat protection, sustainable harvesting, ethical sourcing and certification programs – to ensure the responsible stewardship of wild food resources – are vital. Plus, they are an important part of preserving Aboriginal and Torres Strait Islander cultural heritage, which is integral to the chain of knowledge and management of wild food.

DID YOU KNOW?

Kangaroo, wallaby, and other native game are increasingly popular wild meats for consumers seeking lean, healthy protein sources with a low environmental footprint. Or maybe we should be eating witchetty grubs? They taste like creamy eggs when roasted over the fire – that's deadly!

MORE DEADLY SCIENCE

DEADLY KNOWLEDGE FROM THE NIGHT SKY!

The night sky is an incredible source of information to First Nations Australians. They watched the skies – the positions of the stars and the planets – and could tell when the different seasons arrived, as well as when to do different things through the year, like move to warmer places when winter was coming.

Understanding the seasons is super important for survival. Knowing when to look for native berries, or when to hunt for dugong can be a huge advantage, and the night skies held all this information for Aboriginal and Torres Strait Islander people.

On the east coast of Australia, watching the Seven Sisters (also known as Pleiades star cluster) told First Nations people when whales were moving past that coastline. In Central Australia, watching the Seven Sisters told people the time of the year when dingoes were breeding. Dingoes were an important source of warmth on cold nights. Other First Nations people tell of the Seven Sisters connection to honey ants, bush tomatoes and the thorny devil...

Head outside on a clear night and see if you can see the Seven Sisters. You can use the deadly night-sky resource on the next page if you like.

DID YOU KNOW?

Did you know there was an emu in the sky? Watch this deadly YouTube video, and check out the map on the next page, then head out at night to see if you can see it! **Hint: it's usually only visible at certain times of the year, so you might have to check first.**

With the movement of the Earth, the position of the Emu in the Sky changes throughout the night and through the year. Find some images of the Milky Way in April, July, November and January, then see if you can trace the outline of the emu over these pictures.

When the emu is in the sky, it means it's time to collect emu eggs to eat, but it also tells us when the seasons are changing and that can be super useful when you are trying to find wild food.

Check out these deadly YouTube videos that tell some of the stories of the night sky:

ABC Australia: Ancient astronomy and modern technology combine to tell stories of the night sky

Aboriginal Night Skies: University of Southern Australia

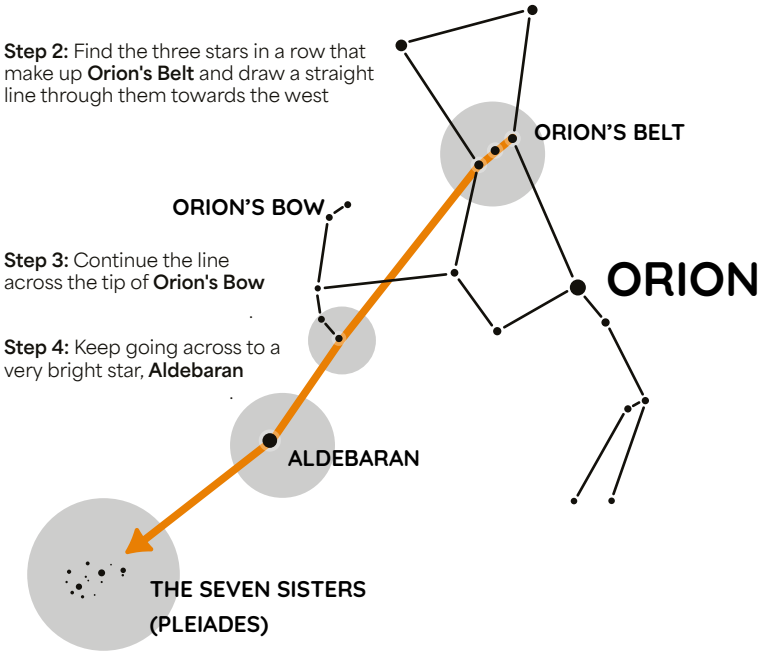
MORE DEADLY SCIENCE

DEADLY KNOWLEDGE FROM THE NIGHT SKY!

Finding the Seven Sisters

Step 1: Face the northern sky.

Step 2: Find the three stars in a row that make up **Orion's Belt** and draw a straight line through them towards the west



Step 3: Continue the line across the tip of **Orion's Bow**

Step 4: Keep going across to a very bright star, **Aldebaran**

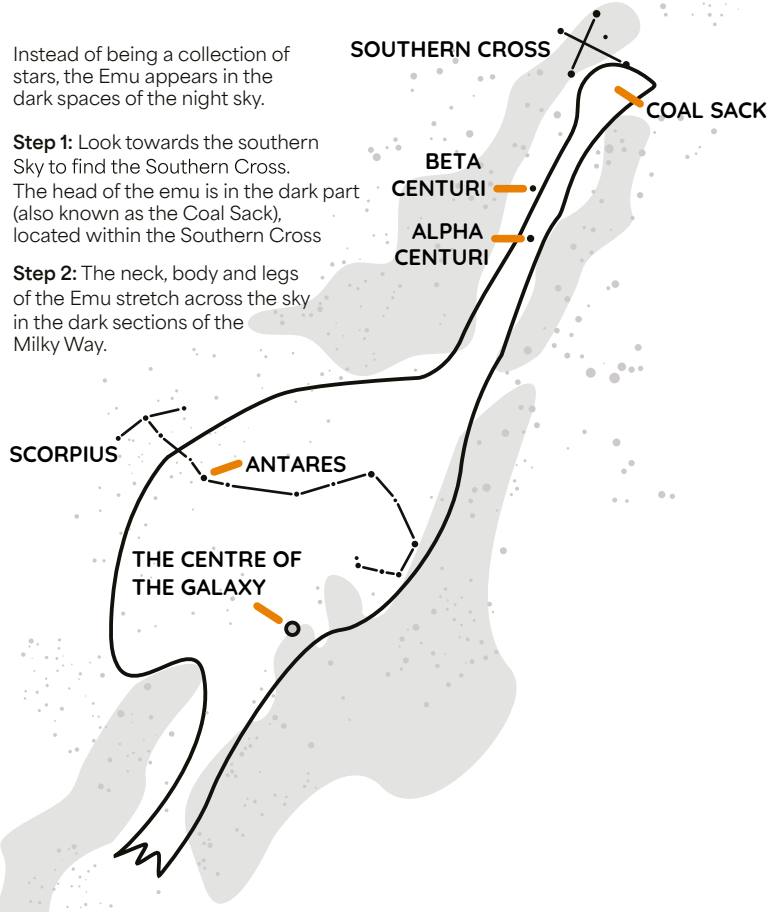
Step 5: Continue following that line down and to the west, where you'll find the Seven Sisters.

Emu in the sky

Instead of being a collection of stars, the Emu appears in the dark spaces of the night sky.

Step 1: Look towards the southern Sky to find the Southern Cross. The head of the emu is in the dark part (also known as the Coal Sack), located within the Southern Cross

Step 2: The neck, body and legs of the Emu stretch across the sky in the dark sections of the Milky Way.

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YEARS 3-4 | DIGGING THE DATA

LESSON OVERVIEW

This lesson explores the importance of collecting species data to understand diversity, migration patterns, habitat selection and – most importantly – where help is needed. It considers what sorts of things scientists need to count to understand species diversity and explores the concept of citizen-science projects related to this. Students are encouraged to collect species data on bird life around the school, and analyse the results using species identification websites, as well as by paying attention to where the bird lives, what noise it makes, its size, beak shape and colour, etc. They are also asked to consider what can be done to encourage more birds to the area – by building a bird feeder, for example, or installing a bird bath. Discovering the Indigenous names for all the species will help reflect a First Nations lens at this point, as will reading *How the Birds Got Their Colours* by Mary Albert. Further engagement in students' understanding of species adaptation can be accessed on page 3 of *Australian Geographic Book 1: Animal Adaptations*.

Learning intention

- To learn why collecting data about different species is important.
- To understand how students can help scientists study species diversity.
- To explore bird life around the school, learn about their habitats and behaviours, and explore ways to encourage more birds to the area.

Guiding questions

- Why is collecting species data important for understanding biodiversity and identifying areas needing conservation?
- What types of data do scientists need to collect to understand species diversity?
- How can citizen science projects help in collecting species data and contributing to scientific research?

Resources

- *How the Birds Got Their Colours*, Mary Albert
- Bird Observation Tools (binoculars, notebooks, pencils, field guides, etc)
- Books or online databases of Indigenous bird names
- Species identification resources (websites or field guides)
- QR code activity: *Australian Geographic Book 1: Animal Adaptations*, p.3.
- Bird identification apps: Merlin BirdID, iNaturalist, Birds in Backyards
- Citizen Science sites

Vocabulary

- Data
- Biodiversity
- Citizen science
- Adaptation
- Conservation
- Habitat
- Beak shape
- Species diversity

PREDICT, OBSERVE, EXPLAIN

PREDICT	Begin by prompting students to consider what sort of things scientists need to count to understand species diversity. Encourage them to brainstorm ideas about the characteristics of organisms that scientists might observe or record to gather species data. Pose questions such as "What details about an organism might be important for understanding its role in an ecosystem?" and "How can collecting species data help us understand biodiversity and identify areas that need help?" Introduce the concept of citizen science projects related to species diversity. Encourage students to predict how citizen science projects can contribute to scientific research and conservation efforts. Prompt them to consider the benefits and challenges of involving the community in scientific data collection. Read *How the Birds Got Their Colours* by Mary Albert to the students. After the reading, facilitate a discussion about the cultural significance of birds and their colours in First Nations cultures. Encourage students to make predictions about how Aboriginal and Torres Strait Islander peoples' stories and knowledge might influence our understanding of bird species diversity and their roles in ecosystems.
OBSERVE	Provide students with the opportunity to collect species data on bird life around the school. Equip them with observation tools such as binoculars, notebooks, and pencils. Guide them to observe and record details about the birds they encounter, including where they live, what noise they make, their size, beak shape, colour, etc. Encourage students to work in pairs or small groups to enhance collaboration and peer learning. Task students with finding out the First Nations names for all the bird species they identified during the observation activity. Provide resources such as books or online databases to support their research. Encourage students to explore the cultural significance of these birds in First Nations cultures and discuss how First Nations knowledge can enrich our understanding of biodiversity
EXPLAIN	After the bird observation activity, guide students in analysing the results of their data collection. Use species identification websites or field guides to help students identify the bird species they encountered. Facilitate a discussion about the diversity of bird species in the area and the significance of their findings. Encourage students to interpret their data and draw conclusions about the health of the local bird population. Prompt students to consider what can be done to encourage more birds to the area based on their observations. Discuss potential habitat enhancements such as building bird feeders or installing bird baths. Encourage students to brainstorm ideas for creating bird-friendly environments around the school and develop action plans to implement their ideas. Engage students in a discussion about species adaptation using the QR code beak activity. Use examples from the activity to illustrate the concept of adaptation and its role in species survival. Encourage students to apply their understanding of adaptation to other organisms they encounter in their environment.

EXTEND THE LEARNING

ENCOURAGING BIRDS TO THE AREA

Explore how students can take action to make their school or local environment more welcoming to birds. This could involve planting native plants that provide food and shelter, installing bird feeders and birdhouses, or creating a small pond or bird bath.

COMMUNITY INVOLVEMENT

Foster community involvement in bird conservation efforts. Encourage students to share their knowledge and enthusiasm for birds with their families, friends, and neighbours. Organise community events, such as birdwatching walks or habitat restoration projects, to raise awareness and promote bird conservation.

BIRD HABITAT MAPPING PROJECT

Students are to create detailed maps of the school grounds or local area, highlighting bird habitats and nesting sites identified during the observation activity. Encourage students to collaborate and use mapping tools such as GPS devices or mapping apps to document their findings. Discuss the importance of habitat mapping for conservation planning.

DID YOU KNOW?

Australia is home to over 70 types of honeyeaters, and as a species they have adapted to their environment. These birds have specialised tongues specific to their nectar-feeding diet. Many have brush-tipped tongues that enable them to efficiently extract nectar from flowers, while some, such as the Eastern Spinebill, have long, slender tongues that can probe even deeper to reach nectar hidden deeper within.

Maths. It's not everyone's fave, but the application of data collection and its analysis is an incredible tool. The helmeted Honeyeater is a critically endangered bird endemic to south-eastern Australia. Close to extinction due to the loss of its wetland habitat, and an invasion of aggressive feral birds such as the Common Myna (also known as the Indian Myna or the European Starling), conservationists initiated a huge data collection effort, using satellite tracking and traditional field observations to gather information on the bird's behaviour, habitat use, breeding patterns and migration routes.

This detailed insight provided solutions for habitat restoration and targeted culling of invasive species, plus, the data was used to raise public awareness with the local community encouraged to engage in citizen-science projects, which fostered a deep sense of stewardship for the species. As a result, the population of Helmeted Honeyeaters has stabilised, and there have been successful breeding and reintroduction programs. While it is still critically endangered, the species now has a fighting chance for survival.

MORE DEADLY SCIENCE

BECOME A DEADLY BUG DETECTIVE!

For today's bug detective work, you will need:

- Notebook or paper
- Pen or pencil
- Pieces of fruit including lemon, apple and soft fruit
- Pieces of vegetables including cucumber, tomato and potato
- Insect identification guide or app: like this one (Picture Insect available on the App Store and Google Play)
- Magnifying glass (optional)
- Sherlock Holmes hat (optional)

You might need a sandwich and a cold drink too, and remember to put on sunscreen! Place pieces of fruit and vegetables in different spots around your garden. Then, monitor how many bugs head to each food source.

If you can go out multiple times, you will get much richer information to analyse later, particularly if you go out at different times of the day, and in different weather conditions. Each time you go out, record the following information in your notebook:

- Date and time of observation
- Weather conditions (sunny, cloudy, rainy, etc.)
- Bug species observed (using the app if necessary)
- Number of each bug species
- Which food source the bug was attracted to

Once you've got all this info, it's time to be a sleuth!

Ask the following questions and add your own:

- Does one species like fruit more than vegetables?
- Do some bugs only come out at night?
- Did you notice anything unusual during your observations?
- Were there other animals/birds around?
- Was anything else attracted to the food you put out?
- What can this information tell you about your local environment?

DID YOU KNOW?

An entomologist is someone who studies insects. Entomophagy is the word for the practice of eating insects. Aboriginal groups across Australia still eat bush tucker that includes larvae, honey ants, scale insects, lerps and Bogong moths. Green ants are now served in some restaurants.

Watch this video:

For more information watch: The CSIRO wants Australia to start eating more bugs:

Grub's up!


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YEARS 5 - 6
CULTURAL PRACTICES
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YEARS 5-6 | CULTURAL PRACTICES

LESSON OVERVIEW

This lesson is about understanding the importance of First Nations cultural ideology and practice in species preservation, land care and bush regeneration in Australia. It considers seasonal calendars, investigates which calendar is used in the Country you are on, why this is useful, and what these calendars can tell us about migration, adaptation and harvesting wild food. Identifying the mass migrations of Australian species, such as humpback whales, budgies, and Bogong moths, and reading *Amazing Animal Journeys* by Jennifer Cossins, and *Gurawul the Whale: An ancient story for our time* by Max Dulumunmun Harrison, can help students understand the reasons behind migration, and how cultural practices are highly attuned to these patterns, including the seasonal movements of First Nations people. Finally, discuss 'cool burns' or cultural burns – Why are they undertaken? What are the benefits of burning Country? Why is this burning OK, but bush fires are not? – and the Rule of Three, taking only a third of available resources, leaving a third for other animals, and a third to repopulate the species. **Cultural burning should only be attempted by experienced First Nations knowledge holders. Please seek the support of a local knowledge holder and do not attempt this yourself.**

Learning intention

- Understand the significance of First Nations cultural beliefs and practices in preserving species, caring for the land, and restoring natural habitats.
- Explore the Aboriginal or Torres Strait Islander seasonal calendar used in your local area.

Guiding questions

- Why is First Nations cultural ideology and practice significant for preserving Australia's native species and caring for Country?
- How can we learn from this ancient yet ongoing knowledge?

Resources

- *Amazing Animal Journeys*, Jennifer Cossins
- *Gurawul the Whale: An ancient story for our time* by Max Dulumunmun Harrison
- *Australian Geographic Book 1: Animal Adaptations*, p. 10-13
- CSIRO guide to First Nations seasonal calendars
- ABC Australia: Indigenous fire methods protect land before and after the Tathra bushfires
- Cultural burns

Vocabulary

- Cultural preservation
- Country
- Land care
- Bush regeneration
- Cultural burning
- Cool burn
- Migration
- Seasonal calendar

DEADLY SCIENCE

PREDICT, OBSERVE, EXPLAIN

PREDICT	Prompt students to think about the importance of First Nations cultural ideology and practices in preserving species, caring for the land and regenerating the bush. Encourage them to brainstorm ideas about how Indigenous knowledge can contribute to conservation efforts. Pose questions such as “What traditional practices do you think First Nations peoples use to preserve species and their habitats?” and “How might understanding Aboriginal seasonal calendars help us protect biodiversity?” Encourage students to predict the significance of Aboriginal seasonal calendars in understanding migration patterns, adaptation strategies, and food harvesting practices. Prompt them to consider why animals migrate and how knowledge of mass migrations of Australian species such as humpback whales, budgies, and Bogong moths contributes to our understanding of ecosystems. Read *Amazing Animal Journeys* by Jennifer Cossins and *Gurawul the Whale: An ancient story for our time* by Max Dulumunmun Harrison to the students. After the reading, facilitate a discussion about the lessons learned from the book and encourage students to predict how this knowledge can inform their understanding of species preservation and migration.
OBSERVE	Provide resources for students to research and discover which Aboriginal seasonal calendar is used in the Country they are on. Encourage them to explore the usefulness of the calendar in tracking migration patterns, adaptation strategies, and food harvesting practices. Guide them to observe how this knowledge can contribute to species preservation and land management. Task students with identifying mass migrations of Australian species such as humpback whales, budgies, and Bogong moths. Provide materials such as books, articles, or online resources for research. Encourage students to observe and record information about these migrations, including their timing, routes, and significance to ecosystems.
EXPLAIN	After researching Aboriginal seasonal calendars and mass migrations of Australian species, guide students in analysing their findings. Facilitate a discussion about the importance of this knowledge in species preservation, land care, and bush regeneration. Encourage students to explain how understanding Aboriginal cultural practices can help humans live in better harmony with the natural world. Prompt students to consider three ways humans could live in better harmony with the natural world based on their learnings. Encourage them to reflect on the benefits of cultural burns and discuss why they are undertaken. Differentiate between cultural burns and bushfires, highlighting the benefits of controlled burning for land management and biodiversity conservation. Encourage students to explore the concept of cultural burning and its benefits further through research and discussions. Invite Indigenous guest speakers and Elders to share their knowledge and experiences with cultural burns, providing students with opportunities to deepen their understanding of Indigenous land-management practices.

EXTEND THE LEARNING

LIVING IN HARMONY WITH NATURE

Plan a community garden project focused on native plant species that support local biodiversity. Students will research and select plant species that attract birds, butterflies, and other wildlife to the garden. They will design and maintain the garden, learning about the importance of habitat restoration and creating green spaces that promote species survival.

CREATIVE ARTS

Encourage students to express their understanding of species survival through creative mediums such as art, music or poetry. Students can create artwork inspired by local wildlife, compose songs or poems about the interconnectedness of species in ecosystems, or produce short films or animations highlighting conservation messages.

LEARNING OUTDOORS

Take learning outdoors by organising outdoor classroom activities focused on species survival. Conduct biodiversity scavenger hunts where students search for and identify different plant and animal species, or lead guided nature walks where students learn about the ecological roles of species within their local environment.

Aboriginal communities have been living, hunting and farming on Country for millennia. Their rich knowledge and highly refined cultural practices are an essential part of not just protecting endemic species but helping them to flourish. Fire management, cool burning, the Rule of Three, cyclical farming, seasonal migration, sustainable season-led harvesting, rewilding, and holistic land-care management are all part of Australia's Traditional Ecological Knowledge (TEK). It is this knowledge that provides invaluable insights into sustainable resource use, resilience to environmental change, and strategies for adapting to ecological challenges.

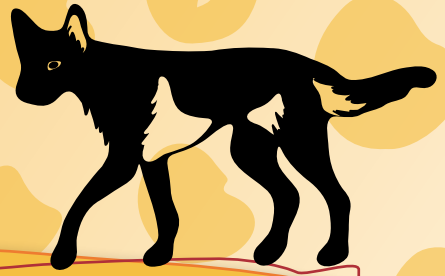
DID YOU KNOW?

You may know them as 'budgies', short for 'budgerigars', but did you know that this name is probably derived from the Gamilaraay word gidjirrigaa, from gidjirr meaning 'yellow' from the gidgee (wattle tree), influenced by the 19th century NSW Pidgin word budgery meaning 'good'?

Credit: Yaama Gamilaraay! Language Reawakening Program

MORE DEADLY SCIENCE

MASTER THE ELEMENTS!



Aboriginal and Torres Strait Islander people had detailed knowledge of wind and weather patterns, which helped them to predict changing seasons, animal migration and plant cycles, so they knew when and where there would be food. This rich knowledge of the wind was also used when hunting, to make sure the prey couldn't smell the hunter, and when navigating – that's deadly!

Test your skills as a STEM legend and master the power of the wind! Using the following materials, build an anemometer to test the wind in your backyard:

- 4 paper cups
- 2 straws
- Needle or pin
- Sticky tape
- Marker pen
- Pencil with eraser
- Ruler
- Glue (optional)
- Stop watch or phone clock

INSTRUCTIONS

Mark the midpoint of the two straws; flatten them in the middle where the mark is and cross them over into a 'cross' formation. Stick them together with tape or glue. Attach a cup on the end of each straw with tape. Make sure that the plastic cups are all facing the same way. Push the pin into the centre of the cardboard cross, then place the sharp bit of the pin into the eraser on top of the pencil. You can see all of this on this YouTube link.

Now you're ready to do science! Take the anemometer out into a breeze and see if it spins! The idea is to count how many revolutions the machine makes in a minute, and then compare this to other times of the day or on a different day.

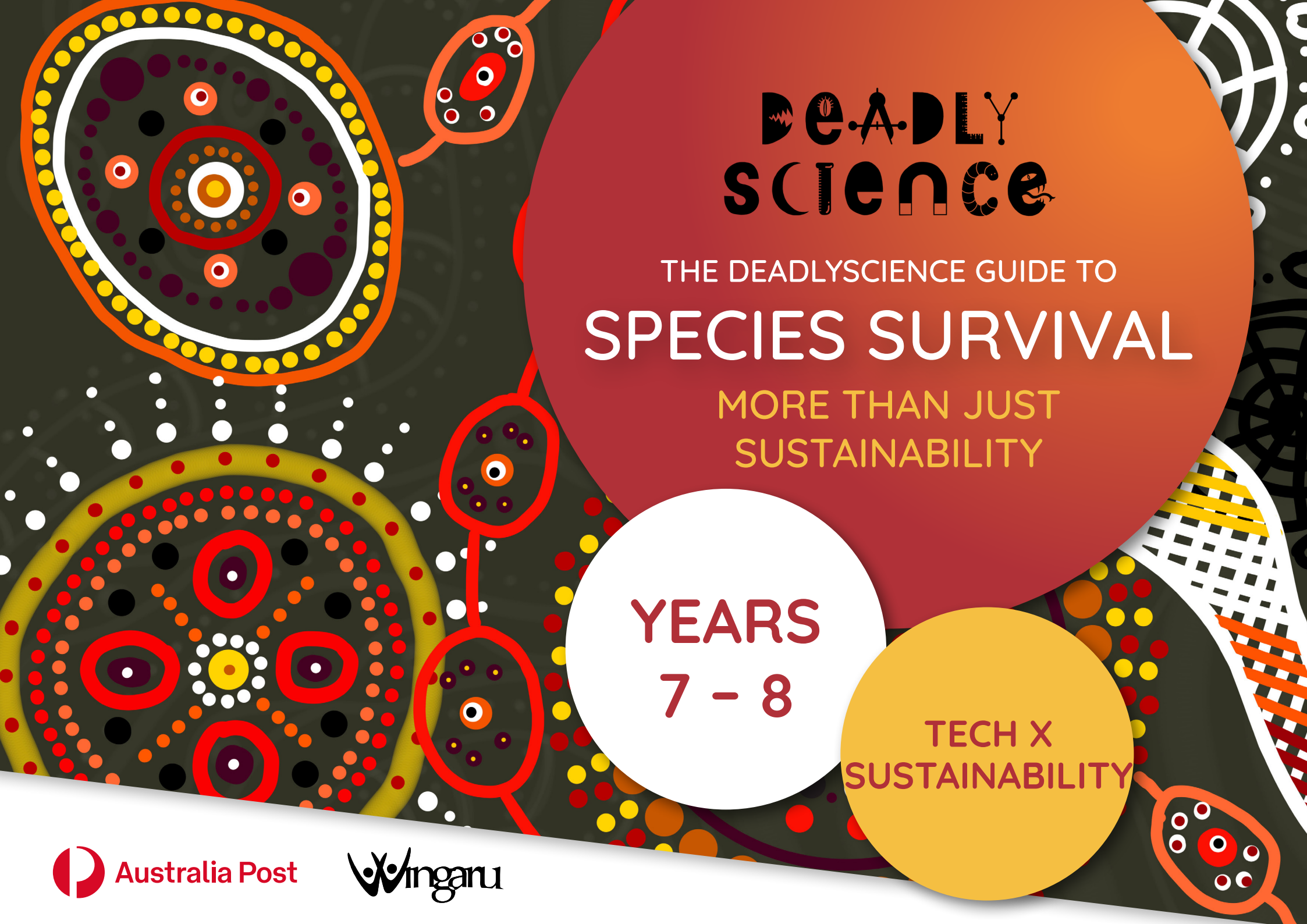
What could big winds signify? Think about changing seasons and weather patterns; and the migration of wildlife.

If the wind suddenly changes direction, how could that impact a First Nations hunter? Or someone travelling through the bush relying on traditional knowledge of the landscape? Or firestick farming practices?

DID YOU KNOW?

Artist Jorna Newberry paints the Wind Dreaming from her mother's Country, used during ceremonies to ask the winds to blow. This ceremony is called the Walpa Tjukurpa, and comes from Utantja, near where the boundaries of Western Australia, Northern Territory and South Australia, meet, in Pitjantjatjara Country. Sacred Tjukurpa song cycles are sung, and ceremonial dancing traces the symbolic journey of the Ancestors.

This Country is rich with populations of kangaroos and camels, rock wallabies and birds. It provides good resources for people who hunt for their food and live off the land. Jorna explains that "the wind ceremony forms winds that create air to cool the land" and describes how wind can be used to hunt: being down-wind from your prey (so they can't smell you) makes it easier to hunt successfully.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YEAR 7 – 8 | TECH X SUSTAINABILITY

LESSON OVERVIEW

This lesson is an investigation into the role of tech within conservation and biodiversity programs, including the use of drones, sensors, artificial intelligence and GPS tracking, as well as culling solutions that utilise traps and viruses. Learn about feral species and consider whether the prevention of overpopulation is beneficial compared to the money spent culling invasive animals. How could tech solutions be used to protect Indigenous flora and fauna? Investigate the success of First Nations rangers in saving native species, focusing on Kiwirrkurra rangers using trail cameras to monitor bilbies. And identify traditional species-monitoring practices, such as seasonal observations and patterns of breeding and migration, which allowed prediction; tracking animals to check on population health, and to know where to hunt; controlled burning, to flush animals out and to revegetate the land; and monitoring water resources – with the information captured in storytelling and songlines.

Learning intention

- Understand how tech is used in conservation efforts around Australia.
- Explore the impact of feral species in Australia and the effectiveness of prevention measures.
- Discuss how tech can protect Indigenous flora and fauna, with examples from Indigenous ranger programs.

Guiding questions

- How does technology play a part in conservation and biodiversity programs?
- What are the challenges posed by feral species, and how can tech address them?
- How can technology support Indigenous efforts to protect native species?

Resources

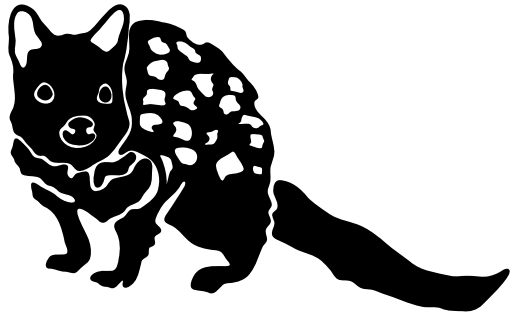
- National Environmental Science Program: *Kiwirrkurra Rangers are using a two-way science approach to monitor and manage wild bilby populations*
- Invasive Species Council
- Indigenous Rangers Program
- *Australian Geographic Book 8: Renewable Resources*
- *Australian Geographic Book 1: Animal Adaptations;* pp 18-19

Vocabulary

- Conservation technology
- Feral species
- Overpopulation
- Culling
- Traps
- Sensors
- Drones
- Indigenous flora and fauna
- Species monitoring
- Trail cameras
- Satellite tracking
- GPS

PREDICT, OBSERVE, EXPLAIN

PREDICT	Prompt students to predict the role of technology in conservation efforts. Discuss examples such as drones locating koalas after bushfires, citizen science sites, and tags tracking sea life. Encourage them to consider how these technologies contribute to scientific research and conservation. Introduce the topic of feral species in Australia and initiate a discussion on whether preventing overpopulation is beneficial compared to culling invasive animals. Encourage students to predict the effectiveness of different approaches and the ethical considerations involved. Discuss tech solutions such as traps, viruses, sensors, and drones and how they're used to reduce the impact of feral species. Prompt students to predict the effectiveness of these methods in protecting endemic wildlife populations.
OBSERVE	Explore how technology can protect Indigenous flora and fauna. Investigate the success of Indigenous rangers using trail cameras to monitor bilbies or satellite tracking technology to monitor endangered species like the northern quoll. Identify traditional species monitoring practices such as seasonal observations, tracking animals, controlled burning, sustainable hunting, and monitoring water resources. Encourage students to observe and understand the importance of these practices in conservation efforts.



PREDICT, OBSERVE, EXPLAIN

EXPLAIN	Challenge students to design their own conservation projects incorporating technology. Provide a scenario related to local environmental issues, such as: • Urban biodiversity decline • Water pollution in local rivers • Coastal erosion along the shoreline • Invasive species threatening native flora and fauna • Waste management challenges • Air quality issues in urban areas Ask them to develop a comprehensive plan outlining the use of technology to address the problem. Encourage creativity and interdisciplinary thinking in their project proposals. Organise a debate or panel discussion where students present their findings on their conservation projects. Encourage them to articulate arguments for or against the use of specific technologies in conservation, considering ethical, social, and environmental implications. Reflect on how First Nations communities have historically cared for their environment through practices like controlled burning and sustainable hunting. Explore how combining Indigenous knowledge with scientific approaches can improve conservation efforts. Discuss the cultural importance of land to First Nations peoples and their holistic approach to conservation.

EXTEND THE LEARNING

FERAL SPECIES MANAGEMENT ROLE PLAY

Students role-play as conservation managers tasked with addressing a feral species problem in a specific ecosystem. Provide background information on the species, its impact on native biodiversity, and potential management strategies. Students must collaboratively develop and justify a management plan, considering factors such as ecological impacts and ethical considerations.

COMMUNITY ENGAGEMENT

Task students with developing education campaigns to raise awareness about the role of technology in conservation among their peers and community. Students can create multimedia presentations, social media campaigns, posters for around their school or educational workshops to promote understanding and support for conservation initiatives. Encourage students to incorporate First Nations perspectives and values into their communication strategies.

New-age tech is increasingly being taken up in biodiversity and sustainability projects in Australia because it offers innovative and more refined approaches to species protection and feral animal management. Introduced species such as horses, foxes, cats, deer and cane toads wreak untold havoc on endemic species populations. Tech is now informing how we control this influx, with sensor devices and GPS tags used to track feral animals, acoustic monitoring of species during breeding times, drones to analyse population numbers and migration, and a huge uptake in citizen-science programs that utilise mobile phone technology.

Taronga Zoo has developed a scent-based territorial management tool for dingoes and wild dogs. As apex predators, dingoes can be a threat to livestock, but killing them has an impact on the rest of the ecosystem, allowing invasive predators to take over. By mimicking the dingoes scent markings, invasive predators are kept out, which potentially will lead to improved conservation of threatened and non-threatened native species.

DID YOU KNOW?

A university in Queensland has teamed up with Landcare Australia and WIRES to expand a drone-based koala detection program. The partnership –'WildSeek' – aims to build a national conservation AI network, involving citizen scientists across the country collecting data via drone to be analysed by an AI analytics hub. That's deadly!

MORE DEADLY SCIENCE

ANCIENT UNDERSTANDING GOES HIGH TECH!

Access to clean water is essential for every species to be capable of survival, including us. Aboriginal and Torres Strait Islander people have detailed knowledge of where there is clean water in the bush, and this knowledge is critical to health, wellbeing and a sense of identity. As global environmental pressures intensify and there is a shortage of water – both in remote areas, but also our towns and cities, it is this sort of deep knowledge that will help to ensure human survival.

Explore different materials that filter water and use them to make water safe to drink from a dam or creek. Filters work by allowing water molecules to pass through while trapping contaminants. Compare sand, a coffee filter, cotton wool, and a dishwashing sponge as filters. Place them in bottles with the bottom cut off, punch a hole in the lid, and pour dirty water through each filter to observe the results. Check out how to do it by watching this YouTube video.

WHAT YOU WILL NEED:

- Four 1L plastic bottles with lids
- Four smaller jars
- Measuring cup
- Scissors
- 1L of dirty water (just add soil from the garden!)
- Sand
- Coffee filter
- Cotton wool
- Sponge

ASK YOURSELF THE FOLLOWING QUESTIONS:

- Which filter worked best?
- What would happen if you combined filter materials?
- What things in the bush could be used to purify water?
- What technological solutions can you think of for filtrating water?

CHECK OUT THE FOLLOWING:

Reverse osmosis systems

UV water purifiers

Activated carbon filters

Membrane filtration technologies: such as ultrafiltration (UF) and nanofiltration (NF)

Electrochemical water treatment

Advanced oxidation processes

This is a great Sydney Water explainer: Turning River Water into Drinking Water.


DEADLY SCIENCE
THE DEADLYSCIENCE GUIDE TO
SPECIES SURVIVAL
MORE THAN JUST SUSTAINABILITY
YEARS 9 - 10
UNDERSTANDING DNA
Australia Post
Wingaru

YEAR 9 – 10 | UNDERSTANDING DNA

LESSON OVERVIEW

This lesson looks at DNA studies used to unlock the mysteries of plants and animal species, and thereby helping us to protect their populations. It considers how the genetic information of organisms is coded in their DNA, and how a genetic mutation in a species population can actually help survival. Echidna's, for example, have developed backwards facing legs, a mutation that works to their advantage as the ultimate digging tools: to dig for food, burrow away from predators, and retreat underground to thermoregulate their temperature.

Students are encouraged to explore why the thylacine became extinct, and current scientific studies that hope to bring it back to life, and question what the implications of this are – legally, societally and ethically. They could be asked what other extinct organisms should be brought back to life and why? And to consider why it is important for survival of a species to have genetic variety, as well as understanding what scientists mean when they say they have 'sequenced' or 'de-coded' a species.

Finally, explore Australia's 'megafauna' and consider why they became extinct. Are these reasons something that we could now prevent happening again?

Learning intention

- To explore how DNA studies contribute to understanding and protecting plant and animal populations.
- Understanding the role of DNA coding and mutations in survival.
- Investigate scientific efforts to revive extinct species and the implications.
- Discuss the importance of genetic variety for species survival.

Guiding questions

- How do DNA studies help in understanding and protecting plant and animal populations?
- What role does DNA coding and mutations play in the survival of organisms?
- Why did certain species become extinct, and what are the scientific efforts to bring them back?
- Why is genetic variety important for species survival?

Resources

- *Guardian Australia: Bringing the thylacine back to life*
- *Should We Change Species to Save Them?: NY Times*
- Applying Indigenous Australian biocultural knowledge and values in synthetic biology: a case study
- Optional – Go Extinct! Megafauna boardgame (available by request from DeadlyScience)
- *Australian Geographic Book 8: Renewable Resources;* pp 28

Vocabulary

- DNA sequencing
- Genetic diversity
- Mutation
- Extinction
- Conservation
- Megafauna
- Genetic engineering
- Biodiversity
- De-extinction

PREDICT, OBSERVE, EXPLAIN

PREDICT	Begin by immersing students in the captivating realm of DNA studies, emphasising their pivotal role in unlocking the secrets of plant and animal life and aiding in population protection. Provide a brief overview of DNA's structure and function, highlighting its significance as the blueprint of life. Facilitate a collaborative brainstorming session where students work in groups to explore the potential applications of DNA research in conservation. Encourage them to consider how genetic studies can help identify and mitigate threats to endangered species, restore ecosystems, and preserve biodiversity. Provide prompts to stimulate critical thinking, such as discussing how DNA analysis could aid in understanding species migration patterns or identifying genetic adaptations to changing environments.
OBSERVE	Assign students to research and present case studies of real-world DNA studies that have made significant contributions to conservation, such as: • Use of DNA barcoding to identify species in biodiversity hotspots • Sequencing of genomes to uncover genetic adaptations in endangered populations • Application of genetic markers in tracking wildlife migration patterns • DNA studies on the population genetics of threatened or endangered species • DNA studies on the extinction and evolutionary history of Australia's megafauna species Students should analyse their chosen case study in detail, focusing on the objectives, methods, results, and implications of the DNA study. They should consider the following: • Overview of the DNA study topic and its importance in conservation • Description of the selected case study, including its objectives and methodologies • Discussion of the study's results and their implications for conservation • Reflection on the significance of the study in advancing our understanding of genetic diversity and its role in ecosystem preservation

PREDICT, OBSERVE, EXPLAIN

EXPLAIN	In a presentation format, students share their findings from the DNA case studies they researched, demonstrating their understanding of the scientific principles underpinning the study. Encourage them to articulate the relevance of DNA research to conservation biology, highlighting how genetic insights can inform conservation strategies and management practices. Facilitate a structured discussion where students reflect on the broader implications of DNA research in conservation. Encourage them to consider ethical, legal, and societal aspects, such as the implications of de-extinction efforts on ecosystems and cultural heritage. Prompt students to explore potential controversies surrounding genetic engineering and the ethical dilemmas associated with manipulating natural populations. Encourage students to explore First Nations perspectives on conservation and biodiversity. Provide resources that discuss traditional ecological knowledge and cultural practices related to land stewardship and species preservation. Facilitate a discussion where students compare and contrast Western scientific approaches with First Nations ways of knowing, highlighting the importance of integrating diverse perspectives in conservation efforts. Encourage students to consider how Indigenous knowledge can complement scientific research and inform sustainable environmental management practices.

EXTEND THE LEARNING

DNA WORKSHOP

Organise a hands-on workshop where students can learn basic DNA extraction and analysis techniques. Provide materials and equipment for DNA extraction from plant samples. This activity provides practical experience with DNA technology and reinforces understanding of DNA's role in conservation. Consider requesting a DeadlyLearner session through DeadlyScience to support your class and virtually meet with a DNA expert.

EXTINCTION INVESTIGATION

Task students with investigating the extinction of Australia's fauna, such as the giant kangaroos and marsupial lions, and identifying factors that contributed to their demise, such as climate change, human hunting, or habitat loss. Students will explore whether similar extinction events could be prevented today through conservation efforts and habitat protection. Consider requesting a copy of the game, Go Extinct! Megafauna, to play with your students about Australia's megafauna.

POLICY ADVOCACY PROJECT

Challenge students to analyse existing conservation policies in their community and propose recommendations for integrating DNA technology into conservation management practices. Students can research successful policy implementations and identify gaps or areas for improvement.

Deoxyribonucleic acid (DNA) is a very long molecule that exists in every living thing, a unique genetic identifier. The more we discover about DNA, the better we understand the idiosyncrasies of vulnerable species, and therefore how to protect them. Genome sequencing involves sequencing every single gene in a species' genome. It allows conservationists to identify new species of plants and animals so they can be protected, and it's even helping to resurrect lost species.

Habitat destruction, climate change, feral animals, land clearing and other impacts have seen the rapid escalation of species extinction worldwide. DNA science and genetic sequencing allows us to potentially reverse this, which in turn will reinvest the ecosystem these species are a part of with the survival capacity they require to flourish.

DID YOU KNOW?

Tassie devils almost became extinct due to a contagious facial cancer (Devil Facial Tumour Disease (DFTD). By sequencing the devil's genome, and unravelling the genetic blueprint of the species, scientists gained critical insights into the biology, immune system and susceptibility to disease. This research helped identify genetic markers associated with resistance to DFTD, which paved the way for selective breeding programs aimed at producing devil populations capable of resisting the disease and helping the species recover.

MORE DEADLY SCIENCE

HOLD THE GENETIC CODE OF LIFE – IN YOUR HAND!

Extracting DNA from a strawberry. While we know that DNA is microscopic, there IS a way to see it without a microscope...

You will need:

- 2 x strawberries
- 1 x freezer (ziplock) bag
- 2 x teaspoons of dishwashing liquid
- ½ cup of water
- 1 x teaspoon of salt
- Fine-mesh strainer or coffee filter
- ½ cup rubbing alcohol (available at the supermarket)
- 1 x paddle pop stick
- 2 x glass cups/ jars
- Spoon
- Napkin

DNA exists in all living things – plants, animals and bacteria, but strawberries contain far more DNA strands per cell than other living things: eight instead of the usual four. In this experiment, dishwashing liquid dissolves the strawberry cell membrane, which helps release the DNA. Salt then breaks down the protein chains to release the nucleic acid in the DNA, and alcohol helps bind the DNA together so that it is visible to the naked eye!

- Pour rubbing alcohol into a glass jar and put it in the freezer to cool
- Add half a cup of water into the other glass jar
- Add 2 teaspoons of dishwashing liquid and 1 teaspoon of salt to the water
- Stir until the salt is dissolved
- Place two strawberries into the ziplock bag
- Pour the dishwashing and water solution into the bag, too, and seal with minimum air
- Mush up the strawberries with your hands until there are no large chunks left
- Place a strainer over the glass jar and pour the strawberry mixture into the strainer
- Use a spoon to extract the mixture through the strainer
- Pour the chilled alcohol into the cup with the extraction

Within a few minutes, a cloudy white substance will begin to form on top of the strawberry solution. This is the DNA. Use a paddle pop stick to remove it

- Place it on a napkin/kitchen roll and observe its properties
  - What does it look like?
  - What colour is it?
  - What could you do with this extracted DNA?

How incredible is it that you've just extracted the genetic code of life?!

DID YOU KNOW?

Deconstructing natural elements to be able to better understand them is an integral part of First Nations knowledge. Aboriginal and Torres Strait Islander people used the ancient separation technique of winnowing to separate seeds from chaff, using the wind to separate substances of different densities; and oils were extracted from plants by cold-pressing, which involves grinding the plant matter to a pulp and then squeezing until the oil is released. Beyond that still, Aboriginal communities have practiced selective breeding and cultivation of plants and animals for thousands of years, leading to the development of locally adapted varieties with desirable traits. Check out the book *Dark Emu: Aboriginal Australia and the Birth of Agriculture by Bruce Pascoe*. It's kinda like the precursor to DNA science! That's deadly...

DEADLY SCIENCE

Wingaru

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LINKS AND SOURCES

ABC Australia: Caring on Country

Backing First Nations-Led Approaches to AI Tech for Healthy Country

CSIRO: Tracking Feral Animals with Sensor Technology

Watarrka Foundation: Aboriginal Fire Management: What is Cool Burning?

Australian Citizen Science Association

Numbers of Living Species in Australia and the World: Department of Climate Change, Energy, the Environment and Water

Flora of Australia Volume 1

Improving policy efficiency and effectiveness to save more species: A case study of the megadiverse country Australia

Australia: State of the Environment 2021

Australia's Wonderful Birds

Bush Heritage

Australian Wildlife Rehabilitation Conference

Guide to Australian Bush Tucker

Through Our Eyes - Dhinawan 'Emu' in the Sky with Ben Flick

ABC Australia: Ancient astronomy and modern technology combine to tell stories of the night sky

Aboriginal Night Skies: University of Southern Australia

Picture Insect ID app

CSIRO guide to First Nations seasonal calendars

ABC Australia: Indigenous fire methods protect land before and after the Tathra bushfires

Cultural burns: Watarrka Foundation

Measuring Weather: Wind Speed, Gippsland Tech School

National Environmental Science Program: Kiwirrkurra Rangers are using a two way science approach to monitor and manage wild bilby populations

Invasive Species Council

Indigenous Rangers Program

WildSeek Project: Community Wildlife Intelligence Hubs

Make a Simple Water Filter Experiment: Sydney Water

Reverse osmosis systems

UV water purifiers

Activated carbon filters

Membrane filtration technologies: such as ultrafiltration (UF) and nanofiltration (NF)

Electrochemical water treatment

Advanced oxidation processes

Turning River Water into Drinking Water: Sydney Water

Guardian Australia: Bringing the thylacine back to life

Should We Change Species to Save Them?: NY Times

Our Knowledge, Our Way Guidelines: CSIRO

RESOURCES

Australian Geographic Book 1: Animal Adaptations

Australian Geographic Book 6: Animal Survival

Australian Geographic Book 8: Renewable Resources

Bijil Ba Wudhi Deberra by Auntie Lorraine Padgham

How the Birds Got Their Colours by Mary Albert

Amazing Animal Journeys by Jennifer Cossins

Gurwal The Whale: an ancient story for our time, by Max Dulumunmun Harrison

Dark Emu: Aboriginal Australia and the Birth of Agriculture by Bruce Pascoe

Go Extinct! Megafauna board game [available from DeadlyScience

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