Ngarrindjeri culture embedded in

Year 10 Science

Teacher Handbook

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.

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.
About these resources

These science teaching resources are designed for both Aboriginal and non-Aboriginal students, and aim to

1. Help close the parity gap by encouraging more Aboriginal students to complete secondary school by developing engaging, culturally relevant science lessons;

2. Raise awareness, in all students, of Aboriginal cultures and traditional knowledge with a focus on people, cultures and ecology.

These learning materials focus on culture and ecology of the Ngarrindjeri lands in South Australia. There are references to Ngarrindjeri people and plants as well as some references to Kaurna plants and uses of materials from the Adelaide Plains.

Aboriginal cultural information is shaded in green. Words from the Ngarrindjeri and Kaurna language groups are highlighted in in different colours.

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.

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We encourage educators working with students from other Aboriginal cultures and language groups to adapt these activities to other cultures and plants in collaboration with local Aboriginal people.

Photo: Carolyn Schultz
Information for Teachers

This curriculum package is designed for Year 10 Science and includes a series of “stand alone” student activities that can be done without internet access. Most lessons can be made more interactive with internet access and can readily be adapted by educators of primary, secondary students and adults.

The Teachers’ Handbook provides links for videos and interactive databases, as well as “screen grab” images from a variety of websites that can be provided to students if internet is not available. All resources will also be made available in electronic format (CD/USB or website or both).

The resource consist of four parts

1. Student Activity Booklet – Year 10 Science, 5 themes, 21 tasks
   - Theme A – Rushes, Weaving and Plant Cell Walls
   - Theme B - Plant Databases
   - Theme C - Indigenous Land Management / Biodiversity
   - Theme D – Seeds, Germination and Human Nutrition
   - Theme E - Australian Native Foods: Feeding Australia Sustainably

   Each theme begins with a context page, and each task has a summary outlining discovery and understanding.

2. Teacher’s Handbook

   Each task provides Australian Curriculum (ACARA) information (Content descriptions and general capability), equipment lists, assessment suggestions, lesson plans and suggested answers for all questions.

3. Additional Resources – for core tasks

   Key references and supporting material for core tasks.

4. History lesson package

   Year 10 History package (5 topics) that complement the science resources.
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 as an e-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’.
Weaving science

Through the exploration of Indigenous use and understanding of plants, this resource contributes to students’ idea of science on the land and strengthens their scientific investigation and analysis skill set.

Weaving of rushes is widely appreciated in Australia as an art form and for the creation of useful vessels. Underlining both of these is a long understanding of plants; germination, distribution, sustainable harvest, physical attributes and biodiversity. This is early evidence of scientific understanding of the Australian landscape.

Starting with the *bilbili* weaving rush, this resource asks students to compare and analyse species. Students are asked to think about the physical structure of a plant, focusing on the strength attributes of plant cells walls and also plant development from seed through investigation into germination. These attributes should be highlighted as part being part of biodiversity. Understanding the location and environment of plants is then explored through learning about and using plant databases. Students should then put what they have learnt into action through scientific investigation and the creation of their own database. This resource also touches on the role of bush foods in feeding Australia sustainably and also careers within this area.

Overview of Activities

**Theme A. Rushes, weaving and plant cell walls** – 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 early plant cell wall strength.

**Theme B. Plant databases** – Students undertake an investigation using databases which incorporate the use of maps. Through looking at the distribution of plants, students also learn about the area of the Ngarrindjeri people and early evidence of databases.

**Theme C. Indigenous land management /Biodiversity** – Asking students to think about what they believe pre-European Australia would have looked like and learning about methodical land practices by Australian Aboriginal peoples, this task focuses on land management. Incorporated into this is consideration of biodiversity and genetic diversity, where students are asked to conduct an investigation of their local environment.

**Theme D Seeds, Germination and Human Nutrition** – Through scientific investigation into seed germination and nutrition, students will learn about environmental triggers and their role in revegetation projects. This activity reflects the application of triggers by Australian Aboriginal triggers in land management practices and reliance on seeds for revegetation and nutrition.
**Theme E. Australian Native Foods: Feeding Australia Sustainably** – Students are to investigate the role of bush foods in sustainable agriculture. Tasks include looking at what was traditionally eaten by Aboriginal Australian and methods to incorporate these bush foods into the modern Australian diet.

**If you plan to use only a few lessons** – Look at the other lessons for appropriate resources (videos/images) to provide appropriate context for your lesson. Try and provide local context through places they have been, school garden or community where possible.

**5 E’s – Engage, Explore, Explain, Elaborate, Evaluate**

Many teachers will be familiar with the 5E’s approach to learning. For those that are not, here is a link. For every task, we have provided suggestions for the first step “engage” and it should be relatively easy for teachers to emphasise/reformat lessons to close the learning loop and ensure the other 4e’s are covered, using the information provided in this manual.


**Transferability to other Indigenous cultures**

We hope that this resource provides a framework for adapting this resource to other Indigenous cultures.

We suggest the following steps to adapt these lessons.

1. Engage with your local Indigenous community
2. Seek funding (to facilitate a timely completion)
3. Identify plants with similar uses to the table (see below)
4. Make changes to cultural information / plants / experiments as appropriate
5. Share

**Access & Resources**

For access to electronic copies (word documents) of the student and teacher booklets, contact Carolyn Schultz, carolyn.schultz165@gmail.com, and a link for the [Yitpi Curriculum for Teachers](#) Dropbox will be provided.

The Dropbox also contains copies of all the provided e-resources.

Resources required are provided at the start of each task.

A summary of provided e-resources is provided (next page), and a list of plants to grow to be self sufficient (on the following page).
Summary of e-resources (available via Dropbox, contact carolyn.schultz165@gmail.com for access)

- Required resources are labeled by Task number, and include a descriptive title, eg
  - TaskA1_Cyperus_gymn_rush1_stems for measuring.pdf
- Additional resources have _additional after the task number eg
  - TaskA1_additional_both rushes, and are shaded grey

<table>
<thead>
<tr>
<th>Task</th>
<th>Items (not filenames, see booklets for references and image attributions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_B_C_D</td>
<td>Appropriate terminology Indigenous Australia Peoples from FlindersUniversity (two versions)</td>
</tr>
<tr>
<td>A1</td>
<td>Cyperus_gymn_rush1_stems for measuring (print A3 if possible and laminate)</td>
</tr>
<tr>
<td></td>
<td>Cyperus_vag_rush2_stems for measuring (print A3 if possible and laminate)</td>
</tr>
<tr>
<td></td>
<td>stem width excel calculations and graph</td>
</tr>
<tr>
<td>A1_additional</td>
<td>Images, both rushes (2 stems only)</td>
</tr>
<tr>
<td>A3</td>
<td>Fit for purpose_full size image CarrierBasket/tighter/stronger weaving</td>
</tr>
<tr>
<td></td>
<td>Fit for purpose_full size image mat, open looser weaving</td>
</tr>
<tr>
<td>A3_additional</td>
<td>Transcript of film of basket weaving Millerrum by Tindale - 1937</td>
</tr>
<tr>
<td></td>
<td>Taranthi Interpretive Guide Yvonne Koolmatrie echidna basket</td>
</tr>
<tr>
<td>A4_additional</td>
<td>Creation story of Thukeri (Catholic Education SA, as told by Leila Rankine)</td>
</tr>
<tr>
<td>B1_additional</td>
<td>Meningie wetland fact sheet</td>
</tr>
<tr>
<td>B3_C1</td>
<td>Mattingley &amp; Hampton (editors) (1998) Survival in our own land.</td>
</tr>
<tr>
<td>B3_additional</td>
<td>Map of Ngarrindjeri clans unknown source</td>
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<tr>
<td>C1</td>
<td>Image for making A3 print Kaurna calendar_Heyes 1999_from Adelaide Nature of City</td>
</tr>
<tr>
<td>C1_additional</td>
<td>NR_SouthEast_aboriginal-bush-foods-seasonal-calendar-gen</td>
</tr>
<tr>
<td>C1_additional</td>
<td>Ngadju_WA_Seasonal Calendar_Report_CES</td>
</tr>
<tr>
<td>C2_C3_D3</td>
<td>Aboriginal-bush-foods-plants-poster-gen</td>
</tr>
<tr>
<td>C2_C3_D3</td>
<td>Aboriginal-bush-foods-sugar-sap-seeds-poster</td>
</tr>
<tr>
<td>C2_C3_D3</td>
<td>Aboriginal-bush-foods-underground-poster-gen</td>
</tr>
<tr>
<td>C2_additional</td>
<td>Clarke 2013 Aboriginal ethnobotany of the Adelaide region</td>
</tr>
<tr>
<td>C2_additional</td>
<td>Selected images from the Ngarrindjeri dictionary</td>
</tr>
<tr>
<td>C3_additional</td>
<td>Nyoongar_WA_food plants, including native spinach</td>
</tr>
<tr>
<td>C4</td>
<td>Nuffield Foundation Quadratting_Biodiversity in your backyard</td>
</tr>
<tr>
<td>C5</td>
<td>amrl-me-taking-action-for-biodiversity-gen</td>
</tr>
<tr>
<td>D1</td>
<td>GuidetoHealthyEating</td>
</tr>
<tr>
<td>D1_additional</td>
<td>NutsForLife_Good_health_fact_20_4</td>
</tr>
<tr>
<td>D3</td>
<td>SAPS - Parts of a plant and a flower</td>
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<tr>
<td>E2</td>
<td>Sensory analysis_Muntries products excel analysis</td>
</tr>
<tr>
<td>E2_additional</td>
<td>IFTSensorySciencePartII_full slide presentation</td>
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<tr>
<td>E3_additional</td>
<td>Gott 2008 Indigenous Use of plants in S-E australia</td>
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<tr>
<td></td>
<td>NSW-edu-Stage 5 Food Technology_incl preservation</td>
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<td></td>
<td>Food Additive Code Numbers (July 2014)_FSANZ</td>
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<tr>
<td>E4_additional</td>
<td>PICSE_booklet2014_Living Science_Career Resources_AtoZ</td>
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### Native plants to grow at school to be self sufficient for the indicated lessons

<table>
<thead>
<tr>
<th>Task</th>
<th>Plant species (bold, first time listed)</th>
<th>Common name</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td><strong>Cyperus gymnocaulos</strong></td>
<td>Spiny flat-sedge or spiny sedge</td>
<td>Preferred weaving rush</td>
</tr>
<tr>
<td></td>
<td><strong>Cyperus vaginatus</strong></td>
<td>Flat-sedge</td>
<td>Related to weaving rush but too thick to weave with</td>
</tr>
<tr>
<td>A3</td>
<td><strong>Cyperus gymnocaulos</strong> (as used in A1)</td>
<td>Spiny flat-sedge or spiny sedge</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Cyperus vaginatus</strong> (as used in A1)</td>
<td>Flat-sedge</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Ficinia nodosa</strong> (previously Isolepis nodosa)</td>
<td>Knobby club-rush</td>
<td>Alternative if C. vaginatus not available (and more realistic weaving alternative)</td>
</tr>
<tr>
<td>A4</td>
<td><strong>Lomandra longifolia</strong></td>
<td>Spiny-headed mat-rush</td>
<td>For making rope, longer leaves so easier to work with</td>
</tr>
<tr>
<td></td>
<td><strong>Dianella spp</strong></td>
<td>Black-anther (or spreading) flax-lily</td>
<td>Don’t need both, but can help with discussion</td>
</tr>
<tr>
<td>D4</td>
<td><strong>Cyperus gymnocaulos</strong></td>
<td>Spiny flat-sedge or spiny sedge</td>
<td>Preferred weaving rush</td>
</tr>
<tr>
<td>E1</td>
<td><strong>Backhousia citriodora</strong></td>
<td>Lemon Myrtle</td>
<td>Strongly flavoured leaves</td>
</tr>
<tr>
<td>E2</td>
<td><strong>Kunzea pomifera</strong></td>
<td>muntries</td>
<td>Naturally sweet fruit. 3-5 years before plant sets fruit</td>
</tr>
</tbody>
</table>

- Native nurseries (for plants and possibly seed)
  - Raukkan Community Nursery (Kevin Kropinyeri), ngopamuldi@internode.on.net
  - Indigeflora Nursery, Hackham, 8326 2143
  - State Flora (Belair / Murray Bridge), http://www.stateflora.sa.gov.au/home
  - Growing Bush (Karen Lane), growingbush@adam.com.au
  - Barossa Bush Gardens (Pam Payne), M. 0448 676 348
## Ngarrindjeri Language related to Themes A and D

<table>
<thead>
<tr>
<th>Ngarrindjeri word</th>
<th>English meaning</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilbili (n) *</td>
<td>weaving rush (Cyperus gymnocaules)</td>
<td>1, p78; 2, p28</td>
</tr>
<tr>
<td>lakun (v)</td>
<td>to weave</td>
<td>1, p8</td>
</tr>
<tr>
<td>koyi (n)</td>
<td>coiled basket with coiled handle</td>
<td>1, p76</td>
</tr>
<tr>
<td>lakun koyi (v)</td>
<td>to weave baskets</td>
<td>1, p76; 2, p9</td>
</tr>
<tr>
<td>punji; yalani (n)</td>
<td>woven mat</td>
<td>1, p76</td>
</tr>
<tr>
<td>kurtun</td>
<td>collecting together</td>
<td>1, p77</td>
</tr>
<tr>
<td>tawari or dawari</td>
<td>basket made of rushes</td>
<td>2, p28</td>
</tr>
<tr>
<td>lundun, pintjun</td>
<td>picking out</td>
<td>1, p77</td>
</tr>
<tr>
<td>lamun</td>
<td>softening, tenderising rushes</td>
<td>1, p77</td>
</tr>
<tr>
<td>ruwe</td>
<td>country, home</td>
<td>1, p1</td>
</tr>
<tr>
<td>ka:la</td>
<td>acacia bush</td>
<td>2, p22</td>
</tr>
<tr>
<td>klapari</td>
<td>bread made from grinding seed of ka:la</td>
<td>2, p22</td>
</tr>
<tr>
<td>wurri (n)</td>
<td>seed from a species of wattle bush</td>
<td>3</td>
</tr>
<tr>
<td>kuranthantha (n)</td>
<td>plant, a plant species</td>
<td>3</td>
</tr>
<tr>
<td>kulpuri (n)</td>
<td>a plant</td>
<td>3</td>
</tr>
<tr>
<td>kolaki (n)</td>
<td>a plant species used as food</td>
<td>3</td>
</tr>
<tr>
<td>yandiru (n)</td>
<td>flower</td>
<td>3</td>
</tr>
<tr>
<td>??</td>
<td>root</td>
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</tbody>
</table>

* There are five other words that are also used for weaving rushes (Ngarrindjeri Lakun (2011, pg 15); yalkari, mrakwuri, ku:yiti, mungadu and kukandu

n, noun; v, verb.

**References**


For more language information see Task C2 and references.

<table>
<thead>
<tr>
<th>Title</th>
<th>© Date</th>
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<tbody>
<tr>
<td>Tribute to Tom Trevorrow</td>
<td>2013 Ngarrindjeri Regional Authority and Change Media</td>
</tr>
<tr>
<td>Weaving and Whispers at TarraWarra Biennale</td>
<td>2014 Ngarrindjeri Regional Authority and Change Media</td>
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<td>Meningie Foreshore Redevelopment</td>
<td>2014 Ngarrindjeri Regional Authority and Change Media</td>
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<tr>
<td>Nation to Nation - Aboriginal Regional Authorities in SA</td>
<td>2015 Ngarrindjeri Regional Authority and Change Media</td>
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<tr>
<td>We are Water People</td>
<td>2016 Ngarrindjeri Regional Authority and Change Media</td>
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<tr>
<td>Yarluwar Ruwe Evaluation</td>
<td>2016 Ngarrindjeri Regional Authority and Change Media</td>
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<tr>
<td>Fulton Hogan Ngarrindjeri/NBN video</td>
<td>2016 Ngarrindjeri Regional Authority and NBN</td>
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<tr>
<td>We Are Ngarrindjeri</td>
<td>2014 Ngarrindjeri Regional Authority and Change Media</td>
</tr>
<tr>
<td>Everything Is Connected - Ngarrindjeri Carving</td>
<td>2015 Change Media and Ngarrindjeri Land and Progress Association Inc</td>
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<tr>
<td>Everything Is Connected - Ngarrindjeri Weaving</td>
<td>2015 Change Media and Ngarrindjeri Land and Progress Association Inc</td>
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<tr>
<td>Everything Is Connected - Ngarrindjeri Dance</td>
<td>2015 Change Media and Ngarrindjeri Land and Progress Association Inc</td>
</tr>
<tr>
<td>FLOW - Life Giving Lands and Waters</td>
<td>2013</td>
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<tr>
<td>Additional videos about Ngarrindjeri Culture and Peoples</td>
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<tr>
<td>--------------------------------------------------------</td>
<td></td>
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<tr>
<td><strong>Reframing culture</strong></td>
<td></td>
</tr>
<tr>
<td>© 2012 Ngarrindjeri Regional Authority and Change Media</td>
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<tr>
<td><a href="http://vimeo.com/52964967">http://vimeo.com/52964967</a></td>
<td></td>
</tr>
<tr>
<td><strong>Nukkan Kungun Yunnan (See Listen Speak)</strong></td>
<td></td>
</tr>
<tr>
<td>© 2009 Ngarrindjeri Regional Authority and Change Media</td>
<td></td>
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<tr>
<td><a href="https://vimeo.com/44838720">https://vimeo.com/44838720</a></td>
<td></td>
</tr>
<tr>
<td>More videos can be found by searching for Ngarrindjeri at Vimeo</td>
<td></td>
</tr>
<tr>
<td><a href="https://vimeo.com/search?q=ngarrindjeri">https://vimeo.com/search?q=ngarrindjeri</a></td>
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</tbody>
</table>
The Australian Curriculum, YEAR 10, Content & Learning Outcomes

SCIENCE UNDERSTANDING – Biological Sciences

Transmission of heritable characteristics from one generation to the next involves DNA and genes

Students recognise that genetic information is passed on to offspring from both parents by meiosis and fertilisation

Students seek to understand that the consequences of different methods or cultural practices to genetic diversity of plants.

The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence

Students examine geographical distribution of species using databases.

Students examine genetic diversity and explore how it allows populations to adapt to changing environments, thereby facilitating evolution through processes of natural selection.

SCIENCE AS A HUMAN ENDEAVOUR

Nature and development of science

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community

Students explore how Indigenous knowledge is passed through generations and how analytical skills enable this information to be used and organised appropriately.

Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries

Recognising how information technology can be applied to different areas of science including biodiversity, ecology and plant sciences.

Use and influence of science

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people’s lives, including generating new career opportunities

Students evaluate claims relating to health benefits of food products.

Students evaluate claims relating to the reduced environmental footprint of food plants.

Students participate in a sensory science analyses of novel food products and use this data to evaluate what products are preferred by most students.

Students describe changes that have occurred in food and agriculture in the last 25 years and predict future applications of novel technologies on people’s lives.

Values and needs of contemporary society can influence the focus of scientific research

Students understand that support from government and industry bodies enable information about Indigenous plants to be available and applicable to the wider society.

SCIENCE INQUIRY SKILLS

Questioning and predicting

Formulate questions or hypotheses that can be investigated scientifically

Students use available resources to identify questions to investigate the suitability of different types of plants or plant-based materials to address specific needs.

Students develop ideas through investigations and experiences to investigate further the influence of Aboriginal knowledge on current land management practices.
Students explore the validity of claims relating to biological processes and formulate questions that can be investigated scientifically.  
Students explore the role of insects in increasing the genetic diversity of plants.  
Students use existing and new knowledge to investigate food preservation methods and design an experiment to test the effectiveness of a food preservation method.

Planning and conducting

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

Students combine research using primary and secondary sources with their own investigations.  
Students plan and conduct an investigation to measure or improve the biodiversity of a local area  
Students investigate the structure and function of plants through experimenting with samples and assessing their findings.  
Students choose a method to germinate seeds and follow the process of germination, collecting data and making observations.

Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students analyse data and use spreadsheets to draw graphs and describe samples.  
Students examine geographical distribution of species, nutritional information and plant-use using databases.

Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.

Students analyse daily measurements and translate their data into growth rates.

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data

Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.

Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.

Critically analyse the validity of information in primary and secondary sources, and evaluate the approaches used to solve problems

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.
Year 8, 9, Science & other disciplines

SCIENCE - Year 8

SCIENCE UNDERSTANDING - Biological Sciences

Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce.

*Students explore the role of cell walls in enabling use of plants for tools and arts, as well as the process of seed germination.*

SCIENCE INQUIRY SKILLS

Planning and conducting

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed

*Students investigate the structure and function of plants through experimenting with samples and assessing their findings.*

Theme A/D

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SCIENCE - Year 9

SCIENCE UNDERSTANDING - Biological Sciences

Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems.

*Students investigate how ecosystems and the land can be managed to preserve biodiversity.*

Theme C

SCIENCE AS A HUMAN ENDEAVOUR

Nature and development of science

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community.

*Students explore how Indigenous knowledge is passed through generations and how analytical skills enable this information to be used and organised appropriately.*

Theme B / Theme C / Theme D

Values and needs of contemporary society can influence the focus of scientific research.

*Students understand that support from government and industry bodies enable information about Indigenous plants to be available and applicable to the wider society.*

Theme D

SCIENCE INQUIRY SKILLS

Planning and conducting

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed

*Students investigate the structure and function of plants through experimenting with samples and assessing their findings.*

Theme A/D

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

*Students examine geographical distribution of species, nutritional information and plant use using databases.*

Theme B / Theme D

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

*Communicating ideas through group discussion and written word.*

Theme A, D
GEOGRAPHY - Year 8

GEOGRAPHICAL KNOWLEDGE AND UNDERSTANDING

Landforms and Landscapes

Spiritual, aesthetic and cultural value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples.

*Exploring the multilayered meanings associated with landforms, students connect cultural, scientific and geographical concepts.*

Theme B, C

GEOGRAPHICAL KNOWLEDGE AND UNDERSTANDING

Geographies and interconnections

The perceptions people have of place, and how these influence their connections to different places.

The effects of people’s travel, recreational, cultural or leisure choices on places, and the implications for the future of these places.

*Students compare perception and use of place through discussion about land management.*

Theme C

ENVIRONMENTAL CHANGE AND MANAGEMENT - Year 9

Environmental change and management

The Aboriginal and Torres Strait Islander Peoples’ approaches to custodial responsibility and environmental management in different regions of Australia

*Students compare perception and use of place through discussion about land management and explore production of traditional plants.*

Theme C, E

GEOGRAPHICAL INQUIRY AND SKILLS Year 10

Collecting, records, evaluating and representing

Represent data in a range of appropriate forms, for example, climate graphs, compound column graphs, population pyramids, tables, field sketches and annotated diagrams, with and without the use of digital and spatial technologies

Interpreting, analysing and concluding

*Apply geographical concepts to draw conclusions based on the analysis of data and information collected*

*Students engage their inquiry skills through interpretation and representation of data from both primary and secondary resources.*

Theme B, C, D, E

DESIGN AND TECHNOLOGIES - Year 8

Design and technologies knowledge and understanding

Investigate the ways in which products, services and environments evolve locally, regionally and globally and how competing factors including social, ethical and sustainability considerations are prioritised in the development of technologies and designed solutions for preferred futures

*Students consider factors which influence the selection of appropriate materials for tools and equipment for traditional means.*

Theme A, B, C, D, E

DESIGN AND TECHNOLOGIES - Year 9 / 10

Design and technologies knowledge and understanding

Critically analyse factors, including social, ethical and sustainability considerations, that impact on designed solutions for global preferred futures and the complex design and production processes involved.

*Students evaluate the design and technologies associated with production of both crafts and tools.*

Theme A
### Theme A: Rushes, weaving and plant cell walls

<table>
<thead>
<tr>
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<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
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</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Cultural connections, rushes</td>
<td>Cardboard structure and strength and plant cell walls</td>
<td>Plant fibres and their uses – weaving with different rushes</td>
<td>More uses for plant fibres – making rope</td>
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<td><strong>Activity</strong></td>
<td>Classroom</td>
<td>Practical</td>
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<tr>
<td><strong>Discover</strong></td>
<td>Cultural use of rushes by Ngarrindjeri people</td>
<td>The molecular structure of plant cell walls</td>
<td>How to weave</td>
<td>How to make rope from plant fibres</td>
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<td></td>
<td>Why particular varieties of rushes were selected</td>
<td>Structure function relationships in weaving and cardboard</td>
<td>Aboriginal cultural practices ensured the right plants were used for weaving</td>
<td>Plan an experiment to test the effect of environmental factors on man-made fibres</td>
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<tr>
<td><strong>Tasks/Skills</strong></td>
<td>Compare</td>
<td>Explain</td>
<td>Compare</td>
<td>Describe</td>
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<td>Evaluate</td>
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<tr>
<td><strong>Understanding</strong></td>
<td>Biological variation</td>
<td>How layers and cross-links contribute to strengths in nature, man-made products and cultures</td>
<td>Physical properties (e.g., flexibility) in part due to plant species, and can be altered by processing</td>
<td>How man-made fibres are affected by the environment</td>
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<tr>
<td><strong>Content Descriptions</strong></td>
<td>Science Inquiry Skills</td>
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**Cross-curriculum priorities**

**Assessment**

Inquiry Project and Report
Task A1. Cultural connections, rushes and plant cell walls*

SCIENCE INQUIRY SKILLS

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students analyse data and use spreadsheets to draw graphs and describe samples.

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data

Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

<table>
<thead>
<tr>
<th>Equipment - for both options 1&amp;2</th>
<th>A1. Cultural connections, rushes &amp; plant cell walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet / screen or computers to watch video</td>
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<tr>
<td>Rulers with mm marks</td>
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<tr>
<td>Computers or tablet with spreadsheet/graphing program (eg Excel©).</td>
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Equipment – Option 1

A3 printout / laminates of stem images for two species of rush (provided e-resources)

or data project onto wall or butcher paper

Equipment – Option 2*

15-20 fresh stems from two species of rushes (Cyperus gymnocaulos & Cyperus vaginatus).

If using fresh rushes, at the end of the lesson, get students to bundle and dry them, for use in Task A3.

For Teachers

Excel© file with example calculations and graphs (provided e-resources)

Ngarrindjeri Sea Country Plan (2006) (provided e-resources)

Additional resources (not core)

Images both rushes with ruler (provided e-resource)

Engaging Students

How many of you like/liked playing spot the difference (when you were younger)?

Well that’s what botanists do every day. All peoples who live off the land must be able to do it to.
Cultural use of rushes by Ngarrindjeri peoples

Reading: Ask students to read the passage. Highlight uses of the rushes, the idea of sustainable harvesting and the type of rush favoured – bilbili.

Video: Reframing Culture [http://vimeo.com/52964967](http://vimeo.com/52964967)

watch from minute 11.29 to 12.40

Images from [http://vimeo.com/52964967](http://vimeo.com/52964967). Ellen Trevorrow demonstrating weaving and explaining important cultural links

Q. How many differences can you spot between the two types of rush species?

A. Note simple terms have been used for structures rather than the correct botanical terms.

<table>
<thead>
<tr>
<th></th>
<th>stem width (Gc thinner than Gv)</th>
<th>length of leaves at top, Gc had 3 short leaf-like prongs and Gv has ≈ 5 longer leaf-like structures</th>
<th>leaves at top of Gv are mostly brown not green</th>
<th>seed of Gc in tight ball at top, whereas on Gv they are in clusters at the base of a short stem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo. Carolyn Schultz</td>
<td></td>
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</table>

Q. Which one of these two species is most likely to be the basket weaving rush?

A. *Cyperus gymnocaules* (Gc) because most stems have 3 clear leaf-like prongs under the seed head.

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

A. Knowledge passed down through centuries. Originally it would have been trial and error – which ones felt better to weave and which ones lasted the longest for different uses. After colonisation and changed land usage, this knowledge would have been reinforced when the preferred rushes became scarce and other rush such as *Ficinia nodosa* (clubby knob rush) had to be used.

Q. Why do you think the “three pronged rush” is the preferred rush for basket weaving? *If possible – give students examples of both types of dried rushes to play with.*

A. The thinner stem was more pliable and easier to weave than thicker stems that often snapped.
Q. How does basket weaving represent family and culture?

A. Many layers – held together with strong bonds. Watch video with Auntie Ellen explaining the link between weaving, family and culture

<table>
<thead>
<tr>
<th>Cyperus gymnocaulos: Rush 1</th>
<th>Cyperus vaginatus: Rush 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo. Carolyn Schultz</td>
<td>Photo. Carolyn Schultz</td>
</tr>
</tbody>
</table>

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

Measurements can be taken with a ruler or under a microscope or from a photo/scan using free software, such as imagej (http://imagej.nih.gov/ij/)

- If taking measurements from the photographs.
  - Project images on a wall, or
  - Enlarge images on the computer screen (200-400%) and use a ruler
  - Graph ().
- If using imagej, measure with mouse and download data to excel
- Graph in Excel® as example below
  - Insert – Line (2-D Line with Markers)
  - number here are approximate not measured
- Calculate the mean (average)
  - Use Average function in Excel®
- Determine the minimum and maximum value
  - Concept of range – do the ranges overlap?
  - Extension level (standard deviation/standard error)
Important notes about stem diameter and plant development

- The cells in a monocot (grass-type) stem divide at the base, and then the cells expand “longitudinally” which explains why new, shorter stems of both types of rush are generally thicker (see the left three rushes on the *Cyperus gymnocaules* image)
- To get the most accurate measurements, get students to select stems of the same length/same developmental stage (preferably full length)
- The smaller stems are generally on the outside of the plant, with taller stems in the middle
Q. Where along the stem… best place to measure? Explain the reason for your choice.

A. If using whole stems and can see the top and the bottom of all stems. Probably the middle as this is less influenced by the growth stage. The base of the rush (soil end) can be quite thick, in shorter, unexpanded stems.

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

A. The bigger stem is thicker, and less flexible. If you cut a cross section through the stem, you should notice that the cell wall of the basket weaving rush (Cg) is thinner than the wall of Cv.

Fill in the blanks (answers based on photos)

For the weaving rush, C. gymnocaulous,

Based on the sampling of n = 11 stems, the range of sizes of stem (magnified) is from 2 to 3 (smallest to largest) and the average stem width (magnified) is 2.4 mm.

For the weaving rush, C. vaginatus,

Based on the sampling of n = 10 stems, the range of sizes of stem (magnified) is from 2.5 to 3.5 (smallest to largest) and the average stem width (magnified) is 3.2 mm.

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

A. Each student will get slightly different answers. This example the difference is 0.8 mm (3.2 mm – 2.4 mm).

Q. How confident do you now feel in saying that the stems of Rush 1 are thinner than the stems of Rush 2?

A. Students should feel quite confident. The averages are quite different and from the graph nearly all the measured Rush 1 values are less than the values for Rush 2.

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

A. Remember that each loop is 3-dimensional not flat. You can see at least three strands in each loop and appears cylindrical in cross section, so probably around 10 (The recommendation is for 7 to 9 thicker rushes for the centres – refer to Task A3, Ngarrindjeri Lakun, 2003). You could provide students with spaghetti and get them to form a small bundle with say 5, 10 and 15 pieces of spaghetti. Then look at the bundles from on top and determine what bundle looks most like the picture.

Q. What is connecting the loops together?

A. The thinner stem was used to weave each loop together (like a blanket stitch).

Q. What are the likely benefits of this arrangement?

A. The inner loops provide strength and the weaving strand is flexible (and strong – does not break). It is also relatively simple to do and can be made into many different shapes (and uses) by changing the arrangement of the loops.
Task A2: Cardboard structure and strength*

SCIENCE INQUIRY SKILLS

Questioning and predicting
Formulate questions or hypotheses that can be investigated scientifically
Students use available resources to identify questions to investigate the suitability of different types of plants or plant-based materials to address specific needs.

Planning and conducting
Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods
Students combine research using primary and secondary sources with their own investigations.

Processing and analysing data and information
Analyze patterns and trends in data, including describing relationships between variables and identifying inconsistencies
Students analyse data and use spreadsheets to draw graphs and describe samples.

Equipment
- Internet / screen or computers to watch video(s)
- Variety of cardboards. Ideally find 1, 3 and 5 ply cardboards of different strengths

Engaging Students
Ask students to bring cardboard from home. Discuss “fit for purpose” with different strengths of cardboard. Advantages of using the “thinnest” cardboard that will do the job (less energy / resources to make/transport – but need to minimize breakage). Link to same for plants – tall tree needs thicker walls than herb/rush. And Communities – presence of all generations good for both you and old and all in between.

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

Plant Cell Walls: 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.
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.

Q. Brainstorm why cell walls are important for plants.

   A. Maintain the shape of the plant, provide support, provide flexibility, allow plants to grow tall, protection (some leaves have waxes). For comparisons. Insects have exoskeletons for strength and protection. Humans have bones for strength and support.

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

   A. Strength is important to make long lasting baskets. Flexibility is important to allow the weaving thread to be woven to join everything together.

Cardboard structure and strength

Bring in a variety of cardboards to class. Ideally find 1, 3 and 5 ply cardboards of different strengths.

Ask students to discuss what contributes to strength. Thickness of each layer, strength of glue, number of contact points etc.

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

   A. The one on the right. Several strong layers (could be cellulose fibres) linked with the corrugated (wavy) cardboard that could be seen as the cross-linking molecules (hemicellulose and pectins)

Q. Look at the different cardboards. Which one is (looks) the strongest? Explain why.
A. The more layers the cardboard has, and the more and/or stronger each cross-link of glue is with the corrugated layer, the stronger the cardboard is. This can be likened to the strength of a multigenerational community with all generations present, interacting and sharing new ideas and old knowledge.

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

A. Several different factors likely contribute to cardboard strength, especially the thickness of each layer and the number of layers. The length of cellulose fibres in each layer of cardboard is also likely to be important.

You could test this in several ways. 1. By finding cardboard that differs in only one variable (ie different number of layers (3 or 5 ply), but same thickness of each layer (measure with a ruler OR same number of layers (all 3 ply), but with different thickness of cardboard. Test strength by trying to bend in half, or adding different weights and seeing how much weight needed to bend, or crush by more than a set amount (say 50-75%), or resistance to puncturing, from a blunt object (such as flat end of pencil).

After the brainstorming session – get students to set up their own experiment, record their results and analyse data. Get them to do at least 3 times (3 replicates, although 5 is better), varying only one factor (thickness of cardboard).

Alternatively could explore changes in strength/water repellency if a thin layer of wax is added to the cardboard (as they do with some fruit boxes).

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

Imagine if (scenario): a bad batch of glue where the layers didn't stick together (interaction). Would be weaker – same with any community. This is particularly relevant to the “Stolen Generation” and the lower than average life expectancy of Aboriginal peoples, and there is a loss of knowledge, mentors and positive role models.

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

A. Cardboard would be weaker / more floppy.

Q. Imagine … one layer …represents a generation … Explain … changes …strength of the community.

Lower life expectancy of Indigenous Australians has a negative impact on the strength of a community, with fewer Elders to provide advice/share knowledge/guidance/friendship.

Imagine what happens when a whole layer (generation) is removed from the community, as with the Stolen Generation.

THIS QUESTION LINKS TO HISTORY LESSON 3 – STOLEN GENERATION
Task A3. Plant fibres and their uses – weaving with different rushes*

SCIENCE INQUIRY SKILLS

Planning and conducting

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

Students combine research using primary and secondary sources with their own investigations.

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students analyse data and use spreadsheets to draw graphs and describe samples.

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

Equipment

Teachers are encouraged to contact a local Elder or Aboriginal weaver to assist with the activity. Consider a visit/stay at Camp Coorong, http://peaceliberation.tripod.com/pages/nlpaWebPage/ where weaving and other cultural teachings are available. Lessons may also be available through Tauondi Aboriginal College http://www.tauondi.sa.edu.au/, and sometimes through Sophia Centre, 225 Cross Road Cumberland Park SA 5041 (http://www.sophia.org.au/), or selected regional galleries.

Internet / screen or computers to watch video: 'Basket-making, Coorong, South Australia' 1937 (Norman Tindale, AA 338/25/2, showing weaving by Milerum (Clarence Long) of the Tanganekald people, during December 1937 (See if you can get borrow a copy video Milerum weaving (from museum)). Transcript http://archives.samuseum.sa.gov.au/aa338/AA338-25.htm (provided e-resources).

Fresh rushes (1 species) for comparison to dried rushes

Dried rushes (2 species) for weaving mats/coasters

- *Cyperus gymnocaulos* – preferred for weaving
- *Cyperus vaginatus* – alternative 1 (most different / harder to weave with)
- *Ficinia nodosa* – alternative 2 (more like the preferred rush for weaving)

For dried rushes. Cut and dry for **3 to 6 weeks** in a place with good air circulation, turning frequently.

Prepare starter basket made from *Cyperus gymnocaulos*. A starter looks like
Prior to use, soak for 1 hr in hot water and 3-4 hours in cold water until flexible
(Ngarrindjeri Lakun, 2013)
Damp sheet to keep rushes moist
Bamboo skewers (to loosen stitches)
Scissors (to trim rushes)
Consider growing plants at the school or contact a local weaving group or landcare group
Buy plants from a native plant nursery (eg State Flora (Belair / Murray Bridge) or Provenance Indigenous plants)

Materials for Plan & Conduct – flexibility test
- ruler,
- 15-20 cm long pieces of 13 mm irrigation tubing (see images below)
- Scissors

Images for printing (optional) of basket and mat for “fit for purpose” activity

Additional resources (not core, provided e-resources)

Transcript of film of basket weaving Milerum by Tindale
Taranthi Interpretive Guide Yvonne Koolmatrie echidna basket

Engaging Students
Homework: What types of objects were woven by Ngarrindjeri peoples of Australia? What physical properties did these items need to have. Assessable resource is https://www.samuseum.sa.gov.au/gallery/ngurunderi/ng4htm.htm, shows images of cloaks, winnowers, baskets, mats, sister baskets,. Properties, strong, flexible, long lasting, relatively light (not too heavy).

This activity gets students to explore how construction materials (physical properties of rushes) and techniques (open vs closed weaving) can be used to produce articles that are fit for purpose.

Films of Norman Tindale’s exhibitions – with summaries
AA 338/25/2 'Basket-making, Coorong, South Australia' 1937. This is a final film production documenting basket-making techniques as demonstrated by Milerum (Clarence Long) of the Tanganekald people, during December 1937.
Highlights that men/boys also did basket weaving.
Q. Compare the dried rushes to ...re-wet rushes. Describe ...3 differences .....  

1. The dried rushes are brittle whereas the re-wet rushes are soft and flexible.  
2. The re-wet rushes are heavy because they have absorbed water.  
3. The colour has changed from a light green/grey to a dark green/grey. 

Q. Plan and conduct ...quantitative data... flexibility of the wet and dried rushes. Record notes ....  

One easy way. Wrap a 60 cm piece of rush around as 13 mm piece of irrigation pipe. (Measure 60 cm using a ruler, then cut). Do 3 to 5 pieces of rush for each treatment (and count the number of splits in the rushes, in the example below there were three splits).  

Discuss Consequences of split rushes. Will be weaker and untidy. Likely reason why re-wet rush is more flexible is that water molecules interact with fibres in the rushes and hold them fibres together with hydrogen bonding. 

Images: Carolyn Schutz. Left: dry rush, at least 3 splits. Middle: dried and re-wet, no damage; Right: green rush, one split (for interest).  

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

A. A is a bag for carry stuff. B is a mat. Could be for placing stuff on to keep it out of the sand/dirt/mud. 

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

A. The weaving is tighter in A than B, with less space between adjacent stitches. There is only about 1-1.5 fibre widths between each stitch, whereas in the mat there is 3-4 fibre widths between stitches. The mat (B) is flat, whereas the bag has an opening (is more 3 dimensional) although there are no “seams” as you would have in say a leather bag. 

Q. List advantages and disadvantages of the weaving technique used in A.  

**Advantages:** Stronger because more connections holding it together. Compare to reinforced concrete which is stronger, the closer the spacing (and thickness) of metal rods.  

**Disadvantages:** Higher “construction” costs because need more fibres to make and would take longer to make because more total number of stitches to do.
Weaving - see full instructions in Student Activity Booklet

Weaving with the “other” rush, *C. vaginatus*

*Ficinia nodosa* would be easier than *C. vaginatus*, but still not preferred compared to bilbili (*C. gymnocaulus*). Not sure why.

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

A. It is much harder to weave with the “other” rush, *C. vaginatus*, because it snaps as you try to weave with it, so bits stick out. Rushes more likely to break so will not be as strong as there will be more places where it can unravel from.

THIS QUESTION LINKS TO HISTORY LESSON 5 – WATER FLOWS

Q. How would the lives …been affected when access to …rushes was prevented by early colonists ….

A. It would have been very difficult for them because they would have had to go without their normal everyday things, in addition to their favorite foods. Imagine if you had to live without your bowls, storage container, backpacks and couches/rugs? They had to walk further to find what they needed, if they were even allowed into the areas where the preferred rushes grew, and if there were any even left after stock had eaten them.
Task A4. More uses for plant fibres – making rope*

**SCIENCE INQUIRY SKILLS**

**Questioning and predicting**

Formulate questions or hypotheses that can be investigated scientifically

*Students use available resources to identify questions to investigate the suitability of different types of plants or plant-based materials to address specific needs.*

**Planning and conducting**

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

*Students investigate the structure and function of plants through experimenting with samples and assessing their findings.*

**Processing and analysing data and information**

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

*Students analyse data and use spreadsheets to draw graphs and describe samples.*

**Equipment**

- Internet / screen or computers to watch video(s)
- Dried leaves *Lomandra longifolia* (or *Dianella* spp). Both are widely used in landscaping. Collect already dry material from around plants, or cut and dry a few weeks ahead of time. Contact a garden maintenance worker in your area if needed.
- Consider growing it at the school
- Retort stand with a clamp or anything convenient to hook leaves over
- Weights/sinkers/baskets that can be added to ropes to test strength
- If doing final Inquiry project – student will need access to one or more plant based strings (cotton, jute, sisal, hemp)

**Additional resources** *(not core, provided e-resources)*

- Use of plant fibres is reflected in the Creation Story – Thukeri
- Resource from Catholic Education “Thukeri: A Ngarrindjeri Dreaming Story”: A Story as told by Leila Rankine”
- [feelingthemurray.wikispaces.com/file/view/Thukeri.doc](feelingthemurray.wikispaces.com/file/view/Thukeri.doc)

**THIS READING LINKS TO HISTORY LESSON 1 – NGARRINDJERI KALDOWINYERI (creation)**

**Engaging Students**

- Ask students to bring in examples of rope/ties from home. What are they made off? Discuss concept of thickness / ply to make stronger. Which ones are natural fibres? Can you see joins? How do you get from thick strappy leaves to rope/string.
Q. Use … ‘Ngarrindjeri Nation Sea Country Plan (2006)’ to describe … fishing aids …developed thousands of years ago to catch fish .. (Sea Country)


Q. 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.

A. There are different laws for recreational fishers, commercial fishers, and Aboriginal traditional fishing. see http://pir.sa.gov.au/fishing. In summary, recreational fishers have to obey laws that relate to “size, bag, and boat limits; closures and aquatic reserves; rock lobster pot registration; fishing gear; and protected species”. Commercial fishers, are also subject to laws on size and quotas, and recently the government has been buying back commercial license to increase fish stock for the future.

The size and bag limits for recreational fishers, and quotas for commercial fishers are species dependent, and are underpinned by scientific data (monitoring) of fish numbers (http://pir.sa.gov.au/fishing/fishing_limits).

Q. What other things are currently made out of plant fibres or were historically made out of plant fibres?

A. Cotton (clothing/string), Flax (string), Wood (furniture / bowls), Bamboo (structural supports / clothing)

Watch video (s)

Making rope. Website includes a full transcript of the video, from which the activity was modified. http://www.abc.net.au/gardening/stories/s3861974.htm

Students make two ropes

Joining them in different ways (6 cm or 2 cm overlap) compare the physical properties of the ropes.

Q. Describe the differences between rope 1 and rope 2.

A. Rope 1 has a longer, thicker bulge than rope 2.

Q. Why was one rope stronger than the other?

A. From the experimental data recorded with the weights, rope 1 should be stronger, because of the longer region of overlap between the two strands of plant fibre. This provides a greater frictional force to hold the two pieces of fibre together. http://www.physicsclassroom.com/class/newtlaws/Lesson-2/Types-of-Forces

Q. How do you think you could make ropes that were even stronger?

A. Make the rope 3 or 4 ply instead of 2 ply. Find a plant with even longer leaves (thus allowing an even longer overlap).

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

A. Nets and traps would likely have only been left in the water when actively fishing. Rope based materials might have been dried in the sun, then placed in the shade for storage.
Q. What environmental factors could affect the lifespan of a rope?

A. moisture, UV (sun), mould (eg fungi or other microorganisms "eating" the rope), heat, salt.

Likely ranking (predictions) of harshest environmental conditions for rope made from plant fibres.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Immersion in fresh water</td>
</tr>
<tr>
<td>1 (harshest)</td>
<td>Immersion in salt water</td>
</tr>
<tr>
<td>4</td>
<td>In air, in shade</td>
</tr>
<tr>
<td>3</td>
<td>In air, in full sun</td>
</tr>
</tbody>
</table>

Plan and execute a series of experiments to test your theory.

- Suggest a 4 week time frame
  - collect salt and lake/river water (if possible so have all the bugs too)
  - brainstorm what “measurements to take” each week
    - colour
    - strength (simple – eg tugging)

- Use commercial rope / string
  - Could compare different strings

<table>
<thead>
<tr>
<th>Nature fibre</th>
<th>Plant source</th>
</tr>
</thead>
<tbody>
<tr>
<td>String (cotton)</td>
<td>Cotton, <em>Gossypium hirsutum</em></td>
</tr>
<tr>
<td>Jute (hessian)</td>
<td><em>Corchorus olitorius</em></td>
</tr>
<tr>
<td>Sisal</td>
<td>Agave, <em>Agave sisalana</em></td>
</tr>
</tbody>
</table>


- Allow students to devise a different test(s) for strength
  - Explain
    - Why new test is different/better
    - What aspect of rope quality is being tested (eg join strength or strength of individual fibres)
### Overview of Theme B - Plant Databases

<table>
<thead>
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<th></th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Plant databases*</td>
<td>Using information in databases</td>
<td>Evaluating information</td>
<td>Indigenous knowledge and citizen science</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Computer</td>
<td>Computer</td>
<td>Classroom</td>
<td>Classroom</td>
</tr>
<tr>
<td><strong>Discover</strong></td>
<td>FloraSA database</td>
<td>Atlas of Living Australia</td>
<td>Ngarrindjeri country</td>
<td>How cultural knowledge is preserved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spreadsheet skills</td>
<td></td>
<td>Citizen Science</td>
</tr>
<tr>
<td><strong>Tasks/Skills</strong></td>
<td>Identify</td>
<td>Brainstorm</td>
<td>Evaluate</td>
<td>Infer</td>
</tr>
<tr>
<td></td>
<td>Analyse</td>
<td>Analyse</td>
<td>Compare</td>
<td>Explain</td>
</tr>
<tr>
<td></td>
<td>Explain</td>
<td>Design</td>
<td>Explain</td>
<td>Hypothetical</td>
</tr>
<tr>
<td></td>
<td>Compare</td>
<td>Self-guided learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Understanding</strong></td>
<td>Importance of different environments for different plants</td>
<td>Role of ICT in collecting, presenting and interpreting complex datasets</td>
<td>Information transfer, accuracy and application</td>
<td>Quality control in Indigenous and current knowledge systems</td>
</tr>
<tr>
<td><strong>Content Descriptions</strong></td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
<td>Science inquiry skills</td>
<td>Science inquiry skills</td>
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<tr>
<td><strong>General Capabilities</strong></td>
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<tr>
<td><strong>Cross-curriculum priorities</strong></td>
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<tr>
<td><strong>Assessment</strong></td>
<td>Written Task</td>
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</tr>
</tbody>
</table>
Task B1. Current plant databases*

SCIENCE UNDERSTANDING – Biological Sciences

The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence.

Students examine geographical distribution of species using databases.

SCIENCE INQUIRY SKILLS

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies.

Students examine geographical distribution of species, nutritional information and plant-use using databases.

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations.

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

Equipment  Task B1. Current plant databases*

Internet / screen or computers to watch video(s)

Internet access for students (working alone or in pairs)

Additional resources (not core)

Meningie wetland fact sheet (provided e-resource)

Engaging Students

Do you think the basket weaving plants grew near where you/your family grew up? How would you find out? Or

Where is the closest place to your school to find them growing in a reserve or park?

INTRODUCTION TO TASK LINKS TO HISTORY LESSON 4 (WEAVING: HISTORY & GENDER). NOTE: weaving was, and is, done by women and men (and children of both sexes, as noted in Task A3), not just women as implied by paragraph from Bell (2008).
Video [https://vimeo.com/95818939](https://vimeo.com/95818939), Meningie Foreshore Restoration Project (images below from the video).

**Key messages**

- 40,000 plants grown for this project alone – including the basket weaving rushes – need to grow the right plants in the right places – how would you know? Partnership with the Traditional Ngarrindjeri owners who have an intimate knowledge of where the different types of rushes grow best.
- Weaving rushes grow in fresh water

Q. How many seedling were grown for this project?

A. 40,000 plants

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

A. Fresh water. Reinforce that you need to grow plants in the right environment. Databases provide a way to learn about the correct environment

**Electronic Flora (eFlora) database:** To investigate where rushes grow.

*For a snapshot of 10 different entries, see next page.*

The details of the Collector and Habitat are provided under the thumbnail image of the full entry.

Q. What year was the sample collected? From the first 3 examples provided

<table>
<thead>
<tr>
<th>Sample</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td>2012</td>
</tr>
<tr>
<td>Sample 2</td>
<td>1891</td>
</tr>
<tr>
<td>Sample 3</td>
<td>1980</td>
</tr>
</tbody>
</table>

Q. What type of the environment (habitat) was the plant growing in?

<table>
<thead>
<tr>
<th>Sample</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td>Creek in rocky hills. Low Very Open Woodland</td>
</tr>
<tr>
<td>Sample 2</td>
<td>Alongside of creek. Soakage</td>
</tr>
<tr>
<td>Sample 3</td>
<td>In water at large bore-drain swamp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: H.P. Vonow (no. 415) on 20 Nov 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Creek in rocky hills. Low Very Open Woodland</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: R. Helms (s.n.) on 5 Jun 1891</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Alongside of creek. Soakage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: F. Badman (no. 271) on 20 Sep 1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: In water at large bore-drain swamp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: L. Alexander (no. 2055) on 20 Sep 1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: On edge of dry salty lake - flood out area</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: B.M. Overton (no. 3106A) on 17 Sep 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Flat area of hind-dune, adjacent to Western River, 10 m from bridge.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: K.L. Graham (no. 2949) on 15 Oct 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Stream channel in plain system. 1 degree slope. Rare sandstone outcropping and sparse sandstone pebble (5-50 mm) strewn. Loamy sand.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: H.J. Eichler (no. 15671) on 26 Jan 1959</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Lagoon</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: F.J. Bennett (no. 7062) on 19 Nov 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Open depression in flood plain system. Light medium clay.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: R.J. Ferguson (no. 5118) on 11 Nov 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Plain in flood plain system. SE-facing, 1 degree slope. Clay loam. Low Shrubland.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Collector: W. Bushman (no. 299) on 20 Jun 1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat: Roadside with weeds</td>
</tr>
</tbody>
</table>
Q. What was the nearest place to where you are now?

A. May be difficult to determine precisely.

Q. Is the data mostly quantitative or qualitative?

A. Most data is qualitative, information not numbers. Some quantitative, how many total in state (from the first page “428 specimens displayed of a total of 468 databased”). There are many internet resources to clarify quantitative vs qualitative data, for example

http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-
+quantitative+and+qualitative+data

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

A. Note that most of the Habitat recordings include a reference to water or moisture nearby. Bilbili does not grow in the west of SA, which are mostly desert and have very little water. Bilbili grows all along the banks of the Murray and therefore seed may be spread by water or by birds/animals visiting the water source.

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

A lot of samples are collected along the River Murray, Fleurieu Peninsula, Coorong and into the outback. Not necessarily all following river courses, suggesting ground water is present in these regions. For a map of SA with just the rivers marked, http://www.bom.gov.au/sa/flood/index.shtml.

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

A. The growth of *Cyperus vaginatus* is more less widely distributed, concentrated on the Fleurieu Peninsula and into the Lower region of Ikara-Flinders Ranges.

Q. Which species is more abundant?

A. *Cyperus gymnocaules* is more abundant. [both visually (number of dots) and quantitatively – “240 specimens displayed of a total of 271 databased”]

Note: numbers will increase as new samples are added to the database.

Q. What role could Aboriginal peoples have had in increasing the habitat range of the basket weaving rush?

Task B2. Using information in databases*

SCIENCE UNDERSTANDING – Biological Sciences

The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence

Students examine geographical distribution of species using databases.

SCIENCE AS A HUMAN ENDEAVOUR

Nature and development of science

Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries

Recognising how information technology can be applied to different areas of science including biodiversity, ecology and plant sciences.

SCIENCE INQUIRY SKILLS

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students examine geographical distribution of species, nutritional information and plant-use using databases

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

Equipment

Internet access for students (working alone or in pairs) – in class

Computer with access to spreadsheet (eg Excel ©) – for assessment task

Engaging Students

You want to know what plants are “local” to your area before the land was extensively changed for housing and agriculture. How could you get this information?

Students create their own database.

Use records from Task B1, or get students to work in groups of 2-3 and pick 5-10 records each, then combine class data (check for redundancy – is there bias it what areas students chose?)

Brainstorm what information could be “extracted” from the database and present more easily interpreted? Examples include
- years the samples were collected (notes most of the entries are from the last 20-40 years).
- how many samples are near water?
- Soil type

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

A. Bar graphs to represent the number of samples for a given year. Icons be used to represent presence of different geographical features

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

A. Bilibili is most likely found in areas with available water, such as the edge of a creek or river.
Areas with deserts would be too dry, and perhaps too hot, for Bilibili to survive.

Aboriginal people may have assisted with the spread of Bilibili by moving plantlets to ensure that they had a supply of material for weaving.
ASSESSMENT TASK: Atlas of Living Australia (ALA) database

Assessment guidance:

- provide information on at what point the instructions should start i.e. front page www.ala.org.au or from the *Cyperus gymnocaulos* page
- Do you want pictures/screen grabs? If yes, “snipping tool” of Microsoft is very useful
- Labelled pictures / with arrows etc – would need to provide instructions
- **A more engaging question/task for students** would be to get them to download plant information within a certain distance of the school to answer the question “know what plants are “local” to your area before the land was extensively changed for housing and agriculture.” To do this use the
  - Explore by region or location
  - Explore by address or location (and select by 1, 5 or 10 km radius)

Q. Describe at least 5 different sorts of information …summarised at ALA, on the plant *Cyperus gymnocaulos*.

A. From the CHARTs tab

1. Collection information (that is, what herbarium or institution has the record)
2. What state the sample was collected from
3. What month of the year

From other tabs:
- 4. **Map**
- 5. **Gallery** = photos
- 6. **Literature** = references

Q. What information did you find most interesting and why?

Q. Write instructions, with appropriate web links, on how…download …records …into a spreadsheet.

**Questions – to check students have downloaded the correct file**

Q. How many rows are in the file?

A. 3089 [file downloaded March 2016]

Q. What column contains the information on the year the sample was collected?

A. Column AE

Q. How many entries contain the word “river”? *Hint: use the “find all” feature (of Excel®)*

A. 243
MODEL ANSWER

- Select the link *Cyperus gymnocaulos*
- Select the Records Tab

![Records Tab](image)

- From the records tab, select Downloads

![Downloads Option](image)

- Fill in the requested information (email, filename and reason (education))
  - Do not change download type (all records)
- Finally select the start download button

**Extension ideas - advanced features of Excel**

**SORT DATA feature**

- Click on cell in column AC and row 2 & select **sort** (from the top ribbon)
  - Add questions such as – how many records are from 1800s?
    - Data from row 2 to row 30 = 29
  - What year was the first record? [1847]
Task B3. Evaluating information

SCIENCE INQUIRY SKILLS

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.

Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations.

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

Equipment

Internet access for students (working alone or in pairs) – in class
Mattingley C and Hampton K (editors) (1998) Survival in our own land. ‘Aboriginal’ experiences in ‘South Australia’ since 1836, told by Nungas and others. Chapter 21 (Point McLeay), pp 183-188 (provided e-resource)

Additional resources (not core)
Map of Ngarrindjeri clans unknown source (provided e-resource)

Engaging Students (these examples could also be used for Task B4)

Ask students for examples where they have had to decide between two sources of conflicting information. Provide examples. How did they resolve which source to trust. Discuss primary vs secondary sources; Qualified individuals / reliable institutions vs “unknown” people. OR

Ask students if they have ever had to give and/or receive information to someone in a foreign language. Were they successful? How did they manage it? Link this to lack of common language / reference points and link this to European settlers trying to learn about Aboriginal culture, plants and boundaries. Also discuss cultural differences in land ownership versus land custodianship.

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

“The Ngarinyeri [Ngarrindjeri] consisted of eighteen lakalinyerar [Lakalinyeri (clan)] or groups whose territory, excellent for both hunting and fishing, extended in a triangle from what is now known as Cape Jervis, up the lower River Murray as far as what is now known as Swanport and along the coast east as far as what is now Kingston. Graham Jenkin, whose book Conquest of the Ngarrindjeri tells in detail their story from 1836 to 1915, has estimated their population at some 3000 at the time of the Grinkari* invasion”

grinkari* = kringkari/kgarar or kringkri/kgarar = non-Indigenous person/people, Bell (2008).
Q. List at least three differences between the two maps:

1. Left map, Ngarrindjeri country starts further south. 2. Left map, Ngarrindjeri country continues further south. 3. Left map does not include the town of Murray Bridge. 4. The Coorong is not drawn clearly in the left map. 5&6. Kangaroo Island and Yorke Peninsula are not fully visible in the right map.

Q. Draw and label their locations on the map below.

A. It is difficult to find Swanport (it is a suburb just south of Murray Bridge) – Google Maps was best.

Q. List your source(s) of information.

A. Difficult to find a map with all of them.

Swanport was the hardest to find (it is a suburb just south of Murray Bridge) – Google Maps or http://www.whereis.com/sa/swanport-5253.

Lake Alexandrina and Lake Albert are both on http://www.murrayriver.com.au/the-ngurunderi-dreaming-app/


Students may also find the map ‘The Ngarrindjeri & Ors (SAD 6027 of 1998) Claim Map’ http://www.ngarrindjeri.org.au/native-title. Town names are not legible on this map.

Q. Do you think that either of the maps accurately represents Ngarrindjeri country? Explain your answer.

A. Probably not. A “merging” of the areas in both maps better reflects the written description.

Discuss how difficult it would be to get an agreed boundary (no written documentation prior to colonisation. Europeans recording information from only a few people, who spoke different languages and dialects, neighbouring language groups used the same country at different times). Note that maps such as the AIATSIS language map (see below), use ‘fuzzy boundaries’ to reflect the fluidity of the regions used by the different language groups.

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

Reinforce the concept of “fuzzy boundaries”. The language map looks very similar to map 1, and does not extend all the way to Cape Jervis, therefore it seems that Ngarrindjeri Country may extend further than these boundaries.

The AIATSIS language map (David R Horton (creator), © Aboriginal Studies Press, AIATSIS, and Auslig/Sinclair, Knight, Merz, 1996), can be purchased from http://www.abc.net.au/indigenous/map/. For a zoom in version: http://www.abc.net.au/indigenous/map/

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### 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

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Note on boundaries for the various Indigenous languages and regions. Indigenous boundaries are not fixed. Maps such as the AIATSIS language map (see Question 5) use ‘fuzzy boundaries’ to reflect the shared ‘Country’ that neighbouring Indigenous groups managed. The differences between maps and information recorded by the colonial historians was likely in part due to the fact that Europeans were not sure of Aboriginal landmarks due to language difficulties, but also they did not understand the custodianship principles rather than ownership principles of Indigenous cultures.

Communication was difficult because of language, and Europeans would not have the same knowledge of local landmarks as the Indigenous custodians of the land.

It should be remembered that after colonisation/invasion of Australia by Europeans there was forced movement of Aboriginal peoples. Their movements were often restricted and they were often excluded from their traditional lands.

Here is a more detailed map of the Ngarrindjeri clans (original source unknown, secondary source https://c1.staticflickr.com/1/151/408166947_928c671c2d_z.jpg?zz=1), (provided e-resources).

A similar map was used for the Ngarrindjeri Native title claim, see http://www.ngarrindjeri.org.au/native-title.

Q. Is bilbili found throughout all of Ngarrindjeri country? Explain your answer

No. This information, assuming it’s true, suggests that either other species were used or that bilbili was only collected from part of the normal yearly range (or both).
Task B4. Indigenous knowledge and citizen science

SCIENCE AS A HUMAN ENDEAVOUR

Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries

Recognising how information technology can be applied to different areas of science including biodiversity, ecology and plant sciences.

SCIENCE INQUIRY SKILLS

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data

Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.

Equipment

- Internet / screen or computers to watch video(s)
- Photo device (optional, if you want to get students to upload images to Atlas of Living Australia)

Engaging Students

Ask students if they have ever been involved in citizen science project? Share stories and get students to define what citizen science is. Focus on how community information is validated and why it is useful. Highlight the key role of digital images and computer recognition to turn images into information.

Quotes from Ngarrindjeri Nation Sea Country Plan (2006)

“Ngarrindjeri people speak a common Ngarrindjeri language. We comprise several peoples, each with particular knowledge about areas of Ngarrindjeri Sea Country. We are all linked through creation stories, creation trails and sites, ceremonies and sacred places. Central to our shared culture is our creator ancestor Ngurunderi whose travels and actions created the River Murray, the lakes, the Coorong and coastal Hummocks, our lands, waters, fish and resources.”

This lesson would provide a good opportunity to engage with a local Aboriginal person/community.

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

A. Australian Aboriginal knowledge was maintained and shared orally / learning by doing and/or observing. Not all knowledge was freely available to everyone in the community, with some knowledge restricted to males or females only, or to privileged individuals who showed appropriate respect for the knowledge.

“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.”

Quote from Ngarrindjeri Nation Sea Country Plan (2006)
Q. What evidence can you find that these methods were effective?

A. Aboriginal culture has been maintained for around for 40,000+ years. Aboriginal peoples knew what plants were best for what purpose/safe to eat/medicinal. Aboriginal peoples survived and thrived until colonisation and access to land was restricted / drastically modified.

Not everyone in the community has access to knowledge, and knowledge in some cases is priveledged and comes with responsibility. The deep Ngarrindjeri understanding that everything is connected reinforces protects the ecosystem (remember, lands and waters are a living body and humans are part of the ecosystem).

Q. What makes spoken records of knowledge more difficult in current society?

A. Large populations therefore difficult to distribute knowledge accurately. Knowledge kept in books is quite ‘linear’ and can often represent a narrow point of view. Community groups / committees, with several different minds, ensure that a broader range of information is shared and checked. The ‘linking’ of different computer databases is one way to overcome / minimise the limitations of ‘linear’ knowledge.

A. Oral transfer of knowledge includes “learn by doing” and “learning by watching others” as an important part of knowledge transfer. Reinforced by group activities and stories from the Creation. Some knowledge was restricted and only given to limited number of people (trustworthy/respectful “future” Elders).

Remind students of the game “Chinese whispers” and how easily information can change going through just a few people. The integrity of Indigenous knowledge is maintained, in part, through cultural traditions, obligations and awareness of Country. The addition of learning practical skills, that is “learn by doing” would also contribute to maintaining the integrity of information.

Q. List some new ways for people to share information

A. Blogs/Facebook. An example of an Aboriginal man, Walha Udi Marvyn Mc, sharing his Country (near Ikara-Flinders Rangers. [https://marvynmc.wordpress.com/](https://marvynmc.wordpress.com/)

Walha Udi Marvyn Mc is a regular contributor to Facebook page of “SA Natureteers” [https://sanatureteers.wordpress.com/](https://sanatureteers.wordpress.com/), where nature lovers share photos and help each other identify birds, insects and animals.

Q. How often do you take photos of plants or animals?

A. Get students to explain why / what etc

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

Q. What are the potential benefits of citizen science to society?

A. More data collected for relatively low cost (due to reduced costs of researchers, travel to field sites). More data means that more correlations can be made. Can monitor changes with seasons, climate, flowering, seed set, spread of weeds, success rate of revegetation, and changes in biodiversity. Community involvement in data collections means they have some ownership in projects / can see value in where research money is spent.

Q. What innovations in …ICT have made large citizen science projects feasible?
A. Widespread uptake of mobile devices (phones, tablets) with cameras. Relatively cheap and seemingly unlimited data storage capacity with super computers used to allow access to databases. Image recognition software, allowing researchers to extract specific data from images (it would not be cost effective to pay people to extract data).

Q. What types of errors occur in citizen science projects and how these errors be minimised?

A. Increase in random errors due to use of many different devices to record images. Image recognition software can crop images to standardize images used, or reject data if certain key reference points (eg trees) are not recognizable. Images taken at different times of year will have different data (eg flowers present or absent), so data could be filtered by time of year (or day, or weather).

Get students to take photos of insects/birds/reptiles visiting plants and see if they can identify them. Either from their own gardens or the school garden. Download a GPS app for the phone so that they can have accurate coordinates. Work in group to provide detailed information of the surrounding habitat (Link to Tasks C3-C5).

Q. What can you do if you don’t know the name of the plant or animal species?

- Google. Internet resources make it possible to find pictures / eg native bees
  - Birds
  - Plants
  - Native bees
- Ask an expert (museum/local community group etc)
- Groups such as SA Natureteers will help people
  - Natural Resources (SA Government fact sheets for educators – eg butterflies / moths)

Look for a citizen science project near you.

- Australia–wide
  - [http://biocollect.ala.org.au/#isCitizenScience%3Dtrue%26max%3D20%26sort%3DnameSort](http://biocollect.ala.org.au/#isCitizenScience%3Dtrue%26max%3D20%26sort%3DnameSort)
    - Includes [http://www.flukerpost.com/](http://www.flukerpost.com/), Adelaide area:
    - Cat Tracker, Goanna Watch, Little Corellas, Birding the ‘burbs
### Overview of Theme C: Indigenous land management / Biodiversity

<table>
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<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Indigenous land management</td>
<td>Why is biodiversity important?</td>
<td>Exploring your area</td>
<td>Your plant in nature</td>
<td>Taking action for biodiversity</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Classroom</td>
<td>Classroom</td>
<td>Field work</td>
<td>Field work</td>
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</tr>
<tr>
<td><strong>Discover</strong></td>
<td>Similarities of Traditional management of Country to current day natural resource management</td>
<td>Link between biodiversity and healthy habitats</td>
<td>Plants used by Indigenous peoples in your local area</td>
<td>How to measure biodiversity (quadratting)</td>
<td>Strengths and weaknesses of a local habitat</td>
</tr>
<tr>
<td><strong>Tasks/Skills</strong></td>
<td>Compare</td>
<td>Group work</td>
<td>Identify</td>
<td>Identify</td>
<td>Evaluate</td>
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<tr>
<td></td>
<td>Explain</td>
<td>Analyse</td>
<td>Explain</td>
<td>Design</td>
<td>Design</td>
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<td></td>
<td>Describe</td>
<td>Summarise</td>
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<tr>
<td><strong>Understanding</strong></td>
<td>Practices that provide a continuous food supply.</td>
<td>Importance of ecological processes for maintaining habitats</td>
<td>Parts of a plant and their different uses</td>
<td>Diversity of plant types. Principles of random samples and subsampling</td>
<td>Process of developing a long term plan to increase biodiversity</td>
</tr>
<tr>
<td><strong>Content Description</strong></td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
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<td><strong>General Capabilities</strong></td>
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<td><strong>Cross-curriculum priorities</strong></td>
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<tr>
<td><strong>Assessment</strong></td>
<td>Project</td>
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</tr>
</tbody>
</table>

The information in this section is predominantly from an Australian-wide, not a Ngarrindjeri, perspective.
**Task C1. Examples of Indigenous land management**

**SCIENCE AS A HUMAN ENDEAVOUR**

**Nature and development of science**

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community.

*Students explore how Indigenous knowledge is passed through generations and how analytical skills enable this information to be used and organised appropriately.*

**SCIENCE INQUIRY SKILLS**

**Questioning and predicting**

Formulate questions or hypotheses that can be investigated scientifically.

*Students develop ideas through investigations and experiences to investigate further the influence of Aboriginal knowledge on current land management practices.*

**Communicating**

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations.

*Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.*

**Equipment**

<table>
<thead>
<tr>
<th>C1. Examples of Indigenous land management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet / screen or computers to watch video(s)</td>
</tr>
</tbody>
</table>

**Additional resources** *(not core)*

| Ngadju Seasonal Calendar Report *(provided e-resource)* |
| Mattingley C and Hampton K (editors) (1998) Survival in our own land. ‘Aboriginal’ experiences in ‘South Australia’ since 1836, told by Nungas and others. Chapter 21 (Point McLeay), pp 183-188 *(provided e-resource)* |

**Engaging Students**

Ask students where they think it would be easier to hunt for kangaroos. In an open grassland near water, or in scrubby bush? What do you think most of the Australian landscape was like before European settlement? Bush or grassland? Then read them this quote from the Belair National Park information booklet and ask them if they want to change their answer.

*“The Kaurna people referred to the area now known as Belair as Piradli, which means ‘baldness’. This was in reference to the area’s appearance when looking south from the Adelaide Plains – ‘bald like the moon’.*

*Belair National Park Brochure – National Parks South Australia*
Indigenous weather calendars – Bureau of Meterology


Indigenous weather calendars are available online for a small number of Indigenous language groups. Ngarrindjeri Indigenous weather knowledge was recorded by Reuben Walker (1934) and is celebrated on the Meningie Trail (see photo of sign in Student Handbook).

Video: Bill Gammage: https://www.youtube.com/watch?v=zGO2GbLRWcQ

- For a longer video but few images
  - http://www.anu.edu.au/vision/videos/5001/; 16 mins (watch first 5-6 min)

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

A. Two examples. Open grasslands were maintained for easier hunting / moving through country. Areas near water were often “landscaped” to provide hiding places for hunting.

Q. What evidence was used by Bill Gammage to support his theory that Australia was methodically managed by Australian Aboriginal peoples?

A. Bill Gammage spent 10 years researching his book, and used as sources historical painting, dairies/journals of early explorers and he also talked to Aboriginal communities. He cross-referenced information from different sources to strengthen his argument.

Q. Which of these seasons and activities are likely practiced by the neighbouring Ngarrindjeri peoples?
Many of them, although the timing may have been slightly different, and some of the plants may have been different. Use of birds and animals is likely to have been the same as these are generally more mobile/widespread (could use Atlas of Living Australia here to demonstrate this (link to Task B2).

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

A. Fuel reduction burning. Governments and Industry are increasingly collaborating with Indigenous communities to learn and share knowledge that is producing better land management options but better understanding of the triggers and timing of burning that was often linked to very specific environmental cue that were reinforced through stories and cultural tradition [Is this true for Ngarrindjeri peoples? / references / other examples? – would be good to include more positive information about “current” Aboriginal communities – rather than focuses only on early colonial times?].

Q. Which of these activities are no longer possible …due to changes in the landscape and/or land use?

Gathering of plant foods has been severely restricted due to private ownership of land, often the best land with water. Therefore hunting animals near watering holes also restricted.

Difficult to collect yams / root tubers because grazing animals restricted the distribution of these varied and important food sources.

Land clearing has led to increase in salinity of regions such as the Lower Lakes in the Coorong. This in turn affects the basket weaving plants, such as bilibili and animals such as fish.

Locks along the River Murray had a major impact on water flows into the Lower Lakes of the Coorong and the lives of the Ngarrindjeri people.

Q. Provide ..examples of ‘past’ land management practices (activities) … consequences (outcomes)

A few examples are provided. Note: Sadly, many of these practices are still occurring. Student’s answers should focus on the interconnected of land and our waterways (rivers, seas and oceans).

<table>
<thead>
<tr>
<th>'Past' (non-Indigenous) Land Practices</th>
<th>Consequences (on oceans and rivers)</th>
</tr>
</thead>
</table>
| Excessive land clearing, especially trees | Erosion leading to sediment in rivers and sea.  
Rise in ground water salinity.  
Loss of biodiversity in rivers and seas (due to loss of oxygen and or habitat loss (eg river banks) |
| Use of excessive man-made fertilisers | Fertiliser run off to rivers and eventually ocean, Leading to algal blooms, loss of oxygen, loss of biodiversity |
| Use of river water for large scale irrigation | Low/no water flows. Water is essential for life.  
Increased evaporation leads to increased salinity |

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

Remember that Ngarrindjeri people strongly believe that all things are connected, people, animals, birds, fish and plants, land, rivers, sea; such that even a ‘small’ change, can have a large impact on Sea Country (the landscape) and the community.

“… wool washing industry established in 1892 …employed as many as…twenty men and earned valuable income for the mission [Point McLeay, now Raukkan]. But salinity in the lake, resulting from drought and
Upstream water diversion, finished the project ten years later. It also spoiled the irrigation which had been installed in an attempt to increase productivity.

“The area allotted to the mission, a pitiful remnant of the total Ngarinyeri [Ngarrindjeri] traditional lands, was not large enough and not particularly good for agriculture, so that Raukkan’s history has been beset with difficulties…. The loss of Narrung** deprived Raukkan people of an important area to which they had always had access for firewood, camping and hunting, as well as some useful farming facilities. The land was cleared by the new farmers, substantially reducing any remaining game.”

[** Narrung was crown land adjoining the Point McLeay mission. The Ngarrindjeri at the mission had some access to land around Narrung until 1906 for food and cultural practice, but was ‘sold/given’ to non-Indigenous people (Mattingley & Hampton (1998))]

“The shortage of land led to chronic under-employment and unemployment. Morale fell as a result. 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. Men often had to take outside work, usually seasonal, which meant leaving wives and families behind.”

Evidence given at the 1913 Royal Commission by John Wilson sen.

“I have been here 44 years…Conditions are not the same here today as they were 30 years ago; fish and game are not so easily obtained now. The big guns have frightened the ducks away. Swivel guns were used nine to ten years ago, but they are not used now. We have not had ducks since then. Three of my sons are on the station and two are away. I suppose the two who are here have not gone away because they do not want to leave their wives behind. They cannot take their wives with them because their children are going to school. I have known natives to go away to outside work and remain at it for two or three weeks and then return to the mission.”

Q. 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?

A ‘whole of landscape’ approach that, is embedded in the culture of the society, considers the effects of any ‘change in practice’ on entire community / landscape, rather than just the subset of the community that benefits from the ‘change in practice’.
Task C2: Why is biodiversity important?

SCIENCE UNDERSTANDING – Biological Sciences

The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence.

Students examine genetic diversity and explore how it allows populations to adapt to changing environments, thereby facilitating evolution through processes of natural selection.

SCIENCE INQUIRY SKILLS

Questioning and predicting

Formulate questions or hypotheses that can be investigated scientifically

Students explore the validity of claims relating to biological processes and formulate questions that can be investigated scientifically.

Equipment

Internet / screen or computers to watch video(s)

One of more of the suggested resources provided

Ngarrindjeri: Ngarrindjeri Picture Dictionary for Older Students (2010) and references in Table provided below.

Kaurna: Clarke et al 2013 (Table 3 – is provided e-resource) and references in the table below

Posters (3) from Natural Resources SA on bush food plants (Bunganditj and Ngarrindjeri names). (provided e-resource)

Additional resources (not core)

Clarke 2013 Aboriginal ethnobotany of the Adelaide region (provided e-resource)

Engaging Students

Pose a hypothetical. Could animals live and thrive without plants (and vice versa)? Why? Why not?

Q. Why do you think … different…plants means …more insects, birds, animals and microorganisms…?

A. A greater range of plants means you can have food sources all year round (eg nectar, pollen, seed). Sometimes there are special associations such as butterflies lay eggs on specific plants (see www.butterflygardening.net.au/resources.htm)

Q. What plant and animal associations are you aware of? Examples include

- Mature gums, hollows for bird nesting sites
- Eucalyptus trees and sugar lergs (and Indigenous food source) [lergs are secreted by on insect on the leaves predominantly(?) on one species of gum, Eucalyptus viminalis (manna gum)]
- Bees (& ants & people) eat nectar produced by flowers
  - See linking on role “ants” and “spreading the genes
- Butterflies/caterpillars (eg cotton bush and monarch butterfly)
Are the better examples with an Indigenous link?

- Birds and seed
- Earthworms and other insects/fungi/bacteria decay and recycle nutrients in dead plant material (wood/leaves to compost).

Allow students to pick one of the topics on ecosystem’s ability to do essential biological processes) and in small groups, allow them to explore the validity of claim statement, noting any questions that can be investigated scientifically.

If available, allow them to explore the internet and find examples (and provide references) to support these claims. Possible assessment/project opportunity

A few ideas

A. **Produce more oxygen.** More plants, more photosynthesis – key reaction

![Overall equation for the type of photosynthesis that occurs in plants](https://en.wikipedia.org/wiki/Photosynthesis)

Diversity of plants, will be able to maintain photosynthesis under extreme conditions of heat, cold

B. **Form and build healthy soils.** Microbes in soil (bacteria and fungi) can break down organic matter (rotting leaves). Fungal hyphae in soils help build tracks through soil for better soil structure and water hold ability. Insects and animals make holes in soil aerating it, and move organic material around.

C. **Filter water on its way to the sea.** Plants growing on the riverbanks, including reeds and rushes, help slow down the water, allowing more time for sediment to settle. Plants can take up excess nutrients. Plants rely on other organisms (for pollination/spread etc)

D. **Pollinate crops and plants generally.** Many plants are insect pollinated, not just bees but ants. Plants – see above. Plants also provide shade / layers for birds to perch/feed from

E. **Store and recycle nutrients.** Nutrients can be stored in roots and fungal hyphae in soils, so not washed away when it rains, particularly important in sandy soils. Leaf litter contains nutrients (nitrogen, carbon, and microelements) and these are recycled by insects, animals microbes. Role of animal faeces, kangaroos etc, feeding on plants, moving the nutrition around.

F. **Resist feral invasion.** Feral plants (e.g. weeds) can invade more easily in bare soil. Lots of different native plants in an area means that weed seeds are less likely to germinate. Some plants can actively “suppress” germination of seeds or other plants (allelopathy). Feral animals. Again competition – existing animals can defend their territory. Wedge tail eagles for example will eat feral rabbits.

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

A. (a) Kalathami, Leucopogon parviflorus, coastal beard heath; (b) Nganangi, Carpobrotus rossii, pigface.

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

A. The images are of fruits, whereas Ngarrindjeri peoples use the tuber (for food) and the leaves for (string), not the fruits.
<table>
<thead>
<tr>
<th>Common Name <em>(Latin name)</em></th>
<th>Ngarrindjeri name</th>
<th>Indigenous use of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulrush root <em>(Juncus &amp;/or Typha</em>species)</td>
<td>Manangkeri</td>
<td>Edible tuber, fibre for string</td>
</tr>
<tr>
<td>She-oak; <em>(Allocasuarina species)</em></td>
<td>Kolgi</td>
<td>Edible seed capsule. Young cones or stems used to control thirst. Wood used for artifacts</td>
</tr>
<tr>
<td>Sweet appleberry <em>(Billardiera species)</em></td>
<td>Kunduwi</td>
<td>Climber with sweet edible small fruit</td>
</tr>
<tr>
<td>Native Cherry <em>(Exocarpus cupressiformis)</em></td>
<td>Panpandi / Wiltjeri</td>
<td>Edible fruit</td>
</tr>
<tr>
<td>Muntries <em>(Kunzea pomifera)</em></td>
<td>Manthari</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 <em>(Carpobrotus rossii)</em></td>
<td>Nganangi</td>
<td>Prostrate succulent plant with edible fruit. Leaves good for mosquito bite</td>
</tr>
<tr>
<td>Grass tree; <em>(Xanthorrhoea semiplana)</em></td>
<td>Kinyari / Bukkup / Kildjeri</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; <em>(Eucalyptus camaldulensis)</em></td>
<td>Wuri / Be-al</td>
<td>Bark used for canoes and shields</td>
</tr>
<tr>
<td>Black anther flax lily or spreading flax lily <em>(Dianella revoluta)</em></td>
<td>Piyentak</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 <em>(Acacia meamsii &amp; sp)</em></td>
<td>Wurruldi (tree) / tangari (gum)</td>
<td>Edible seed, medicinal gum, bark (string, ligatures and slings)</td>
</tr>
<tr>
<td>Old man’s beard <em>(Clematis microphylla)</em></td>
<td>Yalkari</td>
<td>Edible tuber, medicinal foliage</td>
</tr>
<tr>
<td><em>Acacia longifolia</em> var sophorae</td>
<td>Ka:la / Ka:lar</td>
<td>Edible seed, eaten at green stage &amp; roasted</td>
</tr>
<tr>
<td>Flat sedge <em>(Cyperus gymnocaulus)</em></td>
<td>Bibili / Yalkari</td>
<td>Used for Ngarrindjeri weaving of mats and baskets after drying and then soaking</td>
</tr>
<tr>
<td>Native or bower spinach <em>(Tetragonia implexicoma)</em></td>
<td></td>
<td>Edible leaves</td>
</tr>
<tr>
<td>Yam daisy <em>(Microseris lanceolata)</em></td>
<td>Murnong/Murrong</td>
<td>Small root cooked and eaten or eaten raw. Available Spring, Summer, Autumn</td>
</tr>
<tr>
<td>Coastal beard heath/Native currant <em>(Leucopogon parviflorus)</em></td>
<td>Kalathami</td>
<td>White coloured small edible fruit Nov/Dec</td>
</tr>
<tr>
<td>Coastal daisy <em>(Olearia axillaris)</em></td>
<td></td>
<td>Leaves used as insect repellent when rubbed into skin</td>
</tr>
<tr>
<td>Rivermint <em>(Mentha australis)</em></td>
<td></td>
<td>Leaf used for flavouring and for medicine</td>
</tr>
</tbody>
</table>

Selected entries from the Ngarrindjeri dictionary (2009)

This is the list of Ngarrindjeri men and women (names and two letter abbreviations) who contributed the dictionary, through a series of workshops with linguists. This information was integrated with historical written sources. Note the alternative spellings of many words.

<table>
<thead>
<tr>
<th>bibibili</th>
<th>ka:lar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bibibili</strong></td>
<td><em>Noun.</em> plant rushes; tops of freshwater rushes; blue rush; soft rushes used for baskets and nets. <em>Written source:</em> M= pibibli and bibibi rush (plants); T= nibibli rushes; B= pibibli rush p111; T= pibibli rush (short). Old used for planting of net supports for baskets (lococeri) and for making nets. Cattle eat it so it is now very scarce. T= pibibli rush; soft; species, used for making baskets, smaller than usual reeds and most common in Paringwarwjan people's country. Variant: pibibli rush. <strong>Note:</strong> Berndt and Berndt (1995) on p96 give an explanation of the reeds that are chewed to make twine for nets, and say the 'pibibli' are the blue rushes available in scrub country. The diagram on p102 shows it has a single prong rather than the three prongs of the yalkari. <em>Oral source:</em> NG= bibibili 'tops of any freshwater reeds and rushes'.</td>
</tr>
<tr>
<td><strong>ka:lar</strong></td>
<td><em>Noun.</em> wattle seed bush; <em>Acacia longifolia.</em> <em>Written source:</em> YA is So. kalahdah 'wattle'; McDs. kalahdah 'wattle'; C= kalari (bush) 'coastal wattle'. T= ka:la 'the oak (Casuarina stricta)'. Variant: kaladah; kalari. <strong>Note:</strong> It is unclear if this is a different variety of wattle seed from wurruldi', see Berndt and Berndt (1993 p570). The coastal wattle found in the Ngarrindjeri country is <em>Acacia longifolia</em> var. sophoreas. It seems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>yalkari</th>
<th>wurruldi</th>
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</thead>
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<tr>
<td><strong>yalkari</strong></td>
<td><em>Noun.</em> rushes; reeds; old man's beard; three pronged reed used for weaving. <em>Written source:</em> So. yalkari 'reeds'; T= yalkari 'reeds'; B= yalkari 'reeds'. K= and EM in So. yalkari 'reeds'. B and B= yalkari 'reed used as fibre to make the base of bird traps, baskets and cloaks', p62 p89 and p102. B and B= yalkari 'three pronged reeds' p271; C= yalkari 'old man's beard (Clematis sp.)'; So. yalkari 'species of basket making gras'. Two yalkari 'reed for basket making'. T= pibibli rush. Variant: yalkari; yalkari; So. Berndt and Berndt (1993) says the yalkari is the three pronged reed used for weaving. This is the same reed still used today by weavers, see the diagram on p102. Neville Gollan in 2006 alternatively says 'yalkari' is a plant called Old man's beard Clematis microphylla. <em>Oral source:</em> NG= yalkari, yalkari 'old man's beard Clematis microphylla'.</td>
</tr>
<tr>
<td><strong>wurruldi</strong></td>
<td><em>Noun.</em> acacia or wattle tree; fruit of wattle; wattle seed. <em>Written source:</em> M= wurruldi 'acacia or wattle tree'; T= wurruldi 'fruit of wattle'; B and B= wurruldi 'wattle seed'. p570 Variant: wurruldi. <strong>Note:</strong> Taplin records a variation of this word (in plural form) as 'wurruldr' with different vowels, but says this is the tree (rather than fruit). Maybe they are dialect variations of the same species <em>Acacia longifolia</em> var. sophoreas.</td>
</tr>
<tr>
<td>Common Name (Latin name)</td>
<td>Kaurna name</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Sweet appleberry (Billardiera species)</td>
<td>-</td>
</tr>
<tr>
<td>Native Cherry (Exocarpus cupressiformis)</td>
<td>Tildti-tildti</td>
</tr>
<tr>
<td>Muntries (Kunzea pomifera)</td>
<td>Mantirri</td>
</tr>
<tr>
<td>Pigface (Carpobrotus rossii)</td>
<td>Karkalla or ngangki</td>
</tr>
<tr>
<td>Bulrush root (Juncus &amp;/or Typha³ species)</td>
<td>Wampa or wompa¹</td>
</tr>
<tr>
<td>Grass tree; (Xanthorrhoea semiplana)</td>
<td>Kurr, Yutuke Pinyatta Kayamunto</td>
</tr>
<tr>
<td>She-oak; (Allocasuarina species)</td>
<td>Karko Karkomango</td>
</tr>
<tr>
<td>Red-gum tree; (Eucalyptus camaldulensis)</td>
<td>Batta or Karra; Kangullya</td>
</tr>
<tr>
<td>Black anther flax lily or spreading flax lily (Dianella revoluta)</td>
<td></td>
</tr>
<tr>
<td>Black wattle (Acacia mearnsii)</td>
<td>Minno Minno borumbo?</td>
</tr>
<tr>
<td>Old man’s beard (Clematis microphylla)</td>
<td></td>
</tr>
<tr>
<td>Acacia longifolia</td>
<td>Minno Minno borumbo?</td>
</tr>
<tr>
<td>Flat sedge (Cyperus gymnochaetus)</td>
<td></td>
</tr>
<tr>
<td>Native or bower spinach (Tetragonia implexicoma)</td>
<td>Birira²</td>
</tr>
<tr>
<td>Yam daisy (Microseris lanceolata)</td>
<td>ngampa – root¹ wailyo – plant¹</td>
</tr>
<tr>
<td>Native currant (Leucopogon parviflorus)</td>
<td></td>
</tr>
<tr>
<td>Coastal daisy (Olearia axillaris)</td>
<td></td>
</tr>
<tr>
<td>Rivermint (Mentha australis)</td>
<td></td>
</tr>
</tbody>
</table>

¹ Clarke (2013). Other references exist, but they do not provide a reference for the source and therefore are a guide rather than accurate (for example ² http://www.users.on.net/~wayne_r/Aborigines/kaurna_food_plants.htm
Spelling of Aboriginal words is an on-going area of research.

Language Researchers at the University of Adelaide are collaborating with both the Ngarrindjeri and Kaurna communities to better provide a written version of these spoken languages. These traditional languages are being celebrated and shared at events such as Kaurna Language Week 2014. Permission should be sought before using the languages in the public domain (for example see request from the Kaurna peoples, [http://www.adelaide.edu.au/kwp/](http://www.adelaide.edu.au/kwp/)).

Task C3: Project: Exploring your area

**SCIENCE UNDERSTANDING – Biological Sciences**

Transmission of heritable characteristics from one generation to the next involves DNA and genes

Students seek to understand that the consequences of different methods or cultural practices to genetic diversity of plants.

**SCIENCE AS A HUMAN ENDEAVOUR**

Nature and development of science

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community

Students explore how Indigenous knowledge is passed through generations and how analytical skills enable this information to be used and organised appropriately.

**SCIENCE INQUIRY SKILLS**

Planning and conducting

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

Students combine research using primary and secondary sources with their own investigations

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**Equipment**

Organise a class excursion (see suggestions in the student booklet)

Or

Set as homework/project for students to do in their own time

Posters (3) from Natural Resources SA on bush food plants (Bunganditj and Ngarrindjeri names). (provided e-resource)

**Additional resources** (not core)

Nyoongar (WA) food plants, including native spinach (provided e-resource)

**Engaging Students**

If you got lost in the bush would you know what plants were safe to eat, and which plants provided a source of water (eg juicy fruits)?

Students research on a plant used by Aboriginal people in their local area. Consider using an A3 or bigger map that covers all the parks that the class visited. Get students to add pins to the map to show where their park is.

For Schools in the Adelaide region, there will be more information about the Kaurna language. Ngarrindjeri names are provided from a variety of resources. We have tried to use the currently accepted spellings where possible, and note that many of
the cited references and websites contain “old” spellings. See references list for references on Aboriginal languages.

A pdf of the 2013 paper by Clarke is provided in the e-resource folder and provides quotes from the primary “written” sources of many of the early reports on use of plants.

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

A. Possibly yes, even though it is not listed in Clarke (2013). If unsure – do not eat, best to be shown what you can eat by an experienced person.

Another reference only talks about using leaves (https://australianseed.com/shop/item/tetragonia-implexicoma-)


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

Quote From Clarke 2013

“larger lumps of gum, formed on the stem of the golden wattle … were used for food, like we use bread with meat. Especially when they cooked fish, they would give the lumps of gum a little roasting in the embers. This roasting rendered it soft, and prevented it sticking. Particularly I noticed them doing this on the Onkaparinga River, in about 1844 (Bailey 1914).”

Q. What cultural practices …used to make sure that the plant species survived and did not become extinct?

Not taking the last tuber/seed/fruit in an area. Moving from place to place rather than staying in one area. Prevented “over grazing”. Note: Most current farms now have multiple paddocks and practice “stock rotation” to give grasses/plants time to recover naturally rather than having to re-sow their pastures regularly.

Replanting tubers,

Manually spreading the tops of *bilbili*, the basket weaving rush, by flicking the forming plantlets, so that new plants would grow elsewhere (Link to Task D4).

Q. What cultural practices …used to maintain or increase the genetic diversity of the species?

A. Several examples are listed below.

Harvesting seed and fruit and taking it back to camps likely assisted in the spread of some plant species. There are reports of whole branches from *manthari* (muntries) plants being taken back to camp.
For Quandong, seed were specifically planted by Wiradjuri peoples and branches were moved between areas for cross-pollination.

Once a Wiradjuri woman scolded Gilmore for spitting out the seed of an unusually large 'ground-berry'. The woman searched the grass to find the seed, ‘so that it could be put back where it originally came from and a strong plant grow from it.’

Wiradjuri planted seeds of **quandong**, small trees with pale, narrow leaves and large red fruit. Near Bethungra, Gilmore watched Wiradjuri pollinate **quandong** blossoms with flowering branches carried from another grove. Elsewhere, she saw branches left under **quandong** trees to indicate that the pollinating work had been done and didn’t need repeating. As with the selection and planting of large ground-berrys and grass seeds, Wiradjuri used cross-pollination techniques to favour highly productive **quandong** strains.

Image from **Main G. Heartland: The Regeneration of Rural Place** pg 28

Harvesting rushes for basket weaving / food prevented dominant plants such as bulrushes and *Phragmites* taking over.

Patch burning, allowed fire-responsive plants to germinate.

Plants such as the yam daisy were only allowed to be harvested from early summer to autumn (approx). Harvesting of yams was “forbidden” during times of active growth and seed set (Oct/Nov) to ensure new plants could be produce

Photos. Carolyn Schultz. Yam daisy tubers (left) with two new season tubers (white, edible) and last season (shrivelled) yam. Yam daisy flower (right).
Task C4. Your plant in nature

Planning and conducting
Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods

Students plan and conduct an investigation to measure or improve the biodiversity of a local area

Processing and analysing data and information
Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.

Evaluating
Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data

Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.

Equipment

- Internet / screen or computers to watch video(s)
- Long ruler / tape measure / square of plastic mesh or even coathanger for use as a quadrat
- Outdoor space, with grasses/small shrubs, with a variety of different plants in a relatively small area
- Information sheets - Nuffield Foundation Quadratting_Biodiversity in your backyard! (provided e-resource)

Engaging Students

Have you ever seen an area or garden go from a barren wasteland to a green, biodiverse habitat. Students share stories, focus on how long it took and that requires work and planning and knowledge of plants and how big they grow. How does this green area make them feel? More peaceful/happy/connected?

Visit a local park or botanic gardens and see if you can find “your plant”. Ideally choose a natural environment where the plants(s) are relatively abundant.
Alternatively, if also doing Task C5, consider instead, choosing an area near your school or even the school ground so that you have “before data” to assist in developing an action plan to improve your local biodiversity. You can use subsequent years results to analyse changes over time.
Select an area with at least a few of the species that students researched in Task C3.

First get students to answer the questions in student booklet on their plant
Q. Estimate how many of your selected plants are growing in the park.
Q. Are most of the other plants in the park bigger or smaller than you selected plant? 

Then get them started on formal quadrating 

Follow the details as listed in the web link below (and provided e-resource) 

http://www.nuffieldfoundation.org/practical-biology/biodiversity-your-backyard

Choose a quadrat size [from Nuffield Foundation]

If a survey area covers 400 m² (20 m x 20 m).

With 10 groups collecting data from 10 quadrats each (100 quadrats surveyed), the group will have sampled

- 6.25 m² with 0.25 m quadrats (about 1.6% of the area),
- or 25 m² with 0.5 m quadrats (6.25% of the area)

Go through these steps first,

1. Preparation and Safety
2. Preliminary observations
3. Identifying what species are present
4. Sampling the area, a random sample
5. What to record
6. Analysing the results

Nuffield provide a downloadable Student worksheet that you can modify

Some questions to think about (Nuffield Foundation activity)

1. What are the 5 main species in each area?
2. What do you think are the reasons for any differences?
3. How would you investigate these differences further?
4. What has surprised you most about the diversity of plants on your school playing field?

Information and Communication Technology (ICT) Capability

- Insert photos of their plant and the site into a word document
- Add labels to photographs of the plant parts (flowers, leaf, stem)
Task C5: Action Plan for Biodiversity

Planning and conducting

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods.

*Students plan and conduct an investigation to measure or improve the biodiversity of a local area.*

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies.

*Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.*

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.

*Students process, analyse and evaluate data from their investigations to draw conclusions on the biodiversity of a local area.*

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**Equipment**

- Internet / screen or computers to watch video (optional)
- Clipboard
- Butcher paper/white boards/post-it notes to help students prioritise
- Photo taking device (optional)

**Engaging Students**

Remind students of how good green spaces make them feel (Task C4). Science is now starting to unlock my we feel so good in the bush. See National Geographic Jan 2016, [http://ngm.nationalgeographic.com/2016/01/call-to-wild-text](http://ngm.nationalgeographic.com/2016/01/call-to-wild-text) “When we get closer to nature—be it untouched wilderness or a backyard tree—we do our overstressed brains a favour.” Includes a two minute video.

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**Background notes for teachers**

Action planning is a process that will allow students and teachers to develop priorities and a plan, for how biodiversity improvements will be made.

Encourage

- students to be involved in implementing the plan, with activities 2 or 3 times a year.
• Opportunities for across year interactions / year to year peer-mentoring
• Planting of Aboriginal utility plants, labelled with information gathered by students


Before making any attempt to undertake restoration or revegetation work, it is expected that an investigation has been made into the habitat that previously existed at a site.

For more information on understanding terrestrial habitats and biodiversity, consult the Terrestrial Habitat Assessment Teacher Information Pack (available as a separate download).


Student outcomes

This activity will enable students to:

• prioritise improvements that can be made to enhance biodiversity on their site and/or in the school grounds
• make recommendations about future actions that can be taken on their site and/or in the school grounds.

Funding is often available to schools - check web for current information.

## Overview of Theme D - Seeds, Germination and Human Nutrition

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Seeds provide varied and nutritious food supply</td>
<td>Seed germination*</td>
<td>Seeds provide new sources of genetic diversity</td>
<td>Two ways of producing new weeding plants</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Computer</td>
<td>Practical</td>
<td>Classroom</td>
<td>Practical</td>
</tr>
<tr>
<td><strong>Discover</strong></td>
<td>Food ingredients and how nutrition labels are made</td>
<td>How seeds germinate</td>
<td>How meiosis works</td>
<td>How plants have evolved complementary methods to reproduce</td>
</tr>
<tr>
<td><strong>Tasks/Skills</strong></td>
<td>Analyse</td>
<td>Describe</td>
<td>Explain</td>
<td>Identify</td>
</tr>
<tr>
<td></td>
<td>Evaluate</td>
<td>Analyse</td>
<td>Explain</td>
<td>Identify</td>
</tr>
<tr>
<td></td>
<td>Calculate</td>
<td>Identify</td>
<td>Identify</td>
<td>Evaluate</td>
</tr>
<tr>
<td></td>
<td>Classify</td>
<td>Evaluate</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Understanding</strong></td>
<td>Many seeds contain good balance of essential nutrients</td>
<td>Changes from seed to seedling and the similarities and differences between monocots and dicots</td>
<td>Steps in meiosis that promote genetic diversity by generation new combinations of genes</td>
<td>Consequences of difference propagation methods to genetic diversity</td>
</tr>
<tr>
<td><strong>Content Descriptions</strong></td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
<td>Science inquiry skills</td>
<td>Science Understanding</td>
<td>Science as a human endeavour &amp; Science inquiry skills</td>
</tr>
<tr>
<td><strong>General Capabilities</strong></td>
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<tr>
<td><strong>Cross-curriculum priorities</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Assessment</strong></td>
<td></td>
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</tbody>
</table>
Task D1. Seeds provide varied and nutritious food supply

SCIENCE AS A HUMAN ENDEAVOUR

Use and influence of science

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities

Students evaluate claims relating to health benefits of food products

Values and needs of contemporary society can influence the focus of scientific research

Students understand that support from government and industry bodies enable information about Indigenous plants to be available and applicable to the wider society.

SCIENCE INQUIRY SKILLS

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies

Students analyse data and use spreadsheets to draw graphs and describe samples.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>D1. Seeds provide varied and nutritious food supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer access for students</td>
<td></td>
</tr>
<tr>
<td>Poster – Guide to Healthy Eating (provided e-resource)</td>
<td></td>
</tr>
<tr>
<td>Mattingley C and Hampton K (editors) (1998) Survival in our own land. 'Aboriginal' experiences in 'South Australia' since 1836, told by Nungas and others. Chapter 21 (Point McLeay), pp 183-188 (provided e-resource)</td>
<td></td>
</tr>
<tr>
<td>Additional resources (not core)</td>
<td></td>
</tr>
<tr>
<td>NutsForLife_Good_health_fact_20_4 (provided e-resource)</td>
<td></td>
</tr>
</tbody>
</table>

Engaging Students

Ask students to bring in an empty packet of their favourite/everyday dry crackers. Start the lesson by looking at all the different brands. Get students to "predict" which ones have the most fibre. Then do the actual comparison. 12 g of fibre as in Arnott's 9 grain vitawheats is probably one of the highest (and a great snack to have on hand at all times).

Arnott's 9 grain vitawheats

Photos. Carolyn Schultz.
Q. List some foods you eat that are good sources of the following food components.

A. Focus on “good” sources – meaning contain “a lot” of the component, relative to other foods

**Protein:** meat (beef, lamb, chicken, pork etc), legumes (chick peas, lentils etc), seeds (peanuts, almonds) and eggs

**Fat:** butter, cream, ice cream, seeds (canola, sunflower), chocolate, chip

**Carbohydrate:** (simple sugars, sucrose, fructose). Honey, sugar cane, maple syrup, fruit

**Carbohydrate (complex including fibre/starch).** Grains (wheat, rice, barley, corn), legumes (peas, lentils), nuts

**Vitamins / Minerals:** Vegetables, fruits

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**Seed & Nut Nutrient Table** – with cashew nut as “seed or nut” of choice

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Seed, sunflower Per 100 g</th>
<th>Nut, macadamia, no added salt Per 100 g</th>
<th>Oats, rolled, raw Per 100 g</th>
<th>Seed or nut of your choice Per 100 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kJ)</td>
<td>2397.00</td>
<td>3073.00</td>
<td>1572.00</td>
<td>2442.00</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>22.70</td>
<td>7.60</td>
<td>11.00</td>
<td>17.00</td>
</tr>
<tr>
<td>Fat, Total (g)</td>
<td>51.00</td>
<td>76.20</td>
<td>8.70</td>
<td>49.20</td>
</tr>
<tr>
<td>Fat, Saturated (g)</td>
<td>4.30</td>
<td>10.30</td>
<td>1.50</td>
<td>8.40</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>2.20</td>
<td>4.50</td>
<td>58.10</td>
<td>16.80</td>
</tr>
<tr>
<td>Sugars (g)</td>
<td>2.00</td>
<td>4.50</td>
<td>0.00</td>
<td>5.50</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>0.00</td>
<td>3.00</td>
<td>7.00</td>
<td>11.00</td>
</tr>
</tbody>
</table>

*g=grams

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

A. Sunflower seed has the most protein at 22.7 g (= 22.7% protein). (others range from 7.6 to 14.4 g)

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

A. Mostly unsaturated fats, which are the healthy fats.

Q. What seed has … highest percentage saturated fat (as a percentage of total fat)?

A. Cashew nuts (21.6%). Rolled oats the next highest with 17.2% saturated fat.

<table>
<thead>
<tr>
<th>Seed, sunflower</th>
<th>Nut, macadamia, no added salt</th>
<th>Oats, rolled, raw</th>
<th>Seed or nut of your choice</th>
</tr>
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<tbody>
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<td>Fat, Total (g)</td>
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<tr>
<td>Fat, Saturated (g)</td>
<td>4.30</td>
<td>10.30</td>
<td>1.50</td>
</tr>
<tr>
<td>% saturated</td>
<td>$\frac{100 \times 4.3g}{51g}$</td>
<td>$\frac{100 \times 10.3g}{76.2g}$</td>
<td>$\frac{100 \times 1.5g}{8.7g}$</td>
</tr>
</tbody>
</table>

= 8.4% = 13.5% = 17.2% = 21.6%

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

A. So that you can determine the proportion of “unhealthy” (saturated) fats compared to “healthy” (unsaturated) fats.

Q. Do … research …reliability of claims about “healthy fats”. … list 3 sources. Explain why ….reliable.

A. Unsaturated fats are considered the healthiest fats (although as with many public health messages, this is an oversimplification). Reliable sources are ones from trained professionals who have the capacity to understand complex research papers, and keep up to date, such as those employed by government bodies/hospitals/professional societies. Examples -

Dietitians Association of Australia, [http://daa.asn.au](http://daa.asn.au)

Sources where the author benefits commercially from sales of product or employment – can be highly variable in quality. Sources that cite “primary references” from “peer-reviewed” journals rather than magazines are generally more reliable - eg


Q. What information,…do you think you can infer …comparing… carbohydrate / 100 g …sugar / 100 g?

A. The difference between the two values is likely an indicator of “complex carbohydrates, such as starch or fibre, which are polymers of other sugars, whereas sugars are simple sugars such as sucrose, glucose and fructose.

You could ask students how they might determine if the “complex carbohydrates” (aka difference between total carbohydrates and sugars) were starch (readily metabolise) or fibre (better for you as it promotes regularity and good for healthy bowels). A. Google or look for brands/labels where this information is explicitly
provided. Measuring fibre content of food is “difficult” as there are many different types of fibre – with different health benefits.


<table>
<thead>
<tr>
<th></th>
<th>Seed, sunflower</th>
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<th>Oats, rolled, raw</th>
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</tr>
<tr>
<td>Sugars (g)</td>
<td>2.00</td>
<td>4.50</td>
<td>0.00</td>
<td>5.50</td>
</tr>
<tr>
<td>Difference =Complex carbohydrates (starch &amp;/or fibre)</td>
<td>0.2</td>
<td>0</td>
<td>58.10</td>
<td>11.30</td>
</tr>
</tbody>
</table>

Example of how much fibre for traditional oats.


(note the value of sugar is different 1 g compared to 0 g for the nutritional panel calculator)

Fibre total is 9.2 g / 100 g) (4.5 g soluble, 4.5 g beta glucan),

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

A. Highlight healthy fats/complex carbohydrates – variety is good. Other vitamins and nutrients present (that are often absent in highly processed foods such as white bread. Note the rising incidents of obesity, heart disease and diabetes in Australia and worldwide, mean that research funding is focused on healthy diets, ways to encourage people to eat better. Highlight the difficulty of studying effects of individual foods on people as many different factors and hard to change just one thing/long term effects.
Task D2. Seed germination

**SCIENCE INQUIRY SKILLS**

**Planning and conducting**

Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods.

*Students choose a method to germinate seeds and follow the process of germination, collecting data and making observations.*

**Processing and analysing data and information**

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies.

*Students analyse daily measurements and translate their data into growth rates.*

**Evaluating**

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.

*Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.*

**Equipment**

- Native seed from one monocot (grass) and one dicot species. If not available, use
  - 2 corn (maize) seeds (soaked in water for ≈24 hours)
  - 2 sunflower seeds (soaked in water for ≈24 hours)
- 1L soft drink bottle (clean + lid) or
  - Ziploc sandwich size bag (+ cardboard support cut to size of bag + tape to tape bag to cardboard)
- 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)

**Engaging Students**

- Who grows their own vegetables or herbs at home or has a relative who does it
- How do they get their plants – seeds / seedlings.
Fill in the blanks

A dicotyledonous (dicot) plant has ___TWO_________ seed leaves (cotyledon)

A __MONOCOTYLEDONOUS (monocot) PLANT______ has a single seed leaf (cotyledon)

Some other resources are

http://theseedsite.co.uk/monocots2.html
https://www.youtube.com/watch?v=gI2RxzAT-ww (video, monocots/dicots)
http://splash.abc.net.au/home#!/media/106388/how-seeds-become-plants (video, germination)

Comparison of monocot and dicot seed

From http://biology.unm.edu/ccouncil/Biology_203/Summaries/FloweringPlants.htm
Food (crop) plants: monocotyledonous (a monocot) or dicotyledonous (a dicot)

If you are unsure – Wikipedia lists this information in a panel on the right hand side (see below, right for example for Asparagus).

<table>
<thead>
<tr>
<th>Monocot</th>
<th>Dicot</th>
</tr>
</thead>
<tbody>
<tr>
<td>rice</td>
<td>radish</td>
</tr>
<tr>
<td>barley</td>
<td>tomato</td>
</tr>
<tr>
<td>wheat</td>
<td>stone-fruit (eg peach)</td>
</tr>
<tr>
<td>asparagus</td>
<td>grapes</td>
</tr>
<tr>
<td>onions</td>
<td>avocado</td>
</tr>
<tr>
<td>leeks</td>
<td>macadamia nut</td>
</tr>
<tr>
<td>corn</td>
<td>lemon myrtle</td>
</tr>
<tr>
<td>lemon grass</td>
<td>manthari (muntries)</td>
</tr>
<tr>
<td></td>
<td>yam daisy</td>
</tr>
</tbody>
</table>

Q. Can you identify the dicots and monocots?

A. From left to right, seedling 1 and 3 are dicots; and seedlings 2 and 4 are from a monocots. The examples used here are the same as recommended, sunflower (dicot) and corn (monocot).

- Student select one of two ways to set up germination experiments (ziploc bags or 1L drink bottles)
- Seed need to be soak in water overnight (day before)

Buying vegetable seed

- Corn and sunflower seed are good as they germinate quickly, within 1-2 days

- Look for organic seed or untreated seed. Many seeds for veggie gardens are now treated with a chemical Thiram (an insecticide / fungicide). Check the packet. 
  *Concentrated Thiram is classified as a dangerous goods (Class 9). It is probably present on seed at <1%.*

- If you can only get treated seed
  - Rinse seed well after soaking and before the lesson
  - Get students to wear gloves when setting up, and wash hands and benches down carefully afterwards.
Native seed alternatives

- Yam daisy (*Microseris lanceolata*) and wallaby grass (*Austrodanthonia* spp) germinate quickly but have small cotyledons and thin roots making it difficult for students to monitor easily.
  - Also provides seed size and germination times for some species (and more will be available over time).

Sources of Indigenous (native) seed

- Local land care groups
- Australia Plant Society, SA Branch
- Trees for Life or Greening Australia
- Native nurseries
  - Raukkan Community Nursery (Kevin Kropinyeri), ngopamuldi@internode.on.net
  - Indigeflora Nursery, Hackham, 8326 2143
  - Growing Bush (Karen Lane), growingbush@adam.com.au
  - Barossa Bush Gardens (Pam Payne), M. 0448 676 348

Pre-treatment [simple method]

- Place in tap water in small dish for 24 hr (at room temperature ± 12 hr)

Set up (see Student Notes for how to do) - only difficult steps are detailed here.

- Use either Glad Sandwich bags or Schweppes 1 L bottles (or similar)

For Bottles

- Cut around most of the bottle, leaving top attached with a hinge (1 – 2 cm)

For Germination

- Put in room with bright light but not direct sunlight if possible – most seed will also germinate in lower light (Note: some seed eg yam daisy are reported to only germinate at <20°C)
- For seed that need cooler temperatures to germinate consider soaking in a fridge (or low temperature incubator if available) – works for yam daisy (*Microseris lanceolata*) and wallaby grass (*Austrodanthonia* spp) up to 5 days OK.
- For seed that take longer to germinate, try incubating in open ziploc bag containing perlite for 3-6 weeks before needed
Q. Sketch each seed, record as many observations as you can. Measure ...seed (length & width).

A. Students should note that there is “natural variation” in shape and size for each type of seed. Corn seed is approximately cube shaped (square in cross-section), although some are almost circular in cross section (flattened sphere). Length and width are similar. Sunflower seed have a long axis and a short axis and have a rounded point at one end, and a flattish other end. Length of long axis is approximately 2x the measurement of the width (short axis).

Students may provide an average (mean) value (using a spreadsheet or calculator)

Q. If ... seeds have ... radicle…and cotyledon... measure each day and record .... Includes units (mm).

A. The radicle usually appears first, with the cotyledon(s) a few days later

Students may also produce a graph of day (x-axis) and length (y-axis) a

Q. Can you calculate the growth rate mm/day (or week)?

A. Yes. As per example provided. Since radicle growth is relatively slow, rate per day is more useful that rate per week as it is a whole number.

Q. Compare the growth between the 2 ....types of seeds and write a conclusion ... (3 – 4 sentences)

A. Students should clearly state which seed germinated first. Which one grew the fastest. They could also discuss which one was more variable? Were some of the seeds “bad” and didn't not germinate at all.

Q. In your observation of the seeds germinating, what appeared first, the radicle (root) or the cotyledons ...?

The root-like structure (the radicle) appears first to allow the new plant to absorb water, that is needed for cell expansion and to “grow” out of the soil. The stored protein, oil and carbohydrates (in the cotyledons) provide energy for growth until the leaves appear and photosynthesis can start working producing energy (sugar) from water + CO₂ and the sun’s energy.

Q. Which plant species is a monocot and which is a dicot?

A. Monocots (corn) and Dicots (sunflower).
**Method 1 – 1L soft drink bottle**

<table>
<thead>
<tr>
<th>Monocot (grasses)</th>
<th>Dicot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn (others include rice, wheat, barley oats)</td>
<td>Corn (others include carrot, radish, )</td>
</tr>
</tbody>
</table>

**Method 2 – Ziploc (sandwich size bag) – Native seed**

Tape bags to cardboard support (cut up an old box). Use sticky tape, a piece either side at about the place where the seed are – this helps prevent them from falling to the bottom (0.5-1 cm below the bag seal).

<table>
<thead>
<tr>
<th>Monocot (grasses)</th>
<th>Dicot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wallaby grass (<em>Rytidosperma caespitosa</em>) – previously <em>Austrodanthonia</em></td>
<td>Yam daisy (<em>Microseris lanceolata</em>)</td>
</tr>
</tbody>
</table>

Light grown – 13 days.

Radicle (root-like structure) emerging from seed on right **after 6 days**
Need to make sure only single seeds sown – here hard to see single (mono) cotyledon as two seed growing together

Two seed-leaves (cotyledons) now visible – 13 days

SCIENCE UNDERSTANDING – Biological Sciences
Transmission of heritable characteristics from one generation to the next involves DNA and genes
Students recognise that genetic information is passed on to offspring from both parents by meiosis and fertilisation.

SCIENCE INQUIRY SKILLS
Questioning and predicting
Formulate questions or hypotheses that can be investigated scientifically
Students explore the role of insects in increasing the genetic diversity of plants

Communicating
Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations
Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

<table>
<thead>
<tr>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet / screen or computers to watch video(s)</td>
</tr>
<tr>
<td>Flower image for students to label (from Student Activity Booklet)</td>
</tr>
<tr>
<td>SAPS - Parts of a plant and a flower (provided e-resource)</td>
</tr>
<tr>
<td>Posters (3) from Natural Resources SA on bush food plants (Bunganditj and Ngarrindjeri names). (provided e-resource)</td>
</tr>
</tbody>
</table>

Engaging Students
Ask them to bring a flower from their home or friends garden. Use these examples to highlight the similarity of basic structures, despite the very different flowers. Petals (outer coloured parts for attracting birds/insects – pollinators), Anthers (stamens and filament) pollen (male parts) and then middle (female parts). Do students know where to find pollen & why pollen is important (link to pollination, requirement for getting fruit).

OR
Genetics – differences between parents and siblings

We recommend you provide students with definitions of key words in the Student Activity Booklet from the text/sources that students are using to limit confusion.

Information on genotypes and phenotypes in included because this can help students understand the concepts of have two gene variants (alleles), your genotype, that produces different outcomes (phenotypes) in the population.

We have only provided a few questions / activities as this is a well resourced area of science. A few additional resources are suggested here, but no answers provided.
• Details and comparison of plant mitosis and meiosis

• Several commercial activity books have mix & Match activities

Images from video:  http://www.youtube.com/watch?v=HQ6ScNaBX6M

Q. At what stage does recombination of chromosomes occur?
   A. Prophase 1.

   Note: Technically recombination occurs between non-sister chromatids, not a chromosome. For Year 12 extension. Students must understand the difference between chromosomes and chromatids (sister and non-sister).

Q. How many chromosome separation events occur in meiosis?
   A. Two (anaphase 1 and anaphase 2). Technically, one is separation of chromosomes (meiosis 1) and the other is separation of chromatids (meiosis 2). http://cyberbridge.mcb.harvard.edu/mitosis_6.html and http://cyberbridge.mcb.harvard.edu/mitosis_7.html

Q. Why do plants have nectar (and/or fragrances)?
   To attract insects and/or birds and even small mammals to collect pollen and spread the pollen to increase the mixing up of genes (for increased genetic diversity, which provides long term benefit to the species, rather than a direct benefit to the plant, which has to use considerable “energy” resources to make nectar/fragrance.

Label the following parts of a flower

Anther – pollen – style – ovule (note: the pollen has been released from the anther)

![Flower Structure - labelled](http://www.saps.org.uk/secondary/teaching-resources/707-parts-of-a-plant-and-a-flower)
Q. What process do you think is likely to increase genetic diversity? Self pollination, or insect pollination, where the pollen travels to a different flower.

A. Insect pollination increases genetic diversity because pollen is often deposited onto flowers of a different plant, which will have many different gene variants, that the plant that produced the pollen. This is known as outbreeding, and plants may have other many mechanisms to promote “out-breeding” such as different timing of maturity of pollen and ovules.

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

A. Whole flowers were often placed in water and/or mixed with gum to release the nectar to make a sweet drink, as in the example photos of silver banksia and black wattle. Xanthorrhoea flowers were also used.

Options here to emphasise Indigenous knowledge

Plants and language

Often parts of plant were named based on use – not generic name for similar parts (eg flower etc) – Find some good examples.

There are some good posters available from Natural Resources SA that include (Bunganditj and Ngarrindjeri names). Search for “bush foods” at http://www.naturalresources.sa.gov.au/southeast/home


Other resources


Kinship Laws

Important part of community that increased genetic diversity and importantly reduced the negative impacts of inbreeding.

http://www.indigenousaustralia.info/social-structure/kinship.html
Task D4. Two ways of producing new weaving plants

**SCIENCE UNDERSTANDING**

**Biological Sciences**

Transmission of heritable characteristics from one generation to the next involves DNA and genes.

*Students seek to understand that the consequences of different methods or cultural practices to genetic diversity of plants.*

**SCIENCE AS A HUMAN ENDEAVOUR**

**Nature and development of science**

Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community.

*Students explore how Indigenous knowledge is passed through generations and how analytical skills enable this information to be used and organised appropriately.*

**Use and influence of science**

Values and needs of contemporary society can influence the focus of scientific research.

*Students understand that support from government and industry bodies enable information about Indigenous plants to be available and applicable to the wider society.*

---

**Equipment**

As per Student Activity Booklet, with a few additional details

**METHOD 1**

*Cyperus gymnocaulos* plants in pots (≈ 15 cm diameter) [or clump in the ground – dug up] (one 15 cm pot per group of 4 – will allow each student to make their own new plant)

Clean pots – eg 100 mm Slimline Pot (TL) available from Bunnings http://www.gardencityplastics.com/GrowersPots/SlimlinePots/P100SLK, good because can use 1L soft- drink bottles to make mini-glasshouses

Pruning saw or old serrated knife

Secateurs or sharp scissor (large)

Bucket or plastic container to soak pots before dividing

**OPTIONAL**

Seaweed extract (reportedly a stimulant of root that helps plants overcome stress)

Bottle Top Waterers (optional) - a few per class http://www.diggers.com.au

Mini-glasshouses can be purchased (eg Yates mini-greenhouse) or made from either a plastic tub with a loose fitting lid, a plastic bag (held off the plants with bamboo skewers) or even a cut 1L drink bottle (cap off).

**METHOD 2**

Stems of mature *Cyperus gymnocaulos*, with plantlets already growing at the top
Glass or jar containing water (filled to about 2 cm from the top)

Scissors

**Engaging Students**

What vegetables do they eat that come from the ground.

Modified stems – stolons, tubers and rhizomes – for more information

http://www.backyardnature.net/stemtype.htm

http://www.dummies.com/how-to/content/gardening-what-are-bulbs-corms-tubers-and-rhizomes.html

Q. Complete the table below for the type of modified stems these foods or common garden plants form.

| Type of modified stem | Common plants
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(stolon, tuber, corm, bulb or rhizome)</td>
<td>This information is often at Wikipedia</td>
</tr>
<tr>
<td>Tuber</td>
<td>Potato, sweet potato</td>
</tr>
<tr>
<td>bulb</td>
<td>Garlic, onion, Tulip</td>
</tr>
<tr>
<td>rhizome</td>
<td>Ginger, turmeric, Cyperus</td>
</tr>
<tr>
<td>stolon</td>
<td>Dianella, strawberry</td>
</tr>
<tr>
<td>corm</td>
<td>Gladiolus, freesia</td>
</tr>
</tbody>
</table>

**Additional notes – that may increase survival**

- propagating - do in a shady cool spot if possible – if hot/windy day, spray leaves frequently
- In the first 2 weeks, “hand spray every few days” and water before the top of pot really dries out.
- After 2 weeks, gradually open up covers / and remove when expecting a run of cooler days
- If using a clump from the ground, grow plants on in pots for a few months before putting in the ground to allow the plants to established new roots without too much stress, unless you have very good watering system, regime.

Q. 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?

A. Cutting the leaves and using a mini-glass house help to conserve moisture and help the roots recover until new roots form and can take water up from the soil. Leaves contain many stomata for exchange of CO2 and water, so removing leaves puts less stress on the plant by conserving water, and not requiring as much energy to keep a large shoot mass “alive and photosynthesising”.
Summer is a good time for finding *Cyperus gymnocaules* with young plants. Contact a local wetland / or friends of group that has a plant collection permit to get access to plant material. Or get some of these plants growing in your garden.

For a school excursion, to observer these plants, they are many plants along the River Torrens (between Tapleys Hill Rd and Henley Beach Rd at Lockleys).

**Q. Which *bilbili* tops will form roots...water level (red line) ...as indicated for plant 2?**

A. Difficult to predict with no prior knowledge, but safe to assume that only seeds/shoots in contact with water will develop roots (eg Plant 2 and 3). Student may predict that Plant 4 (and 3) might NOT produce roots, because there is no oxygen, but in fact they do (see below).

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
</table>

**Actual results** (from a similar experiment).

Plant 1 – No roots (and shoots have turned brown).

Plant 2 – 1 or 2 fine roots (less roots possibly because the water level was not always kept topped up)

Plants 3 and 4, both have good roots.

Once they have developed a few roots, they can be transferred to potting mix, in a small pot (~ 5 cm diameter, or several plantlets into a 10 cm pot) and kept moist.

**Q. Which method produces new *bilbili* plants that are more diverse? Propagation by division or from “young plants”**.

A. Propagation from young plants, because the young plant has germinated directly from seed attached to the mother plant. Seeds are produced as a result of meiosis and therefore contain new combinations of genes compared to the mother plant (Link to Task D3). Plants propagated by division of rhizomes are “clones” of the mother plants and arise from mitotic divisions.

**Q. Which method would be better if you own a plant nursery and you were propagating tubers/rhizomes for their flavour or medicinal properties?**

A. Propagation by division would be better because you would have an identical clone and therefore you would be sure of the flavour or medicinal properties. If you were to propagate by seed (a young plantlet) then you would have a new combination of genes and cannot predict the flavour or medicinal properties.

**Students can**
- compare their results on number of shoots and number of plantlets with roots.
- observe to see if there is any correlation between success of “rooting” and the number of shoots.
Overview of Theme E - Australian Native Foods: Feeding Australia Sustainably

<table>
<thead>
<tr>
<th></th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Sustainability of the food supply chain</td>
<td>Muntries, an Indigenous berry from South Australia</td>
<td>Indigenous use of muntries and food preservation</td>
<td>Food and Careers</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Practical</td>
<td>Practical</td>
<td>Practical</td>
<td>Classroom</td>
</tr>
<tr>
<td><strong>Discover</strong></td>
<td>Australian native food plants</td>
<td>Flavours of manthari (muntries) berries and products</td>
<td>How to design and analyse a food preservation experiment</td>
<td>Science careers in the food and Agricultural Industries.</td>
</tr>
<tr>
<td><strong>Tasks/Skills</strong></td>
<td>Describe</td>
<td>Describe</td>
<td>Predict</td>
<td>Evaluate</td>
</tr>
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<td></td>
<td>Analyse</td>
<td>Analyse</td>
<td>Design</td>
<td>Analyse</td>
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<td></td>
<td>Predict</td>
<td>Explain</td>
<td>Analyse</td>
<td>Design</td>
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<tr>
<td></td>
<td>Explain</td>
<td>Identify</td>
<td>Explain</td>
<td>Plan</td>
</tr>
<tr>
<td><strong>Understanding</strong></td>
<td>Factors affecting food security and the opportunities for new crops</td>
<td>The role of sensory science for food product development</td>
<td>Common theme in many food preservation methods</td>
<td>Personal skills that many employers value. Team work and long term planning</td>
</tr>
<tr>
<td><strong>Content Descriptions</strong></td>
<td>Science as a human endeavour &amp; Science Inquiry Skills</td>
<td>Science as a human endeavour &amp; Science Inquiry Skills</td>
<td>Science as a human endeavour &amp; Science Inquiry Skills</td>
<td>Science Inquiry Skills</td>
</tr>
<tr>
<td><strong>General Capabilities</strong></td>
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<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Cross-curriculum priorities</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>Inquiry project</td>
<td>Project</td>
<td>Project</td>
<td>Project</td>
</tr>
</tbody>
</table>
Task E1. Sustainability of the food supply chain

**SCIENCE AS A HUMAN ENDEAVOUR**

*Use and influence of science*

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities

*Evaluating claims relating to the reduced environmental footprint of food plants.*

**SCIENCE INQUIRY SKILLS**

*Questioning and predicting*

*Formulate questions that can be investigated*

Students use available resources to identify questions to investigate the suitability of different types of plants or plant-based materials to address specific needs.

*Communicating*

*Communicating, evidence-based, appropriate scientific language*

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

---

**Equipment**

- Internet / screen or computers to watch video(s)

**Engaging Students**

How many of the fruit trees that grow in and around Adelaide would survive and produce fruit, if they did not get extra watering. What happens if the climate gets hotter and drier? Will we have enough water? What else could we grow instead?

Watch the video on global food security. [http://vimeo.com/26303624](http://vimeo.com/26303624)

---

Q. What are the current challenges … growing world population? Name at least 3.

A. Global food security. At risk because increasing population, fuel costs, way we store food, climate change (droughts/floods/cyclones)

Discuss how growing plants that are local to each environmental is likely more sustainable (less water, less fertiliser)
Q. Do you know of any food plants that Aboriginal Australians eat / ate?

A. Ones that students might know are Quandong, bush tomato, Lemon Myrtle, witchetty grubs. Less common ones include warrigal greens (native spinach), Davidson’s plum, muntries (see Task E2 and E3), Wattle seed, Riberry, Mountain pepper, Muntries, Lemon aspen, Kakadu plum, Finger lime, Desert Lime, Davidson Plum. For Fact Sheets of the most common native foods provided by Australian Native Food and Botanicals, [https://anfab.org.au/](https://anfab.org.au/)

Provide students with a leaf of lemon myrtle. **Reveal name after discussion.**

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

A. Discuss appearance. Leaves are big and look like they are from a tree.

Q. What type of environment do you think... grows in? ... Explain your answer.

The leaves are quite green but dry. Not likely to be a desert plant, as there often have adaptations to conserve water such as cylindrical leaves, or small, or grey, or hairy leaves. It normally grows in the rainforests along the east coast of Australia, so areas with quite a high natural rainfall.

![](image.png)  
Blue dots = collected samples  
*(Backhousia citriodora)*

Q. What does the leaf smell like?

A. It smells like lemon (or lemon grass)

Q. Describe any changes that occurred when you crushed the leaf.

The smell becomes stronger (more intense). This is because the oil is stored inside the cell (either in vacuoles or on the leaf surface in special oil glands, depending on the species), and crushing the leaf, releases the oil to give a stronger smell.

Q. Using … knowledge of the smell …do you know the name of this food product is?

A. Lemon myrtle

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

A. Lemon myrtle is a rainforest plant. Not suited to the Adelaide Plains, although is being grown commercially in the Adelaide Hills, which is generally cooler than the Adelaide Plains, by Tumbeela ([http://tumbeela.com.au](http://tumbeela.com.au)). The trees are probably irrigated during summer.

Q. … information…rigorous assessment …sustainability..native crop …to ...cherries?

A. You would need to know all the “inputs” that go in to producing each fruit crop, such as water, fertiliser, and labour costs for pruning, harvesting and getting fruit ready for market. You would then need to look at the “outputs” predominantly yield of fruit and price per kg of fruit. Plants adapted to Australia’s nutrient poor crops are likely to need less fertiliser. Plants such as quandong from arid parts of Australia are likely to need less water compared to cherries which originated in Europe and Asia.
Task E2. Muntries, an Indigenous berry from South Australia

SCIENCE AS A HUMAN ENDEAVOUR

Use and influence of science

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people’s lives, including generating new career opportunities.

Students participate in sensory science analyses of novel food products and use this data to evaluate what products are preferred by most students.

SCIENCE INQUIRY SKILLS

Processing and analysing data and information

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies.

Students analyse data and use spreadsheets to draw graphs and describe samples.

Evaluating

Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data.

Students evaluate the strengths of their conclusions, considering possible sources of systematic and random errors, and provide suggestions on how to improve future results.

Equipment

- Internet / screen or computers to watch video(s)
- Computer,
- Dots/post it notes,
- White board markers,
- Spoons & plates
- Muntries (fresh (Feb/Mar) or frozen): MuntrieMagic ((08) 8568 2355, email muntriemagic@dodo.com.au), Mount Pleasant Market; or Sandy Grove Kingston South East (Mob: 0417 841 770, Email: sandygrove@rbm.com.au)
- Muntrie fruit straps www.gourmetgoodies.com.au, or Mount Pleasant Market
- Excel sheets – for data analysis (provided e-resource)

Additional resources (not core)

- IFTSensorySciencePartII_full slide presentation (provided e-resource)

Engaging Students

Why do you like fruit? Sweetness? Juiciness? Texture? For most students, sweetness will be a key factor, but everyone is different which is why sensory science is used by food companies. Many native food plants such as quandong have very little sugar, and like rhubarb, are best student. Muntries are naturally sweet, and therefore taste great fresh, like other berries (blueberries/raspberries).
Lesson Plan

Groups of 4-6. One plate per group with tasting of each of three products. Tasting order fruit, fruit straps, jam.

Lead class discussion on the appearance of the fruit.

Q. What does the fruit smell like?

  Not usually very much.

Now taste the frozen muntries.

Q. What does the fruit taste like? Do you recognise ... flavours...?

Does it remind them of anything? Can they compare it to something? Discuss the smell of the fruit. Discuss the taste and texture of the fruit. Usually students can identify apple, cinnamon, spice (like mixed spiced). The ANFIL muntries fact sheet describes it as “...Aroma of moist fruit mince, spice, bush honey and butter...tastes like apple with a juniper essence, a spicy apple taste...”

Discuss sensory science.

Watch this video from University of California (UC) Davis. Sensory science explores touch, taste (flavour) and smell. Explain that normally done in a private booth so that you are not influenced by the opinion of others.

https://www.youtube.com/watch?v=e46DXrLXP2c

Note: University of Adelaide’s Waite Campus has three sensory laboratories and students enrolled in the Bachelor of Food & Nutrition Science at the University of Adelaide do a subject on Sensory Science.

Do students like it or dislike it?

You can use a simple show of hands, a scale, or programs such as MQlicker (https://www.mqlicker.com/)

Rate each product separately (suggested order: Frozen muntries, muntries jam and muntries and food straps)
Indicative class data

An appropriate value for the X-axis, needs to be as big, or bigger than the category with the largest number of votes, say 16 or 20

<table>
<thead>
<tr>
<th></th>
<th>Frozen berries</th>
<th>Jam</th>
<th>Fruit straps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly like</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Like</td>
<td>2</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Neutral</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Dislike</td>
<td>16</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Strongly dislike</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Students can either draw, or use Excel to graph the result for each product

Q. What is an appropriate label for the Y axis? …label the graph.

Number of people

Q. Use …the bar graphs…to answer…what muntries product is most liked…?

The fruit straps are the most liked muntries product.

22 students (10 + 12) either liked or strongly liked them, compared to only 17 students (4 + 13) for the jam, and only 2 for the frozen berries. Nobody “strongly liked” the frozen berries
Task E3. Use and preservation of muntries by Aboriginal people

**SCIENCE INQUIRY SKILLS**

**Questioning and predicting**

Formulate questions or hypotheses that can be investigated scientifically

*Students use existing and new knowledge to investigate food preservation methods and design an experiment to test the effectiveness of a food preservation method.*

**Communicating**

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations

*Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.*

**Equipment**

- Discussions
- Inquiry projects – what needed will depend on what students propose. Heating, drying, salt, natural preservatives (citric acid)
- Food Additive Code Numbers (July 2014)_FSANZ (provided e-resource)

**Additional resources** (not core)

- Gott 2008 Indigenous Use of plants in S-E australia (provided e-resource)
- NSW-edu-Stage 5 Food Technology_incl preservation (provided e-resource)

**Engaging Students**

- Has anyone had food poisoning? Is it fun or not?

Work through the questions.

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

This is open ended question. The authors have not been able to find any information on the yet. Most students seem to think round and quite large.

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

Could have been for increased nutrition and/or flavour. Also may have been for getting a consistency that worked.

Make general suggestions get students to think about what goes in cakes today, and what properties this gives food products. Flour (native grasses, wattle seed) and oil (macadamia, quandong nuts)?

Would the cakes have been everyday food or special occasion?

Trading for rare hard to get items? (discuss carrying long distance / lack of storage). Link to food preservation & drying makes lighter to carry and last longer
Q. What makes food go bad?

Growth of microorganisms such as bacteria/fungi/mould.

Get students to discuss example of what happens to stuff left in the fridge for too long.

Q. What natural preservatives/preserving methods do you know about?

List all the answers on a white board / on a computer.

Refrigeration, salt, sugar, boiling, bottling/jams, drying, natural preservatives such as honey and lemon juice. Lemon juice is one source of citric acid (additive # 330 on Australia food labels)


see additional resources for a numerical list of food additives

Q. … what method(s) …were most likely used …to preserve muntries cakes?

Get students to vote on which one they think was most likely used.

What other methods might have been used and why?

For muntries – probably just drying – although some of the seeds may have had a preservative effect.

Q. What …is the main reason why all of the food preserving methods work?

What is a common theme linking these preserving methods? They all reduce water availability. Living things need water to grow. Bacteria and yeast need more water than fungi. Fungi such as bread mould can live with just a small amount of water.

Water availability in food products is routinely measured in Food Industry and is referred to as “water activity”.

INQUIRY ACTIVITY (or ASSESSMENT PROJECT)

Design an experiment to test the effectiveness of a food preserving method.

Suggest students do something with an in-season fruit or frozen fruit.

- Explain to students the Inquiry process.
- Students work in groups to benefit from their different strengths and weakness
- This phrase can help students remember the steps
  - “Cows move slowly (or moo softly), I don’t care”
  - = “change, measure, same, independent, depend, control”
Task E4. Food and Careers

SCIENCE AS A HUMAN ENDEAVOUR

Use and influence of science

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities.

Students describe changes that have occurred in food and agriculture in the last 25 years and predict future applications of novel technologies on people's lives.

Students evaluate claims relating to the reduced environmental footprint of food plants.

SCIENCE INQUIRY SKILLS

Communicating

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations.

Through brainstorming, examining and researching, students gain an understanding of scientific ideas within a historical and cultural setting. They communicate their understanding through written and verbal means.

Equipment

- Internet / screen or computers to watch video(s)
- Internet access for students (working alone or in pairs)

Additional resources (not core)

- PICSE – Living Science Resource. A to Z of Food, Agricultural Science & Natural Resource Careers (provided e-resource)

Engaging Students

What factors are important to you for your future careers. Do you want interesting/varied jobs, working with people. Consider Food and Agriculture. Do any students know anyone working in these careers – more varied that just selling / serving food. Or get students to find job advertisements, for example by search SEEK (www.seek.com)

Q. What changes have occurred in food and agriculture, in Australia, in the last 250 years?

Prior to colonisation, there was no private ownership of land, and Aboriginal Australian's managed the landscape to provide food throughout the seasons. See Task C1 for more details.

Q. What changes have occurred in food and agriculture in the last 25 years?

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

Plant breeders to develop crops that are higher yielding, more resistant to environmental extremes (hot, cold etc), more resistant to pests and diseases and crops that are efficient/use less resources such as water and fertilisers. Developing renewable energy, biofuels.

Q. Predict future applications of … technologies in the food and agricultural industries on people’s lives.

Non-toxic indicators to know if food has spoiled (to avoid food wastage). More advances in packaging to increase shelf life/retain nutrients.

Watch two videos


![Agriculture Industry careers video](https://www.youtube.com/watch?v=3tC-EBcQK Rc). Highlights the diverse roles available in agriculture and the large number of jobs filled by graduates.

Alternative videos

Food graduates –SA business partnerships: video: [https://www.youtube.com/watch?v=0FKYH9CIUIUs](https://www.youtube.com/watch?v=0FKYH9CIUIUs)

Women in Ag: [https://www.youtube.com/watch?v=4z0PX-BJu8w](https://www.youtube.com/watch?v=4z0PX-BJu8w)

University of Adelaide – Jordy: [https://www.youtube.com/watch?v=nja0mxVYHhc](https://www.youtube.com/watch?v=nja0mxVYHhc)

Biology NRM: [https://www.youtube.com/watch?v=KpWmfnFgtw&list=PLPB2vg9wct5dQERjdB0cc5EFwVad1OY&index=20](https://www.youtube.com/watch?v=KpWmfnFgtw&list=PLPB2vg9wct5dQERjdB0cc5EFwVad1OY&index=20)

The Waite video: [https://www.youtube.com/watch?v=ZtcPM8KZMI8&feature=youtu](https://www.youtube.com/watch?v=ZtcPM8KZMI8&feature=youtu).be

<table>
<thead>
<tr>
<th>Food Scientist</th>
<th>Benefits to company and/or society (consumers)</th>
</tr>
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<tbody>
<tr>
<td>Prior experience and/or subject (discipline) skills</td>
<td>General Science - degree</td>
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<tr>
<td></td>
<td>Chemistry</td>
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<tr>
<td></td>
<td>mathematics</td>
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<tr>
<td></td>
<td>physics</td>
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<tr>
<td></td>
<td>biology</td>
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<table>
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<tr>
<th>Agriculture Careers - different positions</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Pilot</td>
<td>veterinarian</td>
</tr>
<tr>
<td>journalist</td>
<td>jackaroo</td>
</tr>
<tr>
<td>engineer</td>
<td>commodity trader</td>
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</tbody>
</table>
agronomist banker
event coordinator chef
researcher producer/farmer
consultant project manager
economist CEO (chief executive officer)

Requirements of two positions, with **common skills highlighted**

**Food Technician - Evolve scientific recruitment**

<table>
<thead>
<tr>
<th>Prior Experience</th>
<th>Personal Skills</th>
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</thead>
<tbody>
<tr>
<td><strong>Degree or Diploma in Science, Food Technology</strong></td>
<td>Attention to detail</td>
</tr>
<tr>
<td>1-3 years experience in food QC (quality control) and microbiology testing</td>
<td>Ability to follow procedures [instructions]</td>
</tr>
<tr>
<td>[recent graduates welcome to apply, suggests degree = experience]</td>
<td>Team player (ability to work as a team)</td>
</tr>
<tr>
<td></td>
<td>Displays initiative</td>
</tr>
<tr>
<td></td>
<td>Willingness to learn</td>
</tr>
<tr>
<td></td>
<td>Proactive</td>
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<tr>
<td></td>
<td>Highly organised</td>
</tr>
<tr>
<td></td>
<td>Great work attitude</td>
</tr>
</tbody>
</table>

**Plant Specialist - Jurlique**

<table>
<thead>
<tr>
<th>Prior Experience</th>
<th>Personal Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Degree in Science</strong> (Agriculture, horticulture, botany)</td>
<td>Motivation</td>
</tr>
<tr>
<td>Ability to successfully lead projects</td>
<td>Enthusiasm / passionate</td>
</tr>
<tr>
<td>Independently manage concurrent tasks</td>
<td>Drive</td>
</tr>
<tr>
<td></td>
<td>Ability to work in a team</td>
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<tr>
<td></td>
<td>Knowledgeable</td>
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<tr>
<td></td>
<td>Strong communications skills</td>
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<tr>
<td></td>
<td>Time management skills</td>
</tr>
</tbody>
</table>

**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.

**Sample response for skill, “Influencing and Negotiating”**

In my current role, successfully negotiating contracts with suppliers is crucial to ensure cost effective delivery of efficient services to the organisation. I manage each contract, which requires day to day negotiation with suppliers around issues as they arise. For example, there was a conflict between 2 security guards on site, which I had to discuss with the supplier. The outcome was a number of changes to operating practices that ensured minimal impact to their service delivery to the business and an outcome that was readily accepted by the 2 contractors so conflict has not occurred since.

From: vacancies.sa.gov.au/novfiles/vacancyattachments/82036%5CApplicant%20Guide.doc
Q. List 3 things that you didn't know about this career.

   A. List all the answers on a white board / on a computer.

Q. Which of these careers is most interesting to you? Explain Why.

   **Get students to vote on which ones they are interested.**

   Should get a broad range of interests.

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

In general the **more “core” science and maths subjects** a student does, the more choice students will have.

Most Universities would prefer to have student with the **“assumed knowledge”** subjects than a high ATAR in non STEM subjects.

<table>
<thead>
<tr>
<th>Degrees at University of Adelaide</th>
<th>Assumed Knowledge</th>
<th>Pre-requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Food &amp; Nutrition Science</td>
<td>SACE Stage 2 Chemistry, Mathematical Studies</td>
<td>None</td>
</tr>
<tr>
<td>Bachelor of Science (Natural Resources)</td>
<td>SACE Stage 2 Chemistry, Mathematical Studies</td>
<td>None</td>
</tr>
<tr>
<td>Bachelor of Agricultural Science</td>
<td>SACE Stage 2 Chemistry, Mathematical Studies</td>
<td>None</td>
</tr>
<tr>
<td>Bachelor of Science</td>
<td>SACE Stage 2 Chemistry, Mathematical Studies, Physics</td>
<td>None</td>
</tr>
</tbody>
</table>


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

   Team work, communications skills, enthusiasm, initiative and many more.

**Business Planning**

This exercise & assessment

- Assumes students have done Task E1
- Has been designed around group work, class sharing of information and could have either a group final report or individual reports

Additional information can be added if you want to add a commercial element

- Plants are trellised, and spaced 1 meter apart
- Yield from mature manthari plant is 2 kg linear m of trellis

**Suggested Information Collecting Phase**

*This is difficult and you would expect a range of responses*
### Research Benefit Importance Time

<table>
<thead>
<tr>
<th>Research</th>
<th>Benefit</th>
<th>Importance</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Breeding = getting better varieties (eg Better quality (early / late / fruit) and better adapted plants (low rainfall, disease resistant))</td>
<td>High</td>
<td>10 years +</td>
<td></td>
</tr>
<tr>
<td>Sensory Analysis</td>
<td>Know that fresh fruit and products are acceptable to consumers</td>
<td>High</td>
<td>5 years total, in several blocks, with more at the beginning</td>
</tr>
<tr>
<td>Food Safety</td>
<td>Low, this is more the responsibility of the Food Producer buying the fruit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition (Plant = fertilisers)</td>
<td>Healthy plants, means better fruit. But need to be know what is right for new crop – too much is very expensive (and bad for the environment. Need to get this right</td>
<td>High</td>
<td>3 years to optimise, then research assistants can monitor and consultants can be used if new issues arise</td>
</tr>
<tr>
<td>Mechanical engineering for food production</td>
<td>Better quality end products</td>
<td>Low, this is more the responsibility of the Food Producer buying the fruit</td>
<td></td>
</tr>
</tbody>
</table>

### Research Resources to explain / highlight some of the area

<table>
<thead>
<tr>
<th>Research</th>
<th>Resources to explain / highlight some of the area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Breeding = getting better varieties</td>
<td><a href="https://www.youtube.com/watch?v=JP_dmarCJLg">https://www.youtube.com/watch?v=JP_dmarCJLg</a> Key point from this video is that researchers are selecting for 15 or more different characteristics every time.</td>
</tr>
<tr>
<td>Sensory Analysis</td>
<td>See Task E3</td>
</tr>
<tr>
<td>Mechanical engineering for food production</td>
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</tbody>
</table>

Q. What skills will … Muntries industry team need? …needed for the entire project or short term…(1-5 years)

This information could be integrated into the Gantt Chart

<table>
<thead>
<tr>
<th>Manager (business degree)</th>
<th>Entire project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horticulturist</td>
<td>Entire project</td>
</tr>
<tr>
<td>Plant Breeder</td>
<td>Entire project</td>
</tr>
<tr>
<td>Technical Assistants (2)</td>
<td>Entire project</td>
</tr>
<tr>
<td>Research Assistants (1)</td>
<td>Entire project</td>
</tr>
<tr>
<td>Environmental Engineer</td>
<td>First few years</td>
</tr>
<tr>
<td>Food Scientist</td>
<td>First 3 years, then short term contracts</td>
</tr>
<tr>
<td>Marketing</td>
<td>Short term contracts? 1 year every 2-3 years</td>
</tr>
</tbody>
</table>

Partial example Timeline/Gantt chart

<table>
<thead>
<tr>
<th>Research</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>Plant Breeding</td>
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<td>Mechanical Harvesting</td>
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<td>New Product Development</td>
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<tr>
<td>Irrigation Technology</td>
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<td><img src="https://c1.staticflickr.com/1/151/408166947_928c671c2d_z.jpg" alt="Image" /></td>
<td>© Australian Curriculum, Assessment and Reporting Authority (ACARA) CC BY. Carolyn Schultz (CC-BY-SA 4.0) [all other images by Carolyn Schultz are also covered by (CC-BY-SA 4.0)]</td>
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<td><img src="http://www.bom.gov.au/iwk/" alt="Image" /></td>
<td>Image from Main G. Heartland: The Regeneration of Rural Place pg 28 Images: Yam daisy tubers (left) with two new season tubers (white, edible) and last season (shrivelled) yam. Yam daisy flower (right). Photos Carolyn S.</td>
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<tr>
<td>Video on seed germination, <a href="https://www.youtube.com/watch?v=T94hwhYCFsY">https://www.youtube.com/watch?v=T94hwhYCFsY</a></td>
<td><a href="http://biology.unm.edu/ccouncil/Biology_203/Summaries/FloweringPlants.htm">http://biology.unm.edu/ccouncil/Biology_203/Summaries/FloweringPlants.htm</a></td>
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<tr>
<td><img src="http://vimeo.com/26303624" alt="Image" /> Video on global food security</td>
<td><a href="http://vimeo.com/26303624">http://vimeo.com/26303624</a></td>
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<tr>
<td><img src="https://www.youtube.com/watch?v=e46DXrLXP2c" alt="Image" /> University of California (UC) Davis. Sensory science video</td>
<td><a href="https://www.youtube.com/watch?v=e46DXrLXP2c">https://www.youtube.com/watch?v=e46DXrLXP2c</a></td>
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<tr>
<td><img src="https://www.youtube.com/watch?v=3tC-EBcQKRc" alt="Image" /> Agriculture Industry careers video</td>
<td><a href="https://www.youtube.com/watch?v=3tC-EBcQKRc">https://www.youtube.com/watch?v=3tC-EBcQKRc</a></td>
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</tbody>
</table>
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.

This book includes information on identification, propagation, historical uses and flowering time of each plant. Explains the latin/greek origin of scientific plant names.

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.

Provides list of documented and likely plant uses and all the historical recordings from early colonists perspectives including language references


This book is great as it contains botanical illustrations of the plants and information that was prepared in collaboration with local Indigenous women of the Yangennanock Women’s Group. Many of the species included are local to SA and some SA information on use is provided.

Copies are $10 and can be obtained by contacting one of the authors, Dr John G. Conran, The University of Adelaide, e-mail: john.conran@adelaide.edu.au web page: http://www.adelaide.edu.au/directory/john.conran

This journal article includes a table showing the different types of storage carbohydrates found in different root vegetables (yams) used by Aboriginal peoples from SE Australia.

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


Laminated 4 fold A4 size guide (8 pages) with drawings explaining all the botanical terms with diagrams of plant structures

Mattingley C and Hampton K (editors) (1998) Survival in our own land. ‘Aboriginal’ experiences in ‘South Australia’ since 1836, told by Nungas and others. Chapter 21 (Point McLeay), pp 183-188 (see e-resources)


Key reference for understanding Ngarrindjeri culture and perspective.


Still to add - Ngarrindjeri language books

Additional relevant Internet resources


Muntries Fact Sheet (PIRSA), http://www.adelaide.edu.au/directory/carolyn.schultz


Information on teaching Indigenous students
