Ngarrindjeri culture embedded in

Year 10 Science

Image. Carolyn Schultz

Activity Booklet for Students

Theme A – Rushes, Weaving and Plant Cell Walls
Theme B - Plant Databases
Theme C - Indigenous Land Management / Biodiversity
Theme D – Seeds, Human Nutrition and Germination
Theme E - Australian Native Foods: Feeding Australia Sustainably
Acknowledgements

We are grateful to the Yitpi Foundation for encouragement and financial support for this project.

Yitpi is the Kaurna word for seed.

We dedicate this project to the late Professor Tony Rathjen (founder of Yitpi Foundation), and past and present Aboriginal peoples in Australia whose way of life changed forever with the invasion of Australia by Europeans over 200 years ago.

Carolyn Schultz, Fiona Ryan, Maarten Ryder, Sarah McDonnell, Verna Koolmatrie and Kevin Kropinyeri.

Special thanks to Verna Koolmatrie, Kevin Kropinyeri, Derek Walker, Clyde Rigney and other members of Raukkan Community in the Coorong Ngarrindjeri Lands for collaborating on this project.
And to Aunty Ellen of Camp Coorong for teaching us to weave.

Ngarrindjeri Flag designed by Matt Rigney

The 18 dots represent the 18 Laklinyeris (tribes) that make up the Ngarrindjeri Nation. The spears represent the traditional fishing spears of the Ngarrindjeri. The Boomerang is the Sacred Boomerang that when thrown circles the Laklinyeris, informing their clan leaders to attend a Nation Meeting called Tendi (which makes and interprets Ngarrindjeri Law). The Blue represents the waters of Ngarrindjeri Country. The Sun gives life. The Ochre colour of the Boomerang represents our Mother - Mother Earth.


Version 1.1 April 2018
Ngarrindjeri Vision for Country

Kungun Ngarrindjeri Yunnan

(Listen to what Ngarrindjeri people have to say)

“Our Lands, Our Waters, Our People, All Living Things are connected. We implore people to respect our Ruwe (Country) as it was created in the Kaldowinyeri (the Creation). We long for sparkling, clean waters, healthy land and people and all living things. We long for the Yarluwar-Ruwe (Sea Country) of our ancestors. **Our vision is all people Caring, Sharing, Knowing and Respecting the lands, the waters and all living things.**

From Ngarrindjeri Nation Sea Country Plan (2006)

“This vision makes clear the essential link between the wellbeing of individuals, families, communities, their unique ‘world view’ and their right and responsibility to care for Ngarrindjeri lands and waters.”

From Hemming and Rigney (2015)

**Our Goals are:**

- For our people, children and descendants to be healthy and to enjoy our healthy lands and waters
- To see our lands and waters healthy and spiritually alive
- For all our people to benefit from our equity in our lands and waters
- To see our closest friends - our Ngartjis (special animals) - healthy and spiritually alive
- For our people to continue to occupy and benefit from our lands and waters
- To see all people respecting our laws and living in harmony with our lands and waters.”

From Ngarrindjeri Nation Sea Country Plan (2006)
Introduction

“The Ngarrindjeri are ‘water people’ from the Lakes, Coorong, Great Southern Ocean and River systems of the area south and east of Adelaide in South Australia. For thousands and thousands of years Ruwe / Ruwar [Country] provided the Ngarrindjeri with an abundance of fresh foods, fruits, vegetables, medicines and materials for making what was needed for living”.

“The Ngarrindjeri believe that the People, the Land, the Waters and all other living things are as one; together they create a system interconnected and vibrant with life. It is the balance between the many unique ‘ecological systems’ that have been damaged with the need to produce food for an ever expanding population”.


The authors recognise and acknowledge all Indigenous peoples of Australia.
Ngarrindjeri native title claim settled

“Within its pages lay final proof of their traditional ownership of 578 parcels of land and water within the Murraylands, Coorong and Fleurieu – their native title rights” ….

“Justice White said the occasion was about more than an agreement between the Ngarrindjeri people and the state of South Australia; it was an agreement by which every Australian was bound.”

"Today marks the formal recognition of the traditional ownership, by the Ngarrindjeri people, of this land," he said.

"They are being recognised, in effect by all the people in Australia, as the Aboriginal people who have occupied this country prior to European settlement."

"So also is the maintenance of their connection to this land being recognised."

"The court's orders do not have the effect of creating native title ... instead they are a declaration that native title exists in the land and has always existed, at least since the time of European settlement in 1788."

From the Murray Valley Standard (newspaper), December 14, 2017

Appropriate Terminology, Indigenous Australian Peoples

Language is a powerful tool for communication. Here we provide a snapshot of information provided by Flinders University (www.flinders.edu.au/CDIP, General Information Folio 5), that lists more and less appropriate language, and provides a context for the reasoning behind these recommendations. The full pdf is provided in additional resources.

Teachers and students are encouraged to read the entire document and get to know some of their local Aboriginal people to get a personal perspective of the most appropriate language.

No more classifying people

More appropriate

• Indigenous Australian peoples
• Aboriginal peoples
• ‘Torres Strait Islander people or peoples’ may be preferable, depending on the context

Using the more appropriate terms helps to avoid attempting to inaccurately label, categorise and stereotype people.

Less appropriate

• Transitional
• Traditional
• Contemporary
• Modern
• Urban
• Rural
• Isolated or remote Aboriginal people/Torres Strait Islander people

The less appropriate terms can be extremely offensive to many Indigenous Australians as they categorise people and assume that there are real differences between Indigenous Australian peoples of different areas. It is critical that they are not used to refer to or to attempt to classify Indigenous peoples.

In ‘long-settled’ areas, the implication that ‘urban’ Indigenous Australians are less Indigenous than ‘traditional’ or ‘transitional’ people and cultures is most offensive. A real issue is the ‘real Aborigine’ syndrome – the idea that the ‘real’ Aboriginal people live in Arnhem Land or the Central desert, and that only ‘traditional’ Aboriginal people and cultures are ‘really Aboriginal’.
Inquiry skills based on Indigenous culture and plant use

Theme A: Rushes, weaving and plant cell walls
- Task A1. Cultural connections, rushes and plant cell walls*
- Task A2. Cardboard structure and strength*
- Task A3. Plant fibres and their uses – weaving with different rushes*
- Task A4. More uses for plant fibres – making rope*

Theme B: Plant Databases
- Task B1. Current plant databases*
- Task B2. Using information in databases*
- Task B3. Evaluating information
- Task B4. Indigenous knowledge and cultural databases*

Theme C: Indigenous Land Management / Biodiversity
- Task C1. Examples of Indigenous land management
- Task C2. Why is biodiversity important?
- Task C3. Exploring your area*
- Task C4. Your plant in nature*
- Task C5. Taking action for biodiversity*

Theme D: Seeds, Germination and Human Nutrition
- Task D1. Seeds provide varied and nutritious food supply *
- Task D2. Seed germination *
- Task D3. Seeds provide new sources of genetic diversity
- Task D4. Two ways of producing new weaving plants*

Theme E - Australian Native Foods: Feeding Australia Sustainably
- Task E1. Sustainability of the food supply chain *
- Task E2. Muntries, an Indigenous berry from South Australia (SA)*
- Task E3. Indigenous use of muntries and food preservation*
- Task E4. Food and Careers

* Tasks with an asterisk are practical & / or computer (ICT) activities

Throughout this booklet, Aboriginal cultural information is shaded in green and words from the Ngarrindjeri and Kaurna language groups are highlighted in different colours.
Overview of Theme A: Rushes, weaving and plant cell walls

Cultural context

The cultural uses of rushes is used to highlight the links between

man-made items and the biology of a plant cell

as well as the importance of connections,

both physical and cultural, for strength and resilience.

An introduction to the cultural use of rushes by the Ngarrindjeri people looking at what physical attributes of plants are favourable. This is achieved through species analysis and comparison and practicals which illustrate plant cell wall strength.

Key Concepts

Rushes and reeds are a type of plant where the green tissue or stems come from the ground and do not have leaves along most of the stem.

Stems are made up of many plant cells and each cell has a plant cell wall.

Plant cell walls are made up of many layers, that can make them thick and stiff, or thin and flexible or somewhere in between.

Stems often contain long fibres which can be used to make ropes, nets or even paper. Or the whole stem can be used to make baskets and mats.

Knowing which rush species to use for what purpose requires knowledge and observation skills which you will learn about in these four related activities.
Task A1: Cultural connections, rushes*

**Discover**
- Cultural use of rushes by Ngarrindjeri people
- Why particular varieties of rushes were selected

**Understand**
- Biological variation

Native fibre plants are used by Aboriginal Australians for different purposes, such as making fish traps and basket weaving. An important basket weaving plant for the Ngarrindjeri and Kaurna peoples is the rush *Cyperus gymnocaules* (bilbili).

![Image: Carolyn Schultz – My first go at weaving at Camp Coorong](image)

“The weavers continue to pick both the thick and thin rushes until they have what they need. .... The thick rushes are used for the centres the thin rushes to weave with.”

Read the following.

Cultural use of rushes by Ngarrindjeri peoples

“Ngarrindjeri women knew how to make baskets, big baskets for carrying fish and little baskets for special items, winnowers, fish scoops, mats to be worn, mats to sit on, mats as back warmers and mats that are folded over to make coffins.” (Bell 1998: 78)

“Sometimes along the roadside, because it’s not on the farmer’s property but just where the water runs off the road, the rushes are growing very nice, and you’ll see someone picking them. But I move around in a cycle. I pick and move and let the other lot grow. They grow very quick. Later I can return when the young ones have come up again. .... ....It’s cultural weaving because I use the same rushes that my Old People used - it’s the three pronged type of fresh water rushes - there’s a lot of different types of rushes, this is one that was used because it lasts a long time.”

(Aunty Ellen Trevorro in Bell (ed.) 2008: 7-8)

One of the important rushes used by the Ngarrindjeri peoples for weaving is called bilbil and has the Latin name Cyperus gymnocaulos.
Look at the pictures of the two rushes below. (There are also images on the following 2 pages to help you). **Note the differences and label the leaf, stem and seed.**

![Image of Rush 1 and Rush 2](Image. Carolyn Schultz)

How many differences can you spot between the two types of rush species? Describe at least three.
Which one of these two species is most likely to be the basket weaving rush?

*Based on the quote by Aunty Ellen Trevorrow,*

“It’s the three pronged type of fresh water rushes”

*Aunty Ellen Trevorrow in Bell (ed.) 2008: 7-8*

How do you think Indigenous people know which rushes were better for making baskets?

Why do you think the “three pronged rush” is the preferred rush for basket weaving?

How does basket weaving represent family and culture?

Before you start weaving, you will compare some physical properties of two types of rushes.
Measurement and replication are important for determining if observed differences are consistent. Use the images on the next few pages to measure, record and analyse the actual differences between the stems of these two species.

**Complete the table below for each species** (measure to the nearest 0.5 mm)

<table>
<thead>
<tr>
<th>From left to right</th>
<th>stem width (magnified) in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rush 1 (Cg)</td>
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<tr>
<td>Stem 1</td>
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<td>Stem 2</td>
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<td>Stem 10</td>
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<td>Stem 11</td>
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</table>

Measure the diameter of at least 10 stems from each of the two species of rush, *Cyperus gymnocaules* and *Cyperus vaginatus*. You can use fresh, dried or even the provided photographs for your measurements.
Where along the stem do you think is the best place to take the measures?

*You could choose the top, middle, bottom or even a set distance from the top or bottom.* Choosing a consistent position along the stem will help you collect **less variable**, and therefore **better data**.

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**Explain the reasons for your choice.**

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Even within one species there is variation in thicknesses of stems. This is known as biological variation, so it is necessary to take many measurements, not just one.

This variation in stem thickness in the preferred basket weaving rush is recognised and exploited by Ngarrindjeri peoples

“…. The thick rushes are used for the centres the thin rushes to weave with.”

Why do you think the thinner rushes are used for weaving? Explain your answer.

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Cyperus gymnocaules (the basket weaving rush): Rush 1

Image. Carolyn Schultz
Cyperus vaginatus: Rush 2

Image. Carolyn Schultz
Data Analysis

Copy and paste the information into a spreadsheet such as Excel®.

1. Calculate the **average** width of the stems for each rush.
2. Draw a graph of the data

Fill in the blanks

For the weaving rush, *C. gymnocaules*,

Based on the sampling of $n =$ ________ stems, the **range** of sizes of stem (magnified) is from ________ to ________ (smallest to largest) and the **average** stem width (magnified) is ________ mm.

For the weaving rush, *C. vaginatus*,

Based on the sampling of $n =$ ________ stems, the **range** of sizes of stem (magnified) is from ________ to ________ (smallest to largest) and the **average** stem width (magnified) is ________ mm.

What is the **difference** in average thickness between the two stems, in millimetres (mm)?


How confident do you now feel in saying that the stems of Rush 1 are thinner than the stems of Rush 2?
Use of rushes for weaving

Dried rushes are used for weaving by the Ngarrindjeri people to make items for everyday use including mats, baskets and vessels for transport. The fibres which make up the stem give the rush physical flexibility.

Study the above picture of a woven mat. Thinking about how the mat would have been created, answer the following questions.

Estimate how many stems make up the centre of each loop.

What is connecting the loops together?

What are the likely benefits of this arrangement?
Task A2: Cardboard structure and strength and plant cell walls

Discover
The molecular structure of plant cell walls
Structure function relationships in weaving and cardboard

Understand
How layers and cross-links contribute to strengths in nature, man-made products and cultures

Cardboard is made of cellulose and has some features of a plant cell wall.

The strength of cardboard and of plant cell walls can be changed by changing the layering, and by the content of each layer.

Images: Cardboard (Jason Cartwright) and cell wall (Caroline Dahl (Wikipedia)).

Predict and test what happens when changes are made to layers of cardboard. Compare your results to changes in Aboriginal communities when a generation (layer) of the community is removed.

“The removal of a generation caused a break in the family kinship system and the impact of these children’s removal was felt at the time by all family members and as well in the years that followed”

Ngarrindjeri Lakun : Ngarrindjeri Weaving pg 9
**Plant Cell Walls**: Plants keep their shape due to their *cell wall*, which is made of chains of sugars called *cellulose*. The cell wall also gives the plant strength and allows it to grow tall, just like a skeleton.

![Image](http://www.nature.com/scitable/topicpage/plant-cells-chloroplasts-and-cell-walls-14053956)

**Inside a plant cell wall**

The picture above depicts the inside of the plant cell wall. It has many parts that create its structure. These parts include long fibres, *cellulose*, and cross linking molecules including *hemicelluloses* and pectins.
Watch the following video(s) to learn more about plant cell walls.

**Video 1**

Watch the following video on cellulose – the most abundant polymer on earth. Cellulose provides the framework for the plant cell wall. Providing it with strength.


© Education Services Australia Ltd and CSIRO, 2013

**Video 2**

This second video shows how rigid the cell wall is, and shows that the cell wall and plasma membrane are two distinct structures. This can be used as a practical activity.

https://www.youtube.com/watch?v=mewq7ZfXcQ

Brainstorm why cell walls are important for plants.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

What physical attributes of the plant are important for the cultural practice of weaving?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Cardboard structure and strength

Look at the pieces of cardboard provided (or the images below).

http://www.photos-public-domain.com

Which image of cardboard looks most like a plant cell wall? Explain why.

________________________________________________________

________________________________________________________

Look at the different cardboards. Which one is (looks) the strongest? Explain why.

________________________________________________________

________________________________________________________

What design features are giving the cardboard strength? How could you test the strength of cardboard?

________________________________________________________

________________________________________________________

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Predict what would happen to corrugated cardboard if the connections between the layers were not strong?

Peel off one of the layers of cardboard. Describe the changes you observe in the strength and flexibility of the cardboard.

Imagine that one layer of cardboard represents a generation in an Indigenous community. Explain what changes would be noticeable in the community if a layer (or generation) is removed and how this could affect the strength of the community.
Task A3 Plant fibres & their uses - weaving with different rushes*

**Discover**

How to weave
Aboriginal cultural practices ensured
the right plants were used for weaving

**Understand**

Physical properties (eg flexibility)
are in part due to plant species,
and can be altered by processing

Remember what Aunty Ellen said about the best rush for weaving

... it’s the three pronged type of fresh water rushes - there’s a lot of different types of rushes, this is one that was [is] used because it lasts a long time.”

Aunty Ellen Trevorrow in Bell (ed.) 2008: 7-8

In this activity you will experience other benefits the preferred rush, *bilbili*, had for making baskets.

Image: Carolyn Schultz – My first go at weaving at Camp Coorong

“The fresh water rushes are very strong and ideally suited for weaving, the rushes are picked green, dried and then stored ready for use. When needed for weaving the dried rushes are soaked to become flexible again. Rushes can be collected all year round but the summer season is the ideal time for picking the rushes.”

Ngarrindjeri Lakun : Ngarrindjeri Weaving 2013 pg 15
Compare the dried rushes to the re-wet rushes. Describe at least 3 differences between the dried and re-wet rushes of *bilbili*, *Cyperus gymnocaules*.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

Plan and conduct an experiment to collect quantitative data of the difference in flexibility of the wet and dried rushes. *Record notes here from the class discussion prior to starting your experiment.*

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
Material science: Fit for purpose

A.  
B.  

A. (zoomed in)  B. (zoomed in)

Describe the likely use of the two woven articles, A and B above.

________________________________________________________________________

What differences in weaving technique (construction method) can you observe between A and B?

________________________________________________________________________

List advantages and disadvantages of the two weaving techniques.

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<tr>
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Weaving

Weaving is done by people of all ages, both women/girls, men/boys.


How to Weave

The baskets, as well as other woven forms such as fish scoops and mats, are made from sedge grasses which are also known as freshwater rushes. The rushes grow in sandy soil along the edges of the Coorong, Lakes and River Murray waterways.

The rushes are pulled from the ground 2 or 3 at a time and gathered into a bundle which is then tied with a rush. The weavers continue to pick both the thick and thin rushes until they have what they need. The heads (the juvenile plants growing on the tips of the rushes) are snapped off and left to grow for future generations and the bundles are shaken to remove any seeds. The thick rushes are used for the centres the thin rushes to weave with.

Place the rushes in a dry environment where air can circulate around and through them. It will take 3-6 weeks, depending on the season, for the rushes to dry and they need to be turned while they are drying.

Thin bundles of rushes, which we call centres (or fillers), are held together with a single weaving rush, the weaving rush is stitched around the centres to form the coil and the coils are connected to each other as the item progresses.”

© Ngarrindjeri Regional Authority. Illustrations © Tim (Trappa) Barnes 2011; Photographs © EarthArt
Weaving with two different rushes – What rush do you prefer?

You have been provided with a “starter” basket made from *bilbili, Cyperus gymnocaulos* stems. Start weaving with the free end of the weaving rush as demonstrated by your teacher.

*The instructions and illustrations are from*

Ngarrindjeri Lakun: Ngarrindjeri Weaving” (2013) pg 78 – 83. © Ngarrindjeri Regional Authority. Illustrations © Tim (Trappa) Barnes 2011; Photographs © EarthArt

**Step 1. You will need** -

- Dried freshwater rushes, *the rushes need to be soaked for an hour in hot water and 3-4 hours in cold water until they soften and become flexible.*
- A cutting tool is used for trimming the ends of the rushes-scissors are ideal.
- A pointed object like a skewer to loosen any tight stitches.

The traditional tools include a sharp shell for cutting and a sharpened bone with woven string attaching it to the wrist for opening the stitches - this is called an awl.

You have been given a starter, that looks like this


Note:

*centres = fillers = a bundle of rush stems.*

- Start weaving on this starter, using the weaving stitch (very similar to blanket stitch).
- Continue weaving, learning how to turn corners, and add new rushes as needed – as directed and explained below.
- Add a new rush stem for weaving as needed (make sure you use a stem of *bilbili, Cyperus gymnocaulos*).
STEP 3  The Weaving Stitch

- Take the weaving rush and place it over and then back under the centres.
- Reach through the loop (made by the weaving rush going over the centres) and take hold of the weaving rush.
- Bring the weaving rush up through the loop and pull tightly.
- Repeat the process – weave over, under and through the loop.
- Weave 11 stitches or as many as you want.

Note: the number of stitches at the start determines the shape and size of the piece being woven. Others know this stitch as blanket stitch.

STEP 4  Making the First Corner

- Turn the last 4 - 5 stitches around 180 degrees to face the direction they came from.
- Weave into the opposite side placing one stitch in each space created by the previous stitches.

- Continue weaving back until you reach the first stitch you have placed on the centre rushes.

STEP 5  Making the Next Corner

- When you reach the end, weave another 4 - 5 stitches along the centres.
- Trim the short ends at the starting point.

- Turn the last 5 stitches around the corner and continue to weave into the next stitch.
STEP 6 Replacing the Weaving Rush

- Select another weaving rush and trim the ends (if required).
- Loosen the last stitch.
- Push the new weaving rush through 10 centimetres.
- Tighten the last stitch.
- Lay the old weaving rush down with the centres.
- Start weaving with the new weaving rush.

STEP 7 Weaving the Corners

The stitches can become further apart at the corners as the piece grows in size.

To keep the stitches evenly spaced you may need to weave 2 stitches in the one space when weaving around the corner section.

The following information is offered to assist you when you are learning our Ngarrindjeri weaving.

Replacing the centre rushes when they become short -

- Select another thicker rush and trim the ends.
- Open the centres outward.
- Push the new thicker rush into the centres.
- Move the centres back together and continue with the weaving stitch.
- Replace each of the centres as they become short.

Shaping the Weaving

The shape of the woven item is determined by the position the weaving rush is pulled away from the weaving when tightening each stitch.

To make your piece, for example a mat or the base of a basket, the weaving rush is pulled straight out and in line with the weaving.

To shape the sides of a basket or bowl pull the face up at an angle from the weaving. When you pull the weaving rush up at 90 degrees from the weaving the side wall will begin to turn up and after a few rows will be at right angles to the base.

Finishing the Weaving

To finish your weaving -

Taper the centres to form a point approximately 5 centimetres from the last stitch.

Continue to weave to the end of the tapered centres.

To finish, thread the weaving rush back through the woven stitches and cut off the excess weaving rush.
Weaving with the “other” rush, *C. vaginatus* (or *Ficinia nodosa*)

- Once you have completed one full round AND you need to add another rush for weaving, choose a stem from *Cyperus vaginatus* (or *Ficinia nodosa*), the “other”, less-preferred rush.

Weave with the “other” rush for a few minutes.

Describe any differences between how easy or hard it is to weave with the “other” rush, *C. vaginatus*.

How would the lives of the Ngarrindjeri people have been affected when access to basket weaving rushes was prevented by early colonists? How is it still being affected by over-grazing and/or as the lower lakes of the Coorong became more saline?
Task A4. More uses for plant fibres – making rope

Discover
How to make rope from plant fibres
Plan an experiment to test the effect of environmental factors on man-made fibres

Understand
How man-made fibres are affected by the environment

Rope and string are widely used by Indigenous Australians. They can be made from a group of plants known as the flat-leaved sedges or bulrushes.

*Dianella*, flax lily  
*Lomandra* spp, mat rush  
Images. Carolyn Schultz.

Bulrushes were important for food and fibre


“Making a fishing net at Encounter Bay in 1844. The seated woman is softening the bulrush-root fibre by chewing it; the man is rolling the fibre to make cord for a net like the one on the roof of the whale-bone hut.”
A long time ago two Ngarrindjeri men went fishing in a bay near Lake Alexandrina to catch the thukeri mami (bream fish). They set off in their bark canoe to catch the big fat thukeri. They fished and fished until their canoe was over full and they said we have plenty of thukeri we will paddle to shore before we sink. As they paddled to shore they saw a stranger coming towards them so they covered up the thukeri with their woven mats they said this man might want some of our thukeri, when they approached the shore the stranger said to them hey brothers I'm hungry have you got any fish to share, but the two Ngarrindjeri men said no we haven't got many fish we only have enough to feed our families. So the stranger began to walk away then he turned and said you have plenty of fish and because you are greedy and don't want to share you will not enjoy the thukeri fish ever again. As the stranger walked away the two Ngarrindjeri men laughed at him. When the two Ngarrindjeri men unloaded the thukeri on to the banks to scale and clean them, they saw that their nice big fat thukeri were bony and they didn't know what had happened. The two Ngarrindjeri men went home to the campsite in shame and told the Elders what had happened. The Elders were angry and said the stranger was Ngurunderi our Spirit Ancestor and because you two were greedy and would not share with him he has put a curse on our thukeri mami. Now all the Ngarrindjeri people will be punished.
Use the resource ‘Ngarrindjeri Nation Sea Country Plan (2006)’ to describe the types of fishing aids that are still being used by Ngarrindjeri peoples, and were developed thousands of years ago to catch fish and other resources for their Yarluwar-Ruwe (Sea Country).

The Kaldowinyeri (Creation) story Thukeri, has a key message, on the importance of sharing.

What laws are currently in place in South Australia to ensure that harvesting of ‘fish’ (fishing) is conducted in a sustainable manner to ensure ‘sharing’ of current resources, and to ensure that a diversity of fish and shellfish will be available for future generations.

What other things are currently made out of plant fibres or were historically made out of plant fibres?
Making Rope

You will make two pieces of rope, joining them in slightly different ways, and then test the strength of the 2 pieces of rope.

You have been provided with dried leaves from a native plant that has strappy leaves such as Dianella or Lomandra. The leaves have been dried, then soaked overnight in water.

Watch this video to see how easy it is. The example below was made with Lomandra longifolia.

http://www.abc.net.au/gardening/stories/s3861974.htm

Image. Carolyn Schultz.
## Method for Making Rope

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tear the leaves in long strips such that you have 4 x 2 pieces, approx. 3 mm wide.</td>
</tr>
<tr>
<td>2.</td>
<td>Take two moistened straps and twist them in the middle until they fold into themselves. Loop the bend over your right index finger.</td>
</tr>
<tr>
<td>3.</td>
<td>Hold the leaves so they're horizontal, twist the left (top) strands away from you 2 times and then bring towards you and down over the strand in your right hand.</td>
</tr>
<tr>
<td>4.</td>
<td>Take the new left strand, twist twice away from you, then bring forward and down, just like the last one, and repeat 3-4 times. Now place the loop over a retort stand and continue until you have <strong>6 cm (rope 1)</strong> or <strong>2 cm (rope 2)</strong> left. Trim the ends to the same length if necessary.</td>
</tr>
<tr>
<td>5.</td>
<td>To add new strands, twist 2 pieces as in Step 2, then bring them to the left and right ends. Now twist first the new piece into the left strand, then the right, and continue as normal until you are finished.</td>
</tr>
<tr>
<td>6.</td>
<td>Tie a knot in the free end.</td>
</tr>
<tr>
<td>7.</td>
<td>Make a second rope with only a 2 cm overlap at step 4 (joining in new leaves)</td>
</tr>
</tbody>
</table>

Images. Carolyn Schultz.
Test the strength of rope 1 and rope 2

1. Leave one end of the rope attached to the retort stand.
2. Attach a tubing clamp to the end of the rope.

3. Hook weights, one at a time, to each rope, until the rope breaks
   a. use fishing sinkers or other suitable weight (basket+coins) you can count to make it easier to determine the final weight

4. Make notes in the table below each time you add a new weight and record any changes you observe to the rope.

<table>
<thead>
<tr>
<th>Weight added</th>
<th>Rope 1</th>
<th>Rope 2</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 g</td>
<td>intact</td>
<td>intact</td>
<td></td>
</tr>
</tbody>
</table>
Describe the differences between rope 1 and rope 2.


Why is one rope stronger than the other?


How do you think you could make ropes that were even stronger?
Lifespan of man-made materials

Remember “The fishermen made their own fishing lines, called nungi, from thin rope which they had made from the nearby water reeds. They also made hooks from very sharp bird bones…….”

http://dreamtime.net.au/thukeri/

Making a fishing net from thin rope is time consuming and you would want to use it over and over again.

What strategies do you think Aboriginal people use to extend the life of their fishing lines/nets and traps?

What environmental factors could affect the lifespan of a rope?

From your experience, predict what environment would be the harshest for rope made from plant fibres, by ranking the follow conditions.

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immersion in fresh water</td>
</tr>
<tr>
<td>Immersion in salt water</td>
</tr>
<tr>
<td>In air, in shade</td>
</tr>
<tr>
<td>In air, in full sun</td>
</tr>
</tbody>
</table>

Plan and execute a series of experiments to test your theory.
Overview of Theme B – Plant Database

Data and information are easy to find. Knowledge transfer, retention and application are important for communities, organisations and workplaces.

<table>
<thead>
<tr>
<th>Data</th>
<th>Information</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Wisdom</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>THE FUTURE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>What is best? Doing the right things What should be done</td>
</tr>
</tbody>
</table>

Image: Nick J. Webb

The activities in Theme B will allow you to compare the changing ways of learning, sharing and using knowledge.

Indigenous knowledge about Country is passed down through generations. Learn about the cultural practices that maintain the integrity of information. Discover the importance of a common language for knowledge transfer and for analytic skills to investigate the quality and appropriateness of data.

Paper-based data that has been collected for hundreds of years and stored in museums, herbariums and libraries is now being converted into electronic form and shared as computer accessed databases.

The databases you will work with, FloraSA database and Atlas of Living Australia are freely available to people and organisations, such as those working on biodiversity and conservation projects. These projects need people with expert local plant, animal and habitat knowledge.

Now you don’t have to go to University to get this knowledge, you can learn by yourself or from others, such as volunteer groups and access this information anytime and anywhere as long as you have the internet and an appropriate device.
Task B1: Plant Databases

Discover

FloraSA database

Understand

Importance of different environments for different plants

Databases enable plant location, variety and season to be stored electronically and shared with the wider community.

“Ngarrindjeri women knew [know] how to make baskets, big baskets for carrying fish and little baskets for special items, winnowers, fish scoops, mats to be worn, mats to sit on, mats as back warmers and mats that are folded over to make coffins. They knew [know] what plants to collect for the different purposes, when was [is] the best time to collect the plant material and how to prepare it. “

Bell (ed.) 1998: p78

Watch the video to learn about the Meningie Foreshore Restoration Project

Images from video: https://vimeo.com/95818939

How many seedling were grown for this project?

________________________________________________________________________

What type of environment do the basket weaving rushes need to grow?

________________________________________________________________________

You will now use the eFloraSA database to investigate where two species of rushes grow.

In current times we have turned to electronic databases to store information in science, including that of plants.

Follow the instructions below to explore a commonly used database about South Australian plant species.


1. At box GENUS type: Cyperus
2. At box SPECIES type: Gymnocaules
3. Select ‘Search’
4. Click on the link for “Cyperus gymnocaules

   CYPERACEAE  91,504
   Cyperus
   Cyperus gymnocaules Staud. – NW LE GT FR EA EP NL MU YP SL SE
   – Cyperus vaginatus R.Br. var. denseflora Benth.

5. Click on the link for “Cyperus gymnocaules”
6. The “Electronic Flora of South Australia species Fact Sheet” will appear on the next page and has a map of South Australia in the bottom right hand corner.

7. Click on the map.

**Click on three of the squares in the distribution map for *bilbil* (Cyperus gymnocaules) you generated to see where the plant sample was collected from (see next page if you don’t have access to the internet).**

**For each sample, answer the following 3 questions.**

What year was the sample collected?

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What type of environment (habitat) was the plant growing in?

*Include information such as features (rivers/creeks), terrain, soil type, and other plants*

<table>
<thead>
<tr>
<th>Sample 1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What was the nearest place to where you are now?

________________________________________________________________________

Is the data mostly quantitative or qualitative?

________________________________________________________________________
Analyse

In what areas of the state does the basket weaving plant *bilbili* (*Cyperus gymnocaules*) grow?

List at least two major geographical features (rivers, lakes, hills) where *bilbili* appears to grow.

________________________________________________________________________

________________________________________________________________________
**Compare** - Repeat the search for Species 2: *Cyperus vaginatus*

What do you notice about where this species grows in comparison to the *bilbili*?

Which species is more abundant?

What role could Aboriginal peoples have had in increasing the habitat range of the basket weaving rush?
Example of 2 entries for *Cyperus gymnocaulus*


Task B2: Using information in databases*

Discover
Atlas of Living Australia
Spreadsheet skills

Understand
Role of ICT in collecting, presenting and interpreting complex datasets

Turning data into information is not easy.

Making information available to everyone is even harder.

The Atlas of Living Australia is the result of funding from governments and organisations around Australia to pool resources and data to facilitate the transition from data to information, so that you can turn knowledge into understanding and wisdom.

Can you think of ways to make it even better?
You can use databases to track changes and development over time. This can be useful for highlighting important times and creating comparison.

Create a database of information and use this to explore the benefits and applications of herbarium samples/databases. Start with 1850 then to present time in 25 year increments.

| 1850 | 1875 | 1900 | 1925 | 1950 | 1975 | 2000 |

How could this data be presented so that it is more informative or easily interpreted?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Why do you think bilbili is found in some areas and not others? Provide 3 – 4 ideas written in sentence form.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Manual curation and analysis of historical records is time consuming, as you have found out.

Innovations such as computers and high speed internet have made it possible to collate and share data.

Go to the website

- Type in the *Cyperus gymnocaulos*, and press **search**
- Click on the name, usually at the top of the list

**Species: Cyperus gymnocaulos Steud. – Spiny Sedge**

**Kingdom: Plantae**

Record a sighting/share a photo  Occurrences: 3,058

- select **view records** (below the map).

Explore the information provided, by clicking on some of the TABS on this page, and other pages.
ASSESSMENT TASK:

Describe at least 5 different sorts of information that is summarised at Atlas of Living Australia, for the plant *Cyperus gymnocaulos*.

What information did you find most interesting and why?

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Write instructions, with appropriate web links, on how you download all of the records on the plant *Cyperus gymnocaulos* into a spreadsheet.

*Complete these questions based on the information in the downloaded spreadsheet*

How many rows (entries) are in the file?
____________________________________________________________________________________

What column contains the information on the year the sample was collected?
____________________________________________________________________________________

How many entries contain the word “river”? *Hint: use the find all feature.*
____________________________________________________________________________________
Task B3. Evaluating information

**Discover**

Ngarrindjeri country

**Understand**

Information transfer, accuracy and application

*Databases are sources of information. But sometimes the information we find in one place is different from what we find in another. That is why we should always look at multiple resources when conducting scientific inquiry.*

Understanding the difference between primary and secondary sources of information can be helpful, but it is also important to consider the limitations in the collection of primary information such as differences in first languages.

Language and cultural differences made it difficult for early colonists, with their history of land ‘ownership’, to understand Indigenous cultures with their cultural beliefs based on land ‘custodianship’. Colonists attempted to draw a precise boundary between Ngarrindjeri and Kaurna lands, where no fixed border existed.

Maps such as the AIATSIS language map (see Question 5), use ‘fuzzy boundaries’ to reflect the shared ‘Country’ that neighbouring Indigenous groups managed.

Photos: C Schultz. Two panels of a series of interpretative signs at Cape Jervis, an important meeting place for Ngarrindjeri and Kaurna peoples.
The maps below both show the boundary of Ngarrindjeri country. This example illustrates how information from two sources can be different.

<table>
<thead>
<tr>
<th>Ngarrindjeri country</th>
<th>Map 1</th>
<th>Map 2</th>
</tr>
</thead>
</table>

List at least three differences between the two maps:

1. Read this description of Ngarrindjeri country by the early colonists who gave new names to Ngarrindjeri Country landmarks.

“The land of the Ngarrindjeri nation, according to Taplin (1879) and Jenkin (1979:11), is “a great triangle of land” extending from the western extremity of **Cape Jervis** on the tip of Fleurieu Peninsula, north to **Swanport** near Murray Bridge on the Murray River, and south around **Lake Alexandrina** and **Lake Albert**, and stretching further south along the Coorong to Kingston.

2. Find one or more maps that includes the places listed above (in bold: Cape Jervis, Swanport, Lake Alexandrina and Lake Albert).
Draw and label their locations on the map below.

3. List your source(s) of information.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

4. You are told by a leading authority that the information in the written statement (1) is correct. Do you think that either of the maps accurately represents Ngarrindjeri country? Explain your answer.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

54
5. Is the conclusion you made consistent with the language map of the Ngarrindjeri peoples? Explain your answer.

Map: David R Horton (creator), © Aboriginal Studies Press, AIATSIS, and Auslig/Sinclair, Knight, Merz, 1996.

6. Is bilbili found throughout all of Ngarrindjeri country? Explain your answer.
Task B4 Indigenous Knowledge and Citizen Science

Discover

How cultural knowledge is preserved
Citizen Science

Understand

Quality control in Indigenous and current knowledge systems

Sharing Knowledge

Learning by doing is how most of us learn. In Aboriginal cultures, learning is part of every day life from a young age.

“Both men and women hold special cultural and environmental knowledge and both men and women have always been involved, and continue to be involved, in passing down our knowledge between generations and in decision-making about Ngarrindjeri affairs, land waters and resources.

Ngarrindjeri people hold cultural and spiritual connections to particular places, to particular species of animals and plants, and all elements of the environment are part of our kinship system. Particular animal and plant species are the Ngartji (totem or special friend) of Ngarrindjeri people, who have special responsibility to care for their Ngartji. To care for Ngartji is to care for country.”

“Our Ngarrindjeri Vision for Our Sea Country must remain strong, for the health and survival of our brothers and sisters in distant lands that rely on our Ngartjis - birds, fish and other animals - that are nourished by our Yarluwar-Ruwe and travel over long distances”

Tom Trevorrow, Ngarrindjeri Elder, teaching Ngarrindjeri traditions on Ruwe (country)
Different approaches for different times.

With more and more people in society, and the advent of computers and ready access to digital imaging devices, there has been rapid the growth of data available.

Protecting the integrity and accuracy of knowledge is important.

Compare how knowledge sharing was done in pre-colonial Australia to new ways it is being done with larger populations and new technologies.
The way Indigenous people kept ‘databases of information’ prior to colonisation differs to current ways of keeping knowledge on computers and in books.

What strategies were used to ensure integrity and accuracy of Indigenous knowledge prior to colonisation?

What evidence can you find that these methods were effective?

What makes spoken records of knowledge more difficult in current society?
Sharing knowledge – Citizen Science

List some new ways for people to share information

________________________________________________________________________________________

________________________________________________________________________________________

How often do you take photos of plants or animals?

________________________________________________________________________________________

________________________________________________________________________________________

What do you usually take your photos with? A phone, notebook or camera?

________________________________________________________________________________________

________________________________________________________________________________________

What are the potential benefits of citizen science to society?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

What innovations in information, communication and technology (ICT) have made large citizen science projects feasible?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
What types of errors are likely to occur in data collected for citizen science projects and how could the effect of these errors be minimised?

Get Involved – Citizen Science – just a few suggestions

http://www.flukerpost.com/

Or upload photos to Atlas of Living Australia

https://www.ala.org.au/contribute-to-ala/

- Submit a species record
- Did you see something? Photograph something? Capture audio or video of something? Share it here! Start by entering the name of the species to record.

What can you do if you don’t know the name of the plant or animal species?
Overview of Theme C: Indigenous land management / Biodiversity

A common vision of pre-European Australia was that it comprised of long stretches of wilderness, with scrub-covered ranges and tangled gullies. However, a recent book suggests that this was not the case and is further evidence of the role of Indigenous cultures in actively managing Country that is so central to their wellbeing and culture.

Members of the Ngarrindjeri Nation are working with governments to ensure that they have active participation in planning and caring for Country. The following quotes from the Ngarrindjeri Nation Sea Country Plan (2006) highlight the interconnectedness of both Indigenous culture and ‘caring for country’ and between ‘sea and country (land)’.

“Recognition by non-Indigenous landholders that within Indigenous society, natural and cultural values of land and waters are interwoven. Consequently these cannot be separated as occurs in non-Indigenous society.”

“The land and waters is a living body.
We the Ngarrindjeri people are a part of its existence.
The land and waters must be healthy for the Ngarrindjeri people to be healthy.
We are hurting for our Country.
The Land is dying, the River is dying, the Kurangk (Coorong) is dying and the Murray Mouth is closing.
What does the future hold for us?
Tom Trevorrow, Ngarrindjeri Elder, Camp Coorong, 2002”
This series of tasks starts by examining the approaches used traditionally and currently by Aboriginal peoples to care for their country. Different activities are done at different times of the year, requiring a detailed understanding of the environment and the intimate interactions between plants, animals and the land.


Many of these practices are good for biodiversity and have now been incorporated in current practices for land management.

Biodiversity is short for “biological diversity.” Biodiversity is “the variety of all living things, and the systems which connect them.” This includes all the planet’s different plants, animals and microorganisms, plus the genetic information they contain and the ecosystems of which they are a part. It is the result of millions of years of evolution. www.naturalresources.sa.gov.au

European settlement, the introduction of pests and diseases and widespread land clearing associated with agriculture have seen loss of habitat for many living things and have seen a reduction in biodiversity.

Learn more about biodiversity, how to measure it, and participate in a project at your school or in a nearby reserve so that you can play a part in habitat conservation and biodiversity recovery. Understand the interconnectedness of ecosystems and their ability to do essential ecological processes.
Task C1 Indigenous land management

**Discover**
Similarities of traditional management of Country to current day natural resource management

**Understand**
Practices that provide a continuous food supply

The book “The Biggest Estate on Earth”, written by Bill Gamage, takes a historical research approach to provide evidence for Aboriginal land management.

He argues that Country was maintained locally, using similar cultural principles to ensure biodiversity, and making all life abundant, convenient and predictable.

Images: Gamage 2012 Allen & Unwin.
Watch the video, by Bill Gammage, about the management of the land by Indigenous Australians prior to the invasion/colonisation of Australia by Europeans.


While watching the video, make notes about the type of landscapes and why they were created. Also, pay attention to the discussions about water, animals and plants.

**Notes:**

What types of landscapes are managed by Indigenous people, what effect did this management have?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
What evidence was used by Bill Gammage to support his theory that Australia was methodically managed by Australian Aboriginal peoples, prior to colonisation?

The Coorong is a ‘wild and desolate place’ wrote George French Angas (1847), but at the same time he appreciated the seasonal round, the plenty of spring and the measures taken to survive winters.’

‘The rhythm of life marked by the seasons was detailed by Reuben Walker (1934) nearly a century later. The months were marked by what was in season. In June it was swan eggs, and in mid-winter, mushrooms. Then came the fishing season in mid-August to early September as the waters began to warm. In November the lauwarli or Cape Barren geese were on the salt pans when the grasses were green. In late December the manthari or native apples were out.’

Look at the calendar on the next page. This is one representation of the activities that are performed throughout the year by the Kaurna peoples of Adelaide.
The Kaurna calendar for the seasons. There are four Kaurna seasons relating to eight activities on the Adelaide plains. The European calendar is included for reference. - Kaurna Calendar (Hayes & Easson), in Jones 2006 in Adelaide and people pre-1836 in “Adelaide: Nature of a City”. Note: The man in the photograph at the centre of this Kaurna calendar is a Ngarrindjeri man.
Which of these seasons are likely observed, and activities practiced, by the neighbouring Ngarrindjeri peoples of SA?

Which of these activities have been incorporated into current land management practices?

Which of these activities are no longer possible, or are more difficult, due to changes in the landscape and/or land use?

From the Ngarrindjeri peoples

“We ask non-Indigenous people to respect and understand our traditions, our rights and our responsibilities according to Ngarrindjeri laws and to realise that what affects us, will eventually affect them”.

A quote from, Ngarrindjeri Nation Sea Country Plan (2006)
Provide some examples of ‘past’ land management practices (activities) that have had a negative impact on our oceans and rivers and clearly define the consequences (outcomes) of these activities. Assume ‘past’ means from colonisation of Australia by Europeans to the ‘recent past’ (last 5 to 10 years).

What are the likely benefits of an integrated approach of caring for rivers, sea and land together as one ‘entity’, as practiced by Ngarrindjeri peoples?
Task C2: Why is biodiversity important?

**Discover**
- Link between biodiversity and healthy habitats

**Understand**
- Importance of ecological processes for maintaining habitats

Biodiversity is important for maintaining “genetic diversity”

“Genetic diversity, the level of biodiversity, refers to the total number of genetic characteristics in the genetic makeup of a species. ... Genetic diversity serves as a way for populations to adapt to changing environments.”


Images: Carolyn Schultz
Why do you think many different types of plants means there will be more insects, birds, animals and microorganisms (bacteria and fungi)?

What plant and animal associations are you aware of?

Eg. Bees and pollination (flowers provide food source for bees, bees increase genetic diversity by spreading the flowers’ pollen to distant flowers).

Scientists believe that biodiversity enhances an ecosystem’s ability to do these essential ecological processes:

- produce more oxygen
- form and build healthy soils
- filter water on its way to the sea
- pollinate crops and plants generally
- store and recycle nutrients
- resist feral invasion

Pick one of the topics and in small groups, and explore the validity of the statement, noting any questions that can be investigated scientifically.
The table on the next page provides a list of just some of the plants used by the Indigenous peoples of South Australia.

Can you find the Ngarrindjeri names of the plants on the next page?

Determine what fruits are in the Ngarrindjeri mimirar’s (women’s) hands.

Hint: Makes notes on the shape, colour, and size of fruit when you are doing your research.

<table>
<thead>
<tr>
<th>Ngarrindjeri name:</th>
<th>Scientific name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common name:</th>
</tr>
</thead>
</table>


<table>
<thead>
<tr>
<th>Ngarrindjeri name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scientific name:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Common name:</th>
</tr>
</thead>
</table>

Image: Vesper Tjukonai (from Bell et al 2008)

Explain why neither of the fruit in the images (a and b) above are called Manangkeri (Bulrush, *Typha* spp).

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
<table>
<thead>
<tr>
<th>Common Name (Latin name)</th>
<th>Ngarrindjeri name</th>
<th>Indigenous use of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulrush root (Typha species)</td>
<td>Manangkeri</td>
<td>Edible tuber, fibre for string</td>
</tr>
<tr>
<td>She-oak; (Allocasuarina species)</td>
<td></td>
<td>Edible seed capsule. Young cones or stems used to control thirst. Wood used for artifacts</td>
</tr>
<tr>
<td>Sweet appleberry (Billardiera species)</td>
<td></td>
<td>Climber with sweet edible small fruit</td>
</tr>
<tr>
<td>Native Cherry (Exocarpus cupressiformis)</td>
<td></td>
<td>Edible fruit</td>
</tr>
<tr>
<td>Muntries (Kunzea pomifera)</td>
<td></td>
<td>Prostrate plant with small edible berries - mid to late summer. Pounded and dried for later use and trade</td>
</tr>
<tr>
<td>Pigface (Carpobrotus rossii)</td>
<td></td>
<td>Prostrate succulent plant with edible fruit. Leaves good for mosquito bite</td>
</tr>
<tr>
<td>Grass tree; (Xanthorrhoea semiplana)</td>
<td></td>
<td>White base of leaves and nectar from flowers edible. Leaves woven and used for fish traps and holding traps. Resin used as glue for artifacts.</td>
</tr>
<tr>
<td>Red-gum tree; (Eucalyptus camaldulensis)</td>
<td></td>
<td>Bark used for canoes and shields</td>
</tr>
<tr>
<td>Black anther flax lily or spreading flax lily (Dianella revoluta)</td>
<td></td>
<td>White base of leaves infused or chewed to treat common cold and sore throat. Leaves split and twisted to make a strong tie</td>
</tr>
<tr>
<td>Black wattle (Acacia mearnsii &amp; spp)</td>
<td></td>
<td>Edible seed, medicinal gum, bark (string, ligatures and slings)</td>
</tr>
<tr>
<td>Old man’s beard (Clematis microphylla)</td>
<td></td>
<td>Edible tuber, medicinal foliage</td>
</tr>
<tr>
<td>Acacia longifolia var sophorae</td>
<td></td>
<td>Edible seed, eaten at green stage &amp; roasted</td>
</tr>
<tr>
<td>Flat sedge (Cyperus gymnocaulos)</td>
<td></td>
<td>Used for Ngarrindjeri weaving of mats and baskets after drying and then soaking</td>
</tr>
<tr>
<td>Native or bower spinach (Tetragonia implexicoma)</td>
<td></td>
<td>Edible leaves</td>
</tr>
<tr>
<td>Yam daisy (Microseris lanceolata)</td>
<td></td>
<td>Small root cooked and eaten or eaten raw. Available Spring, Summer, Autumn.</td>
</tr>
<tr>
<td>Coastal beard heath/native currant (Leucopogon parviflorus)</td>
<td></td>
<td>White coloured small edible fruit Nov/Dec</td>
</tr>
<tr>
<td>Coastal daisy (Olearia axillaris)</td>
<td></td>
<td>Leaves used as insect repellent when rubbed into skin</td>
</tr>
<tr>
<td>Rivermint (Mentha australis)</td>
<td></td>
<td>Leaf used for flavouring and for medicine</td>
</tr>
</tbody>
</table>
Task C3 Exploring your area

**Discover**
Plants used by Indigenous peoples in your local area

**Understand**
Parts of a plant and their different uses

Indigenous culture is right at your doorstep. Our local environment can provide you with many clues about the traditional lives of Indigenous people. To understand more about the Aboriginal language groups and the importance of language to culture, go to http://www.indigenousaustralia.info/languages/language-groups.html

It is OK to eat the leaves of native spinach, but is it OK to eat the berries?

*See if you can find out.*

![Image: Native or bower spinach (Tetragonia implexicoma). Carolyn Schultz](image)

Do you know how to use *Acacia* gum for food?

![Image: Gum on a golden wattle (Acacia pycnantha). Carolyn Schultz](image)

Investigate how Aboriginal cultural practices may contribute to increased genetic diversity of plant species they once relied upon, and still use today.
Choose one Indigenous plant that grew/grows locally in your area. Research if it is used by Aboriginal people for food, fibre, tools and/or medicine. Many of the plants were used for more than one thing.

Choosing a local Indigenous plant – Visit a local cultural centre

- Camp Coorong, Meningie
- Kaurna Living Cultural Centre
- Tandanya
- Research this at your local council library, through your local landcare group, or the Botanic Gardens, or native plant nurseries.

Answer the following questions.

What is the name of the traditional custodians (Indigenous People) of the area where you are searching?

______________________________

Common name of your plant:

______________________________

Latin name of your plant:

Latin Names are made of a genus name and a species name.

For example Cyperus gymnocaualos
(Genus) (Species)

Indigenous name of plant:

______________________________

(Language group if known, eg Ngarrindjeri / Kaurna)
Resources – How did you find out about your chosen plant? (Complete the following table)

<table>
<thead>
<tr>
<th>Information / Topic</th>
<th>Information Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Take some images of the plant and note any important features (photo / photocopy / sketch). Insert them here.

Label the features you recognise (leaves / flowers / roots / seed).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What else can you find out about your plant?

- What season / season(s) is the plant material available (all year? winter? late summer?)
- How is the plant used? Raw? Or processed (eg cooked)? Eaten (warm or cold)? For medicines – applied alone or as mixture?
- Is it found throughout all of your state or just parts of the state?
- Does the plant grow in any distinct geographical area / habitat?

What cultural practices are used to make sure that the plant species survives and does not become extinct?

What cultural practices are likely used to maintain or increase the **genetic diversity** of the species?
Task C4: Your plant in nature

Discover
How to measure biodiversity (quadratting)

Understand
Diversity of plant types
Principles of random samples and subsampling

To manage and improve any environment, it is necessary to know what the environment looks like now and monitor changes in that environment.

Aboriginal communities had this knowledge as they moved through their landscape and used the plants and animals in their daily lives.

It is not practical to count all the plants in a given area so estimates are made by sampling in a methodical way.

http://www.nuffieldfoundation.org

To have the best chance of finding Aboriginal food and fibre plants near you, try and find a National Park or Reserve area near you which has been protected from urban development and agriculture.
Visit a local park or botanic gardens and see if you can find “your plant” from Task C3.

Before you go, watch one or more videos on quadrating.

https://www.youtube.com/watch?v=KuG-UjpQzm0
https://www.youtube.com/watch?v=cS4qwSK-Mqw

Images. From https://www.youtube.com/watch?v=KuG-UjpQzm0

- Take a close up photo of “your plant”
- Take a photo showing the park itself (with your plant in the foreground) so that you can see lots of other plants and trees

Estimate how many of your selected plants are growing in the park. Can you estimate for example the % area covered by the plant in a 10 m² area? Do all similar sized areas have the same coverage of plant?

Are most of the other plants in the park bigger or smaller than your selected plant?
Now that you have familiarised yourself with your plant and the area, you will do a more formal, quantitative survey using the quadrating technique.

*Teachers to tailor the quadrating activity to the class*

*(see Teachers’ handbook)*

As a group, what do you think is the most interesting thing you learned during this exercise?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
Task C5: Taking action for biodiversity

Discover
Strengths and weaknesses of a local habitat

Understand
Process of developing a long term plan to increase biodiversity

Want to make a difference but don’t know where to start?

ASSESS

PRIORITIZE

SET GOALS

MAKE A PLAN

MAKE THE PLAN HAPPEN

ENJOY THE RESULTS
Choose an area near your school or even on your school ground to develop an action plan to improve your local biodiversity.

Complete this worksheet and you will be ready to take action on the ground.

**Student Worksheet: Taking Action for Biodiversity**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Current results</th>
<th>Priority for improvement (<em>High, Medium, Low</em>)</th>
<th>Goal Result</th>
<th>Action Required (Yes/No)</th>
<th>Actions - long and short term.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard impermeable surfaces</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft surfaces</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Tree and/or shrub cover (local native or Australian native)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree and/or shrub cover (exotic)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Native grass cover</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Exotic grass cover (play areas, ovals)</td>
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<td></td>
<td></td>
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<tr>
<td>Orchards and food gardens</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Mutch cover (no plants present)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare ground</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Surrounding Vegetation: Large patches present (yes/no)</td>
<td></td>
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<tr>
<td>Corridors or Stepping stones present (yes/no)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Issue</th>
<th>Current results</th>
<th>Priority for improvement (High, Medium, Low)</th>
<th>Goal Result</th>
<th>Action Required (Yes/No)</th>
<th>Actions - long and short term.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Who, what, when, where, how)</td>
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<td></td>
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<td></td>
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<tr>
<td>Number of Trees/ha</td>
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<td></td>
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<tr>
<td>Health of individual trees</td>
<td></td>
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<tr>
<td>Understorey &amp; vegetation structure</td>
<td></td>
<td></td>
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<tr>
<td>Leaf litter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logs</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Weeds</td>
<td></td>
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</tr>
</tbody>
</table>

What issue(s) interests you the most, and why?

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

Would you be interested in working on this project (two or three times a year) as part of a team?

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________
Overview of Theme D– Seeds, Germination and Human Nutrition

Cultural context

Seeds are also an important food source for Aboriginal peoples. Some seed are collected when dry (ripe) and ground into flour. Seeds from other plants such as *Acacia sophorae*, a wattle, are harvested while still green and the pods roasted on a fire. Once roasted, seed are removed from the pods and eaten (Gott & Conran 1991). Information is based on the Gunditjmara Clan (Koori Peoples of Victoria).

Image from: Gott & Conran 1991 Victorian Koorie Plants. *Acacia sophorae* (wattle) plant in flower, with pictures of the ripe seed pods and a single seed.

Key Concepts

Seeds are important to us as a source of food and they are a common feature of all “seed plants” as a mechanism for producing new plants.

Seeds come in many different shapes and sizes and are key feature for identifying plants. Seeds contain an embryo that will become a seedling, are surrounding by other tissues that may help disperse the seed and can provide nutrition for the growing seedling.
Seeds, also known as grains, such as wheat, rice and corn are a key part of the diet of many Australians, and are rich in starch, a readily digested polymer of glucose. Many Indigenous cultures used a wider range of seeds, that included higher levels of key nutrients such as protein, vitamins and unsaturated fatty acids. Produce your own food labels to learn more about the nutrients in seeds and nuts.

Germinate seeds to discover the differences between monocot and dicot plants and learn to recognize the cotyledons, or seed leaves that are the first green parts of the seedling to appear.

Seeds and flowers represent two important innovations in plant evolution, and flowers are estimated to have evolved over 130 million years ago. Since then many different species of flowering plants have evolved, often with structural or physiological adaptations that promote genetic diversity for example insect pollination or seeds modifications that facilitate dispersal.

Flowers are the key structures where sexual reproduction occur through a process known as meiosis, where diploid cells in the male and female reproductive organs go through replication and two separations to become haploid cells, pollen and ovules, with new combinations of genes from either parent.

Many plants can also reproduce asexually, for example by division and this property has been exploited by gardeners and scientists to produce clonal plants, that are identical to the parent. Many fruit trees for example are propagated clonally.
Task D1  Seeds provide varied and nutritious food supply

<table>
<thead>
<tr>
<th>Discover</th>
<th>Understand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food ingredients and how nutrition labels are made</td>
<td>Many seeds contain good balance of essential nutrients</td>
</tr>
</tbody>
</table>

Many of us eat highly processed foods that are energy dense, with high levels of sugar and fat. These processed foods lack key vitamins, nutrients and fibre. The combination of these two attributes of much of our processed foods is leading to high levels of obesity and **preventable diseases** in our society.

Eating more wholefoods (fruit and vegetables) and grains (seeds and nuts), **as in more traditional Indigenous diets**, is a great way to fill us up, and improve our health at the same time.

> “As the old means of subsistence were destroyed by the settlers' land clearance and hunting and fishing methods, the Ngarinyeri [Ngarrindjeri] were forced into dependence upon the mission and rations.”

Quote from ‘Survival in our own land’ (Mattingley and Hampton (eds), 1998)

One of the government/societies responses to the increase in preventable diseases is to include nutritional information in food labels to raise awareness about what people eat and to help consumers make healthier choices.

Learn how to make your own nutritional labels. You could even try this at home to see how healthy some of your favourite meals are.

Seeds are important as they provide for the next generation of plants which are genetically different from the parents. This provides new genetic combinations of genes on which evolution can act and new species evolve (over long periods of time).
As part of a balanced diet, we need to eat a variety of different foods to obtain all of the nutrients that our bodies require.

List some foods you eat that are good sources of the following food components.

**Protein**

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

**Fat**

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

**Carbohydrate: (simple sugars, sucrose, fructose)**

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

**Carbohydrate (complex including fibre/starch)**

__________________________________________________________________________
__________________________________________________________________________

**Vitamins / Minerals**

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
One of the reasons that seeds, including nuts are so healthy is that they contain a mixture of three key nutrients protein, fats (oils) and carbohydrates. However different seeds have different relative amounts of these components.

Use the Nutrition Panel Calculator website, to find out the nutrient levels for 1) Sunflower seed 2) Macadamia Nut 3) Rolled Oats (raw) and 4) Seed of your choice.

Macadamia nut (*Macadamia tetrephylla* and *Macadamia integrifolia*) is a traditional Indigenous food that grows naturally in the North East of Australia. This crop was “domesticated” in Hawaii but now is a major crop in Australia (http://www.australian-macadamias.org/consumer/en).

Nutrition Panel Calculator

Follow these instructions to find the values.


2. Click on link “Proceed to Legal Agreement and terms of use and access the Nutrition Panel Calculator”

3. Click on link “I agree” to conditions

4. **Enter a name** for your recipe [eg sunflower], and select **continue**
   
   *The name is not important, but needed to get to the next step.*
5. Select “Add Ingredient”

6. Type in “seed” at the “Find Ingredient” box

7. From the list select seed, sunflower and
   a. Press the Select > button (bottom right)
   b. Type in amount (say 100 g to allow for easy comparison)
   c. Press the Add > button, then scroll up the page to see the results).
   d. The values in the table on the website (below, right) have been copied and pasted into Table 1 (further below).
8. Fill in the corresponding values in the Seed & Nut nutrient Table (below)

9. Repeat these steps for two more ingredients
   - Press **clear all** first, so that you get the values for a single ingredient (not a recipe)

**Complete the seed and nut nutrient table (below)**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Seed, sunflower</th>
<th>Nut, macadamia, no added salt</th>
<th>Oats, rolled, raw</th>
<th>Seed of your choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per 100 g</td>
<td>Per 100 g</td>
<td>Per 100 g</td>
<td>Per 100 g</td>
</tr>
<tr>
<td>Energy (kJ)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein (g*)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Fat, Total (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat, Saturated (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugars (g)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td></td>
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</tbody>
</table>

*g=grams
Compare the values in the table and answer the following questions

a) Which seed/nut has the most protein? How many grams does it have per 100 g?

b) From looking at the data in the table, do seeds contain mostly saturated or unsaturated fat?

c) What seed has the highest percentage saturated fat (as a percentage of total fat)?

Why do you think food labels list total fats and saturated fats separately?

Do some research to determine the reliability of claims about “healthy fats”. State which types of fats are considered healthy, and list up to 3 reliable sources. Explain why you think the sources are reliable.
What information, if any, do you think you can infer by comparing the amount of carbohydrate / 100 g and the amount of sugar / 100 g?

Based on your understanding of healthy foods, which seed(s) should you include in your diet, and the reasons for your recommendation.
Task D2 Seed germination

**Discover**
- How seeds germinate

**Understand**
- Changes from seed to seedling and the similarities and differences between monocots and dicots

There is a diverse range of environmental triggers, such as light and temperature, that seeds require to germinate. Scientific investigation highlights these and we can learn how to apply these trigger in revegetation projects, such as those carried out by Land Care groups and Trees for Life.

Image: Seed of *Acacia pycnantha* (golden wattle) by Carolyn Schultz.
We can sow seeds to grow plants and food. The process by which a seed starts to become a plant is called **germination**. Watch this video of seed germination.

https://www.youtube.com/watch?v=T94hwhYCFsY (image below is from the video).

![Diagram of seed germination]

Use another resource to find out about the different types of plants germination and fill in the missing words

a) A dicotyledonous (dicot) plant has ____________ seed leaves (cotyledon)

b) A ____________________ has a single seed leaf (cotyledon)

Complete the table below to classify food (crop) plants as being monocotyledonous (a monocot) or dicotyledonous (a dicot)

<table>
<thead>
<tr>
<th>Monocot</th>
<th>Dicot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
Can you identify the dicots and monocots from the photograph above?

1. (left-most seedling)

2.

3.

4. (right-most seedling)

Science Practical: Seed germination

There is a diverse range of methods to germinate seeds and the best method differs for each kind of seed. Most crop seeds, such as corn and sunflower, do not require any pre-treatment, but germinate better if soaked in tap water for about 24 hr.

Equipment

If native seeds are not available, use
2 corn (maize) seeds (soaked in water for \(\approx 24\) hours)
2 sunflower seeds (soaked in water for \(\approx 24\) hours)
1L soft drink bottle (clean + lid) or
   Ziploc sandwich size bag (+ cardboard support cut to size of bag)
Paper towel or thick filter paper
Tray to wet paper towel (if doing bottle method only)
Squirt bottle with tap water
Spatula (or plastic knife)
For bottle

- Pour water into the bottle to a depth of 1 cm.
- Soak the paper towel in tray of water, then loosely roll up (to the size of a toilet roll core), then unroll into the bottle so that it reaches the bottom and touches the sides.
- Use a knife to pick up one seed at a time and carefully push the seed down between the paper and the bottle, about 1 cm below the top of the paper. Repeat for the other 3 seeds, spacing each new one about one-quarter of the way around.
- Use 2-3 small pieces of tape to keep top and bottom of bottle attached.

For bag

- Place dry paper towel in bag so that there are no creases.
- Add water to the bottom of the bag, and let capillary action wet the paper (minimising bubbles).
- Keep adding water till there is a about 1 cm of water pooled in the bottom of the bag.
- Use a knife to pick up one seed at a time and carefully push the seed down between the paper and the bag, about 1 cm below the top of the paper. Repeat for the other 3 seeds, spacing each new evenly along the top of the bag.
- Tape sides of bag to piece of cardboard and place in box so about 5-10 degrees off the vertical (to allow gravity to keep seed in contact with damp paper).
Observation

Equipment
Hand lens or stereo microscope or phone camera
Ruler
Permanent marker (fine tip)

- Carefully observe the seeds each day (or every few days).
- Use a permanent marker to draw a line where the radicle (root-like structure) and cotyledon (shoot-like structure) tip are each day.
- If possible take a photo of each seedling (next to a ruler).
- Check that there is still about 1 cm of water in the bottom. If not top it up carefully.

Photos. Carolyn Schultz
Discuss and Explain

1) Sketch each seed, record as many observations as you can. Measure the dimension of each seed (length & width).

<table>
<thead>
<tr>
<th>Seed 1</th>
<th>Seed 2</th>
<th>Seed 3</th>
<th>Seed 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Type</td>
<td>Type</td>
<td>Type</td>
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<tr>
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<tr>
<td>Length (mm)</td>
<td>Length (mm)</td>
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</tbody>
</table>

Sketch & Label

Note any observations
2) If any of the seeds have observable **radicle** (root-like structure) and **cotyledon** (shoot-like structure), measure each day and record in the below table (Roots & Shoots). Includes units (mm).

**Table: radicle & cotyledon**

<table>
<thead>
<tr>
<th></th>
<th>Day_____</th>
<th>Day_____</th>
<th>Day_____</th>
<th>Day_____</th>
<th>Day_____</th>
<th>Day_____</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed 1</td>
<td>Radicle</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Cotyledon</td>
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<tr>
<td>Seed 2</td>
<td>Radicle</td>
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<td></td>
<td>Cotyledon</td>
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<td></td>
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</tr>
<tr>
<td>Seed 3</td>
<td>Radicle</td>
<td></td>
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<tr>
<td></td>
<td>Cotyledon</td>
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</tr>
<tr>
<td>Seed 4</td>
<td>Radicle</td>
<td></td>
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<tr>
<td></td>
<td>Cotyledon</td>
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</tr>
</tbody>
</table>
3) Can you calculate the growth rate mm/day (or week)? For this exercise use Day 1, as the day you first see a root (radicle) or seed leaf (cotyledon) appear.

Example

<table>
<thead>
<tr>
<th>Day</th>
<th>Root (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>2mm growth</td>
</tr>
<tr>
<td>Day 2</td>
<td>1mm growth</td>
</tr>
<tr>
<td>Day 3</td>
<td>1 mm growth</td>
</tr>
<tr>
<td>Day 4</td>
<td>1.5mm growth</td>
</tr>
<tr>
<td>Day 5</td>
<td>3mm growth</td>
</tr>
<tr>
<td>Day 6</td>
<td>2 mm growth</td>
</tr>
</tbody>
</table>

Calculate rate (Day 1 + Day 2 ...etc) / Total Number Days = 1.75 mm per day

Your calculation

( ) = per day

(Equals) (Units)

4) Compare the growth between the 2 different types of seeds and write a conclusion about your findings (3 – 4 sentences)
In your observation of the seeds germinating, what appeared first? The radicle (root) or the cotyledons (leaf like structures)?

Which plant species is a monocot and which is a dicot?
*Remember you used corn and sunflower seeds.*

Monocot

Dicot

**Native Seeds**

*You could try to germinate your own seeds at home or in the classroom. The following are some examples of native seeds that you could keep an eye out for. Consider contacting Trees for Life or a local Land Care group to see if they can give you some seed or ask a neighbour who is growing native plants.*

<table>
<thead>
<tr>
<th>Kunzea pomifera (manthari, muntries)</th>
<th>Acacia pycantha (Golden Wattle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyperus vaginatus</td>
<td>Cyperus gymnoaucos (bilbili)</td>
</tr>
</tbody>
</table>

**Examples of native seed that should germinate in 1-2 weeks (longer in soil)**

*Enchylena tomentosa* (ruby saltbush)
*Austrodanthonia* (wallaby grass)
*Themeda* (kangaroo grass)
*Allocasaurina* (she-oak)
*Microseris lanceolata* (yam daisy) [soak in water at 4°C for 2 to 5 days]
*Melaleuca lancealata* (dryland tea-tree)
*Ficinia nodosa* (knobby club-rush, is used as alternative weaving plant)
*Carpobrotus rossii* (Nganangi, Karkalla, angular pig-face)
*Punctanillia stricta* (marsh grass)
Native seed(s) you are going to germinate

Name of monocot seed________________________________________

Name of dicot seed _________________________________________

Do these seed require any special pre-treatments to germinate?  
*Check the resources provided by the teacher or available at these web sites*


____________________________________________________________________

____________________________________________________________________

____________________________________________________________________

Wattle (Acacia) seed  

Yam daisy (Microseris lanceolata)
Sexual reproduction in plants and animals is made possible because of a process known as meiosis, where a special diploid “sex” cells, that each have two sets of chromosomes go through a special pairing, exchange and division process to produce four haploid “sex” cells, with new combinations of gene variants (alleles) along each chromosome.

When two sex cells, one pollen (sperm) and one ovule (ovary), fuse through pollination (plants) or sex (animals), a new plant or animal is produced that is different from those before, with a combination of characteristics (traits) from their parents. Sexual reproduction increases genetic diversity.

Remember genetic diversity is “the level of biodiversity, refers to the total number of genetic characteristics in the genetic makeup of a species. ... Genetic diversity serves as a way for populations to adapt to changing environments.”

http://en.wikipedia.org/wiki/Genetic_diversity
Read the information above, watch the video, then complete the exercises.

Watch this video of meiosis in a plant cell
http://www.youtube.com/watch?v=HQ6ScNaBX6M
At what stage does recombination of chromosomes occur?

How many chromosome separation events occur in meiosis?

Many flowering plants have both male and female reproductive cells in the same flower. The part of the flower that produces the male sex cell, pollen, is called the anther. Mature pollen is released from the flower and finds either the same or different flowers, and lands on the style, where it will grow down to fertilise the female sex cell or ovary. The style of the flower is where the nectar (and/or fragrances) are produced.

Why do plants have nectar (and/or fragrances)?

What process do you think is likely to increase genetic diversity? Self pollination, or insect pollination, where the pollen travels to a different flower.
Label the following parts of a flower: Anther – pollen – style – ovule
Note: The mature pollen has been released from the anther

Flower Structure - unlabelled


How is nectar used by Aboriginal Australians from South East Australia?

Task D4. Two ways of producing new weaving plants*

**Discover**

How plants have evolved complementary methods to reproduce

**Understand**

Consequences of difference propagation methods to genetic diversity

Plants have developed many different strategies to ensure reproduction and survival of harsh conditions such as winter snow or summer’s dry heat. These adaptations mean plants such as the weaving rushes can reproduce using special underground stems, or stolons, that emerge some distance from the plant. Examples include *Cyperus* (bilbili / wito) and *Dianella*.

Other specialised stems include tubers, rhizomes, corms and bulbs and many of these are everyday foods. A range of modified “underground” stems were an important part of Aboriginal diets, especially in Southern Australia, such as the yam daisy (*wailyo* plant) and ngampa (root) (Clarke 2013), *Microseris lanceolata* (below)) and the vanilla lily (next page).

Photo Carolyn Schultz

Tubers of yam daisy (*Microseris lanceolata*); an important food source for Aboriginal peoples of southern Australia.
As well as storing food/energy for the plant to use later (and food for people and animals), these underground stems means these plants, can usually be propagated by division. This means that from one pot, you can get 4 or more new plants.


COMMON MISCONCEPTION: Stolons, tubers, rhizomes, corms and bulbs are NOT roots, they have more similarity to stems than roots. This misconception comes from the fact that most of them are found underground, where roots are found.

Complete the table below for the type of modified stems these foods or common garden plants form. Use the internet or other resources (eg books) to find answers.

<table>
<thead>
<tr>
<th>Food source</th>
<th>Type of modified stem (stolon, tuber, corm, bulb or rhizome)</th>
<th>Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
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<td>Garlic</td>
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<td>Ginger</td>
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<td>Tulip</td>
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<td>Gladiolus</td>
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<tr>
<td>Strawberry</td>
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</tbody>
</table>
Plants such as the weaving rush, *bilbili*, have a rhizome. In this next activity you will compare two ways of propagating the weaving rush *Cyperus gymnocaules*. The first way is by division, and the second way is from the tops of the plants where the seeds form.

![Rhizomes on a *bilbili* plant, with new shoots visible](http://data.rbg.vic.gov.au/dev/vicflora/flora/taxon/47644076-e3f1-483b-afcf-36fe055672b0)
**Propagation by division**

**Equipment**

Pot (≈ 15 cm diameter) with a mature *Cyperus gymnocaoulos* or similar plant

Native potting mix, that contains a slow release native fertiliser

Pruning saw or old bread knife

Secateurs or sharp scissor (large)

Clean pot (≈ 10 cm diameter)

“mini glass house” made from 1L soft drink bottle (with bottom 10 cm cut off)

Watering can

**Method**

Soak pot in water or seaweed extract (at least 5 mins)

Carefully tip plant out of pot

Slice the bottom 1/3 to 1/2 of soil/roots from the plant and discard

From the top, cut the remaining plant/soil, into half, then half again (so into quarters)

Cut leaves with scissors (or secateurs), leaving about 7-10 cm of stem and remove any dead leaves

Place pot in a mini-glasshouse and then keep in shady spot or under 70% shade cloth (preferably white)

Water the pot every 1 or 2 days (more frequently at first, and in hot weather)

In about 2 months you will see roots coming out of bottom and you may also see new shoots coming out of the potting mix.

Why do you think cutting the leaves and putting the plants under a mini-glass house help the plants survive and get stronger more quickly?
Propagation from “young plants” (heads)

Bilbili, *Cyperus gymnocauleos*, has another unusual way of propagating. Seed can sometimes germinate while still on the plant, getting 5-10 small shoots, young plants, from one seed.

“The fresh water rushes are a clumping plant, they produce both seeds and young plants at the tips of the mature rushes. New clumps are started when a mature rush, *with the young plant at its tip*, lays down under the weight of the growing new plant and makes contact with the soil.” pg 15

The Ngarrindjeri apply their traditional land management techniques of not collecting all the rushes from any one point, only the mature, longest rushes are collected. While collecting, the pickers have a practice of giving back to Ruwe / Ruwar* to ensure that there will be rushes for future generations. The weavers do this by spreading the seeds from the flowering tips and by leaving some of the young plants growing at the tips of the rushes behind; this is the Ngarrindjeri way of sustaining life within Ruwe / Ruwar. pg 18

* “Ruwe / Ruwar to Uncle Tom [Trevorrow] is the People, the Land, the Waters and all other living things ~ he understood that all these elements are interconnected and that one does not flourish without the other. [Links to Theme C]”

From Ngarrindjeri Lakun : Ngarrindjeri Weaving (2013)

Roots may or may not form on the “mother” plant, but if the “young plant” or plantlet is removed and placed in a jar of water, roots will usually form in 1-2 weeks. Once roots have formed, the plantlets can be planted into potting mix and cared for in the same way as the plants you propagated by division.

Sounds too easy to be true. Have a go and see if it works for you!
But first - make a prediction.

Q. Which bilibili “young plant” will form roots if they are placed in a glass of water, where the water level (red line) is maintained at the height of the seeds (top of the main stem), as indicated for plant 2?

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<td>4</td>
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</tbody>
</table>

Complete, for each bilibili “young plant”

1. roots? yes/no, Explain why

2. roots? yes/no, Explain why

3. roots? yes/no, Explain why

4. roots? yes/no, Explain why

Photo. Carolyn Schultz
**Equipment**

Stems of mature *bilbili*, *Cyperus gymnocaulos*, with plantlets already growing at the top

Cup, glass or jar containing water (filled to about 4 cm from the top)

Scissors

**Method**

Cut the main stem, below the new *bilbili* “young plant” (plantlet), to achieve the desired height of the seeds (main stem) relative to the water level

*Record the chosen height, and other observations below*

Place in a bright room or outside uncover, away from direct sunlight

Top up the water level every 4-7 days to keep the new bilbili shoots, at the same level.

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<tr>
<th>Notes:</th>
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<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Height of seeds (main stem), relative to water level (eg 2 cm above, level with water, or X cm below water level)</td>
</tr>
<tr>
<td>Number of stems from a single point (seed):</td>
</tr>
<tr>
<td>Roots present? Yes / No</td>
</tr>
<tr>
<td>If yes, how many roots?</td>
</tr>
<tr>
<td>Date new roots first observed</td>
</tr>
</tbody>
</table>
DID YOU KNOW?

In agriculture, germination of seed on the plant is referred to as “pre-harvest sprouting”. It occurs in some varieties of wheat and barley, especially in high humidity, say after rain, and is an area of active research by Australia scientists.

As a class you have used two different methods to produce 20-30 new plants.

Which method produces new plants that are more genetically diverse? Propagation by division or from young plants?

Which method would be better if you owned a plant nursery and you were propagating tubers/rhizomes for their flavour or medicinal properties? Propagation by division or from “young plants“?
Overview of Theme E - Native Foods: Feeding Australia Sustainably

Modern agriculture relies heavily on monocultures to provide yield benefits and reduce harvesting costs through mechanisation and economies of scale. Plants grown in monoculture are often more susceptible to problems such as diseases or insect attack, which can cause dramatic reductions in yield.

Selecting suitable plant varieties that are broadly adapted to Australia’s varied and often harsh environments is an area of on-going research and innovation. It is part of a world-wide effort to increase the sustainability of agriculture while at the same time feeding an increasing world population, to ensure global food security.

Another source of innovation is new crops. Many of these come from overseas but there is increasing interest in the use of Australian native food plants as used by Aboriginal cultures. Australian plants are already adapted to Australia’s harsh conditions, so it might seem relatively easy to “domesticate” them. However it’s not that easy to find a single plant that produces fruit with all the desired characteristics and high yielding. Many of our everyday fruits have gone through 1000 or even 10,000 generations of selection since they were adopted as food crops by local peoples, and now more intensively by plant breeders.

Explore some of the Australian native food plants currently being grown locally and explore the science required to develop a new plant-based industry. Take part in a sensory science exercise and analyse the data to learn how plant breeders and food manufacturers select the best plants and new products.

You will also investigate food preservation techniques and understand a common basis of many preservation techniques. Techniques such as drying have were used by Aboriginal peoples to produce fruit straps.

Food Manufacturing and Agriculture are major industries in Australia and rely heavily on staff with Science, Technology, Engineering and Maths (STEM) skills. Learn more about the exciting careers in Food, Nutrition and Agricultural Sciences to find a rewarding career. There will always be careers in ‘food production’ as long as people need to eat!
Task E1. Sustainability of the food supply chain

**Discover**

Australian native food plants

**Understand**

Factors affecting food security and the opportunities for new crops

Images: Left, Storeye (CC-BY-SA 4.0); middle, RIRDC publication Pub. No. 14/122; right, Jessica Nilam.

Most of us take food security for granted. We have ready access to fridges and supermarkets stocked with a variety of food.

Global food security is about producing more nutritious food for the world while minimising the impact on the land.

Explore the potential of Australian native food plants to contribute to food security and Australia’s economy.
Watch the video on global food security. http://vimeo.com/26303624

While watching the video, make notes about the key issues that need to be addressed to ensure global food security.

**Notes:**

What are the current challenges that farmers face to ensure there is enough food to feed the growing world population? Name at least 3.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Do you know of any food plants that Aboriginal Australians eat / ate? 

You have been given a leaf from one of the available “native foods” that is sold in shops in Australia, but was first used by Indigenous Australians. These leaves can be used fresh, dried (whole or ground).

What type of plant do you think the leaf comes from? (tree, shrub, grass).

What type of environment do you think the plant grows in? (desert, coastal, rainforest). Explain your answer.
Smell the leaf. Then crush/scrunch up the leaf and have another smell. What does the leaf smell like?

Describe any changes that occurred when you crushed the leaf.

Using your knowledge of the smell of the leaf, do you know the name of this food product?

Would this be a good plant to grow in South Australia? Why/why not?

Describe the information you would need to do a rigorous assessment of the sustainability of a native fruit such as quandong, compared to an established fruit crop such as cherries?
Task E2. Muntries, an Indigenous food plant from South Australia

Discover
Flavours of manthari (muntries) berries and products

Understand
The role of sensory science for food product development

Images: Carolyn Schultz

Look at the flavour and smells of a berry eaten by Aboriginal Australians. This lesson will explore the science being used to make one fruit, manthari (Ngarrindjeri language) or mantirri (Kaurna language) or muntries (current common name) and, an everyday food for all Australians.

Food companies around the world use Sensory Science to find out what their customers want and like in food products. New Product Development provides companies with an edge over their competition and both food manufacturers and chefs are looking for exciting new flavours.
The plant *Kunzea pomifera* produces berries, called muntries.

Growing naturally at Cape Jervis, SA

**olive green plants growing as groundcovers**

Muntries grows naturally in parts of SA and Victoria

blue dots = plants collected

The Ngarrindjeri word for muntries is **manthari** or **mantirri** in Kaurna language.

www.ala.org.au

Each group has been given a plate of frozen **manthari** (muntries or muntrie berries).

*Freezing is a food preservation method that maintains the flavour of muntries, but the berries lose their crisp texture and some colour.*

What does the fruit smell like?

__________________________

__________________________

Now taste the muntries. What does the fruit taste like? Do you recognise any flavours from foods you have eaten before?

__________________________

__________________________

__________________________
Sensory science is used by food companies to find out what people like and is being used to find out what varieties of muntries taste best.

A sensory laboratory allows each consumer to test samples one at a time and give their own opinion, without being influenced by their friends.

Do the following sensory tests and record your own opinion!

Circle your answer on the 5 point scale below.

How do you rate the frozen muntries?

<table>
<thead>
<tr>
<th>Your vote</th>
<th>Class votes</th>
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<tbody>
<tr>
<td>Strongly like</td>
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<tr>
<td>Like</td>
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<td>Neutral</td>
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<td>Strongly dislike</td>
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How do you rate the muntries jam?

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<th>Your vote</th>
<th>Class votes</th>
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<td>Strongly like</td>
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How do you rate the muntries fruit straps?

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<td>Strongly dislike</td>
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</table>
Draw a bar graph for each of the manthari (muntries) products to summarize the class data.

Choose appropriate numbers for the Y-axis so that you can use the same numbers for each graph.

The X-axis is the horizontal line and the Y-axis is a vertical line (remember Y to the sky).

**Berries**

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**Jam**

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**Fruit straps**

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<th>Strongly like</th>
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Label the X-Axis with **Preference** (short for consumer or student preference).

What is an appropriate label for the Y axis? Provide your answer here, and also label the graph.
Use the information in the bar graphs above to answer the question, **what manthari (muntries) product is most liked by students**? Explain your answer.
Task E3. Use and preservation of muntries by Aboriginal people

**Discover**
How to design and analyse a food preservation experiment

**Understand**
Common basis in many food preservation methods

Students will compare current methods of food preparation to those used by Aboriginal peoples in pre-colonisation times.

In summer, Aboriginal Australians travel long distances to the coast of South Australia to feast on berries known to us as *manthari* (muntries). Historically, they would stay near the coast until fruiting finished.

“When I was young we’d go camping just out of Goolwa there. Mum and dad, grandpa and grandma and all the kids, whoever was there........We used to pick fruits at Goolwa, just over from where we were camping. In summer, everyone would come back with little bags of munthries.”

Bernice Karpany


Early settlers noted that Aboriginal people would pound the muntries into **large cakes for trading** and sometimes they were **mixed with other fruits and seeds** (Gott 2008).
Describe what you think manthari (muntries) cakes would have looked like in pre-colonial times?

How big would they have been? How thick? What shape?

Why do you think muntries were mixed with other fruits and seeds?

For foods to be stable enough for trading they need to be preserved in some way.

What makes food go bad (spoil)?

What natural preservatives/preserving methods do you know about?
From all the class responses, what method(s) do you think were most likely used by Aboriginal Australians to preserve manthari (muntries) cakes, in pre-colonial times?

What do you think is the most important **common feature** of many of the food preserving methods?

Design an experiment to test the effectiveness of a food preserving method.
Task E4. Food and Careers

Discover
Science careers in food and agricultural industries

Understand
Personal skills that many employers value
Team work and long term planning

Many of you will spend more than 50% of your life working. Therefore it’s desirable to have employment that meets your needs and supports you, and for many of you, a family. Careers in food science and agriculture are not familiar to many students but are often exciting and varied with opportunities for career progression into management (and therefore higher salaries).

www.aifst.asn.au
www.careerharvest.com.au

Science-based careers in food and agricultural industries are explored and you will learn about the skills valued by employers.

This lesson will explore the broad areas of science required to take a favourite Aboriginal fruit, manthari (Ngarrindjeri language) or mantirri (Kaurna language) or muntries (current common name) and, develop it as a new crop, so that it becomes an everyday food for all Australians.
What changes have occurred in food and agriculture in Australia, in the last 250 years?

What changes have occurred in food and agriculture in Australia, in the last 25 years?

List careers that you think can help in the goal of feeding Australia sustainably.

Predict future applications of novel technologies in the food and agricultural industries on people’s lives.
Now watch these two videos to learn about other careers in Food Science and Agriculture. While watching the video pay attention to the discussions about careers, subject skills and tasks involved.

**Notes Video 1: Career as Food Scientist**

Prior experience and/or subject (discipline) skills

Benefits to company and/or society (consumers)

**Notes Video 2: Careers in Agriculture**
https://www.youtube.com/watch?v=3tC-EBcQKRC.
List the different types of positions available in agriculture
Many employers “hire for attitude and train for skills”. One reason that a University degree is useful is that it demonstrates a “capacity to learn”.

Complete the tables on the next page to see the skills employers are looking for in graduates. Highlight skills that are required for both of these jobs.
## Food Technician - *Evolve scientific recruitment*

<table>
<thead>
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<th>Prior Experience</th>
<th>Personal Skills</th>
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## Plant Specialist - *Jurlique*

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Write a short paragraph to demonstrate to a prospective employer that you have one of the listed personal skills. Use the format Situation, Action, Results, as outlined below.

**SAR Principle**
- **Situation:** Identify a recent situation, setting or project you were involved in that shows how you have effectively applied the element, when this occurred, who was involved and what role you played.
- **Action:** Give brief details of what you did, why and how. Describe how you responded to the situation/task, what problems/difficulties you had to address and how you resolved them.
- **Result:** Briefly outline what the result was. Outline the outcome and/or the feedback you received.

From: vacancies.sa.gov.au/novfiles/vacancyattachments/82036%5CAplicant%20Guide.doc

Use the resources provided by your teacher to find out more about a career you had not heard of before this lesson? List 3 things that you didn’t know about this career.

Share your findings with the class
Which of the careers discussed today is most interesting to you? Explain Why?

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

What school subjects do you think would be helpful for the career that most interests you?

________________________________________________________________________________

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What personal skills are required in the majority of employment roles (jobs) you have explored?

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________
Business Planning

Long term visionary projects require planning, time and money.

You received a modest inheritance and you want to invest it in developing the native food crop, *manthari* (*mantirri*, *muntries*). You have been provided with the following suggested areas that need research and you have enough money to employ 10 people for 10 years as well as set up 3 orchards in regional South Australia.

It takes 5 years before a plant produces fruit, and you can propagation new plants from cutting in 1 year to produce clones with the same characteristics. 1 plant could produce 1000 new plants.

![Creating a sustainable new food industry: muntries](image)

Image: Carolyn Schultz

Work as a team to develop a time-lime (Gantt Chart) of

- What needs to be done first?
  
  *You do not have money to do everything at once, and not all things have to be in the first 10 years*

- Use the internet to explore areas of research you don’t understand

- **Predict** the benefit (outcomes) of each piece of research to your new industry, and **rate** each for its importance (eg high medium low), and **estimate** how many years the research will take

- What skills will your muntries industry team need?
The information on the next page shows the career of scientist, Carolyn Schultz, who helped develop this class activity.

Carolyn has also provided information on the careers that are available in the food industries, using muntries as an example.

The more core skills you have in maths, chemistry, biology, physics and communication, the more choices you have later in life.

To learn more about careers in the Sciences

PICSE –Living Science Resource

A to Z of Food, Agricultural Science & Natural Resource Careers


Whether you’re interested in feeding the world, adapting to climate change, developing the environment or managing future energy sources, this site helps create clearer pathways for you to harvest your agricultural career


Science, Technology, Engineering and Maths (or ‘STEM’) is vital to our future. Learning STEM gives you opportunities and the choice to follow your passion to a fulfilling career. Read stories from people doing amazing jobs in STEM.
The unexpected benefits of being a scientist

Carolyn Schultz’s story: Adelaide to New York & back

High School: The Heights School
Bachelor of Science (Hons)
The University of Adelaide

First Job: Human Cytogenetics, The Queen Elizabeth Hospital, SA

Second Job: Human Cytogenetics, Sloan Kettering New York

PhD New York University, Plant Science

and lots of places & friends in between (worktrips & holidays)

Seattle  
Denmark  
California  
Sorrento, Italy  
Sweden  
Majorca, Spain  
New Zealand  
UK  
Brazil  
Norway

Toulouse, France  
Coorong  
Raukkan

Kangaroo Island

Ningaloo Reef

Cairns

Flinders Ranges  
Gramplins
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<td>Photo: Carolyn Schultz. (CC-BY-SA 4.0) Fruit on native or bower spinach (<em>Tetragonia implexicoma</em>).</td>
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<td>Photo: Carolyn Schultz. (CC-BY-SA 4.0) Gum on a golden wattle (<em>Acacia pycnantha</em>).</td>
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<td>Carolyn Schultz (CC-BY-SA 4.0) Tubers of yam daisy (<em>Microseris lanceolata</em>); an important food source for Aboriginal peoples of southern Australia.</td>
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References

Amery R (ed) 1995, Warra Kaurna - A Resource for Kaurna Language Programs, Published by Warra Kaurna Language project Kaurna Plains School


Bonney N 2004 Common native plants of the Coorong region. Usually available from State Flora Nursery (Belair) and Australia Plant Society (SA branch) and other good bookshops.

Bonney N 2012 Knowing, growing, eating. Edible wild native plants for Southern Australia 2nd Ed.

Clarke PA 2013 The Aboriginal ethnobotany of the Adelaide region, South Australia. Transactions of the Royal Society of South Australia. 137: 97–126.


Jones DS 2006 Adelaide and people pre-1836 In “Adelaide: Nature of a City” (Ed Daniels & Tait).
