Connecting Indigenous Knowledges to the classroom

Indigenous STEM Education Resources

Cultural Burning

Biological Sciences

Classroom activities guide

Acknowledgement of Country

CSIRO acknowledges the Traditional Owners of the lands, seas and waters of the area that we live and work on across Australia. We acknowledge all Aboriginal and Torres Strait Islander peoples and their continuing connection to their culture and pay our respects to Elders past and present. CSIRO is committed to reconciliation and recognises that Aboriginal and Torres Strait Islander peoples have made contributions to all aspects of Australian life including culture, economy and science.

Artwork

‘Meeting on Country, Shifting Sands’
by Aunty Sandra Angus
working with Saltwater People
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Aunty Sandra Angus is an acknowledged Elder and well respected Aboriginal leader in her community. She proudly identifies as an Australian ‘Saltwater Murri’ with ancestral roots that extend to the Wiradjuri and Wongaibon people in NSW, the Ngarrindjeri people in SA and the Gunggari and Jaggera people in QLD.

Contents

Glossary

Term	Definition
Aboriginal/Torres Strait Islander	The Aboriginal and/or Torres Strait Islander Peoples are the first peoples of Australia. They belong to more than 250 different language groups; each connected to their own Country or land. Torres Strait Islander Peoples come from five main island groups located north of Cape York in Queensland. A person is considered Aboriginal and/or Torres Strait Islander if they: • Have Aboriginal and/or Torres Strait Islander family heritage, • Identify themselves as Aboriginal and/or Torres Strait Islander, and • Are accepted by the Aboriginal and/or Torres Strait Islander community where they live.
Abiotic	Parts of an ecosystem that are not alive and has never been alive. Often referred to as a non-living component. Examples: fire, sun, rain, water, rocks, air and temperature.
Biodiversity	The variety of life in an ecosystem. An ecosystem with a wide range of different species, habitats and genes has high biodiversity. Ecosystems with high biodiversity are usually heathier and more stable.
Biotic	Parts of an ecosystem that are living or were once living. Often referred to as a living component. Examples: animals, microbes and plants
Country	The regional lands, waterways, sky and seas associated with Traditional Owners or clan groups that they have responsibility for. Country encompasses more than just the physical land, it's the collection of animals, plants, people, sky, waterways and the spiritual connections between them. Country is alive and referred to as a proper noun, with a capital 'C'. This term is different to the concept of Australia as a whole country and refers to a defined region.
Cultural Burning	A traditional land management practice used by Aboriginal and/or Torres Strait Islander Peoples that involves slow, controlled and low-intensity fire to burn the land. This practice encourages native plants to grow and thrive while removing dead plants and non-native plants from a habitat. Disclaimer: The term "fire-stick farming" was created by early researchers and colonists to describe Aboriginal and/or Torres Strait Islander fire management practices. It does not come from Indigenous languages and may oversimplify the knowledge, skill, and complexity behind these practices. It is preferred to refer to these practices as Cultural Burning.
Custodians	A custodian is a Traditional Owner of the land and waters who carries the responsibility for caring for and looking after Country.

Ecosystem	A community of living things (biotic, e.g. plants, animals, microbes) and non-living things (abiotic, e.g. water, temperature, rocks) that interact with each other.
Fuel load	Refers to the amount of dry plants, leaves and sticks on the ground that can burn in a fire. Cultural Burning reduces the fuel load by burning away dead/dried leaves, sticks and dry grass. A high fuel load means there's a lot of burnable material that can cause a wildfire to move quickly, grow large and be hard to control. A low fuel load means there's not a lot of burnable material, making wildfires smaller and easier to put out.
Invasive plants	Plants that spread quickly in a new area and cause harm by outcompeting native plants, disrupting ecosystems and reducing biodiversity. They are often introduced to new environments by human activity.
Native plants	Plants that naturally developed in a specific region over thousands of years and are well-adapted to the local climate, soil and ecosystem.
Traditional Owner	An Aboriginal and/or Torres Strait Islander Person who is recognised by their community as having ownership and knowledge of a particular area or Country.

Activity 1 - Connect to Country

Learning intention

- Understand abiotic and biotic ecosystem factors.
- Identify abiotic and biotic ecosystem factors.

Success criteria

- Can define key terms: biotic and abiotic Can identify different features of an ecosystem.
- Can sort ecosystem factors into biotic (living) and abiotic (non-living) categories.

Safety

- Wear weather appropriate clothing.

Equipment

For each student:

- *Student activity 1 worksheet: Connect to Country* or prepared page in workbook.
- Outdoor planted space on school grounds.

Activity

1. Select an outdoor space to observe (e.g. native garden, garden beds, creek, nature reserve) or select an ecosystem image to observe.
2. Record your observation of the living and non-living features of the system – including signs of life (scat, footprints, scratching, holes) and sounds (bird or insect calls).
3. Return to classroom.
4. As a class, share and sort observed ecosystem features into categories: biotic (living) and abiotic (non-living).

Reflection

Introduce abiotic and biotic as scientific terminology.

- What makes something living/non-living/never living?
- What characteristics do we see across all living things? (seven characteristics of life: movement, respiration, sensitivity, growth, reproduction, excretion, nutrition)
- Record own/class definitions on the *Student 1 activity worksheet.*

Adaptations

Instead of leaving the classroom use the *Student activity 1: Connect to Country images*.

Student activity 1 worksheet - Connect to Country

All ecosystems are made up of biotic (living) and abiotic (non-living) things. Go outside onto Country, find a section of garden or bushland and note down your observations.

Can you identify whether they are biotic or abiotic?

Location:		
Observations:		
_____ (living)	**_____ (non-living)**	**Unsure**

Definitions	
Biotic	
Abiotic	

Student activity 1 images - Connect to Country

All ecosystems are made up of biotic (living) and abiotic (non-living) things.
Examine the images below and label as many features as you can as biotic or abiotic.

Figure 1. The River Murray near Renmark, South Australia by Tanya Doody, CSIRO

Figure 2. Burning Spinifex on Country, CSIRO

Activity 2 - Fire as an ecosystem factor

Learning intention

- Understand how fire from Cultural Burning affects both biotic and abiotic factors in an ecosystem.
- Understand how abiotic and biotic ecosystem factors can interact.

Success criteria

- Can list effects of fire on select abiotic and biotic factors.
- Can identify interactions between abiotic and biotic factors in an ecosystem, in relation to fire.

Activity

Check for prior knowledge

- How can fire affect an ecosystem?
- Is fire always destructive?
- Could fire be used to control an ecosystem in a positive way?
- Where have you heard of fire being used as a tool to improve the health of ecosystems?

This activity can be completed as a class, in small groups or individually.

1. Read: *Student activity 2: Fact Sheet - Fire as an ecosystem factor*.
2. In different colours, highlight the abiotic and biotic ecosystem factors in the text.
3. Model creating a flow diagram showing the impacts of fire on the abiotic and biotic factors of an ecosystem.
4. Ask students to create a flow diagram using the ecosystem factors in the text to show the impacts of Cultural Burning on an ecosystem. They can use the template provided or create their own.
5. Share flow charts and encourage students to consider what other connections they could include.

Reflection

- What are some abiotic factors mentioned in the text that change after a cool burn?
- How do these changes in abiotic factors affect plant growth in the ecosystem?
- Why do some Australian plants need fire to reproduce? What does this tell you about their relationship with fire as an abiotic factor?
- How do changes in plant biodiversity affect the food web in the ecosystem?
- Why is it important for Traditional Owners to consider weather conditions and animal life cycles before burning?
- How does cultural knowledge help maintain the balance between biotic and abiotic factors?
- What might happen to an ecosystem if Cultural Burning was not practiced for a long time?
- How does Cultural Burning show that humans can have a positive impact on ecosystems?

Student activity 2: Fact sheet

1. Read: *Fire as an ecosystem factor*.
2. In different colours, highlight the abiotic and biotic ecosystem factors in the text.
3. Create a flow diagram showing the impacts of fire on the abiotic and biotic factors of an ecosystem.

Fire as an ecosystem factor

Cultural Burning is a traditional practice used by Aboriginal and/or Torres Strait Islander Peoples to care for Country. It uses slow, cool, and carefully controlled fires to keep ecosystems healthy. These cool burns thin out weeds and prevent some native plants like spinifex and bracken, from becoming too thick. After the fire, the cleared spaces allow other plants such as bush tomatoes, bush raisins and other native plants to grow.

The cleared space allows sunlight to reach the soil, causing the ground to become warmer, the ash from cool burns returns nutrients to the soil and makes the soil better able to absorb and hold water - all of which promote new plant growth. Many Australian plants need fire. The gentle heat can crack the hard seed coats of native plant species, and the smoke can stimulate some seeds to sprout. Because the fire is cool, the seeds are not destroyed.

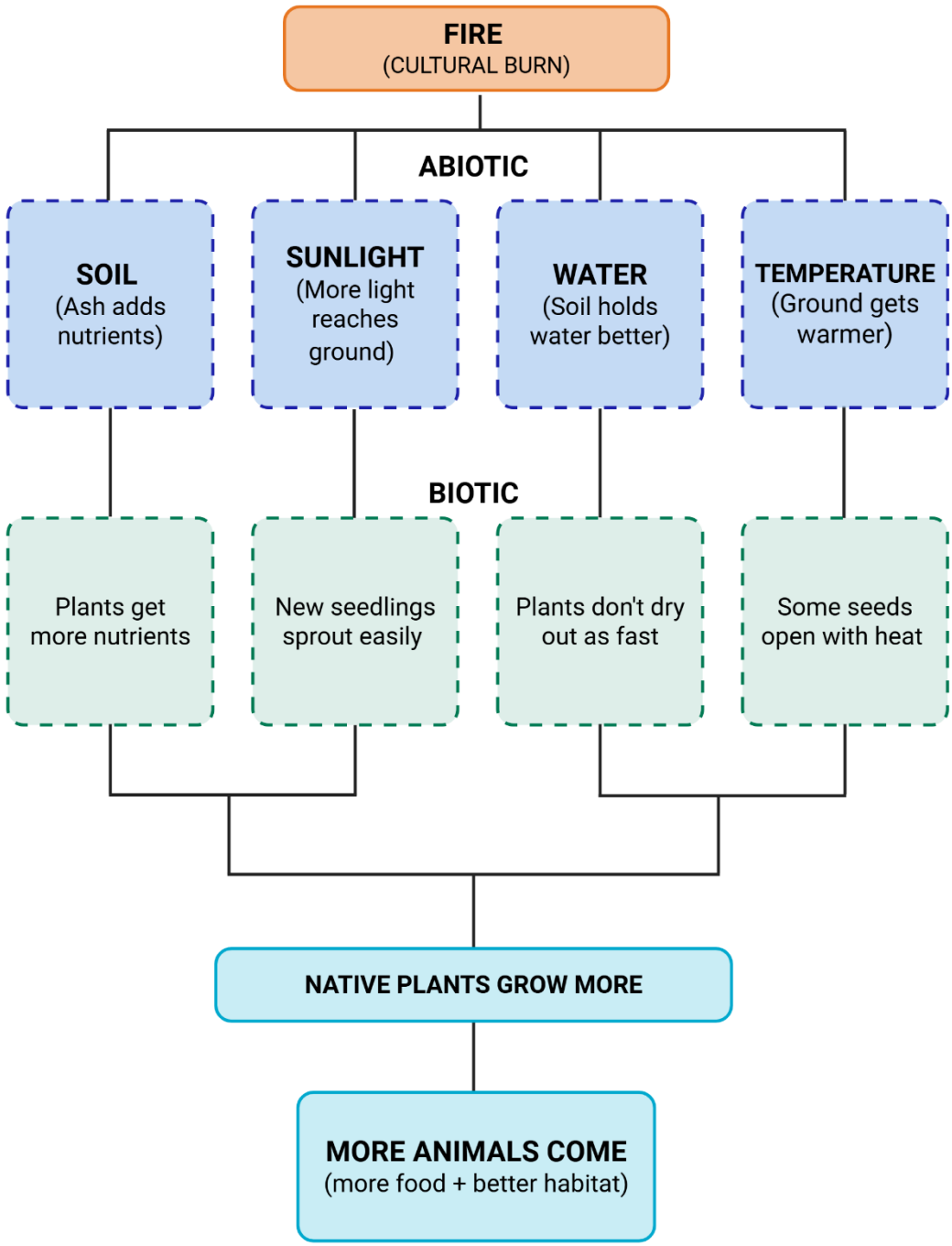
New plant growth and shoots attract grazing animals to the freshly burnt areas, and the increased plant biodiversity improves the food sources and habitat choices for small mammals, reptiles, amphibians and insects.

Cultural Burning is incredibly successful across the vast range of environments found in Australia because the Traditional Owners adapt fire regimes to suit the particular ecosystem being burnt. They avoid burning when animals have young, when the land is too dry and highly flammable, or when strong winds could make the fires uncontrollable. By using cultural knowledge to decide when and where to burn, Traditional Owners protect and support native plants, animals and the health of Country.

Teacher worksheet: Fire as a tool for ecosystem health

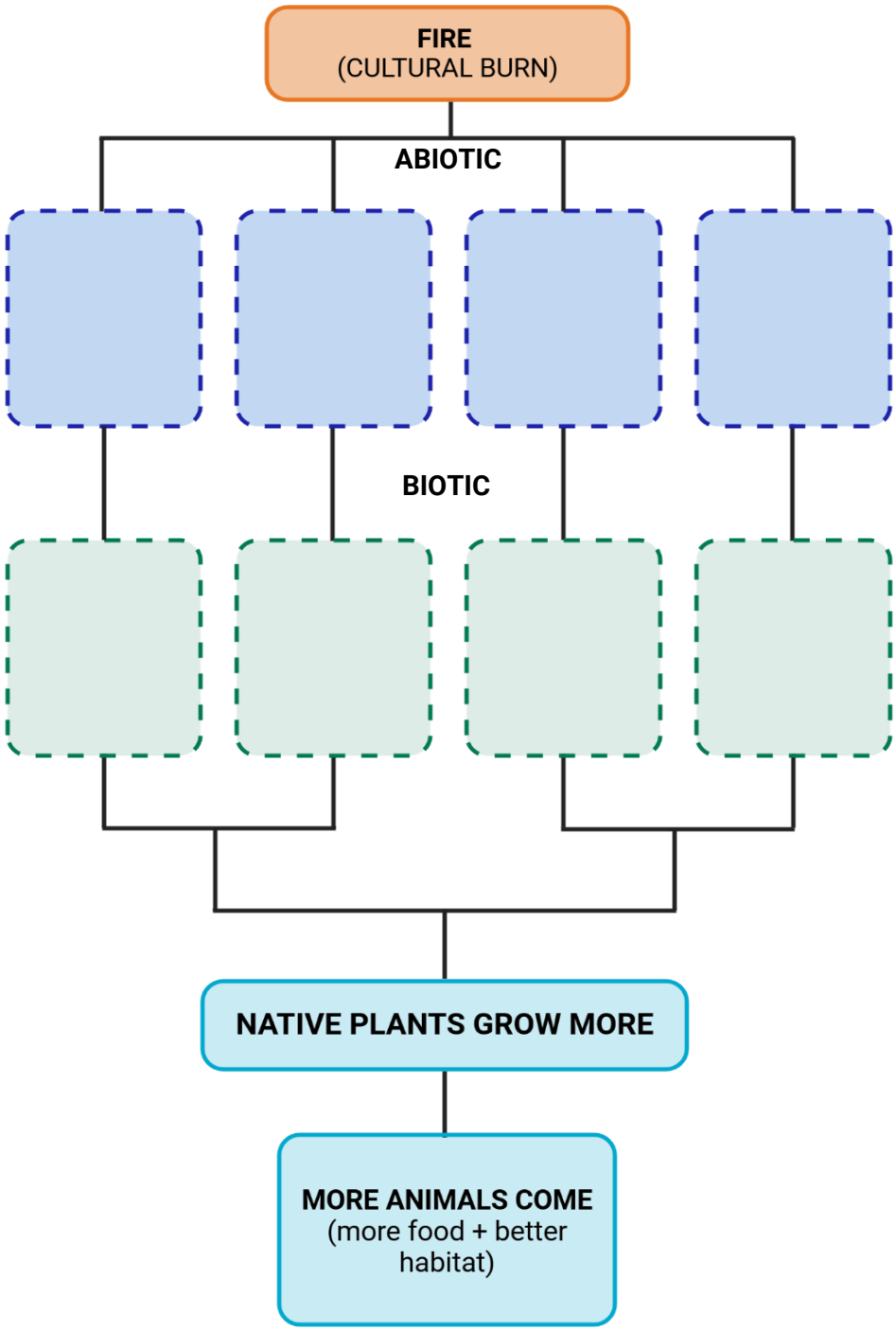
Abiotic and biotic factors interactions after a cultural burn - flow diagram

TEACHER COMPLETED VERSION - Answers



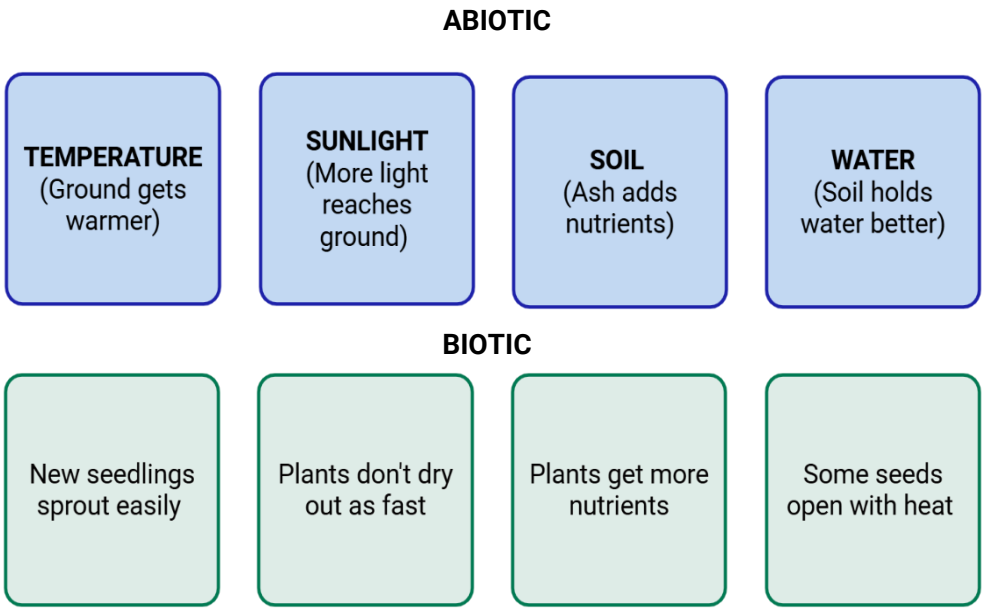
Student worksheet: Fire as a tool for ecosystem health

Cut out the abiotic and biotic cards and place them on the flow diagram based on how they interact after a cultural burn.



Abiotic and biotic factor cards

Cut out the abiotic and biotic cards and place them on the flow diagram based on how they interact after a cultural burn.



Activity 3 - Cultural Burning case study

Learning intention

- Understand that Cultural Burning comes from a place of deep understanding and scientific thinking.
- Acknowledge that Cultural Burning is a contemporary scientific land management practice.

Success criteria

- Can give an example of Cultural Burning as a contemporary ecological tool.
- Can explain how observations of Cultural burns are used by Traditional Owners and scientists to increase knowledge and understanding of ecosystems.

Resources

- *Case study printouts*
- *Case study reflection questions*

Classroom activity: Jigsaw

This activity is a collaborative learning strategy that provides an opportunity for students to become experts on a topic and share new knowledges with the class.

1. Divide students into groups of 3.
2. Assign one case study to each student.
3. Give students time to read over their case study at least twice and become familiar with it.
4. Form temporary "expert groups" - each expert joins other students assigned to the same case study. They will:
    - Discuss the main points of their segment, and
    - Prepare their notes (printable below) to take to their jigsaw group.
5. Bring the students back into their jigsaw groups.
6. Each student presents their segment to the group.
7. At the end of the session, reflect or give a quiz on the material.

Reflection questions

- What is the purpose of Cultural Burning in these case studies?
  (Reduce overgrowth, protect important species, maintain connection to Country and help Byron Bay orchid grow and flower again)
- Why is Cultural Burning different from bushfires?
  (Think about fire timing, intensity, purpose)
- What does the case studies tell us about the importance of Indigenous Knowledge?
- How is cultural knowledge a vital part of Australian conservation?
- Were there any ideas or concepts you hadn't considered before?

Formative assessment opportunity

Thinking routine: I used to think… Now I think

Think about what you have learned about the topic we have been studying and complete the following sentence stems:

- I used to think
- Now I think

Case study 1: Burning for the endangered Byron Bay Orchid

Three practical ways to support Indigenous landscape burning in Australia

Published by Kate Cranney February 2020

Figure 3. Byron Bay Orchid (Byron Bay, New South Wales)

There's a unique yellow orchid growing outside of Byron Bay in New South Wales. It's growing in Arakwal National Park, an area jointly managed by the Bundjalung people of Byron Bay (Arakwal).

The Byron Bay orchid and the heath are significant for Arkawal people. But the flower and its clay heath habitat are in trouble: they're both listed as Endangered under New South Wales environmental law. The heath is threatened by wildfires, weeds, feral animals, urban development and being trampled by the thousands of people who visit this tourist hot spot. The clay heath needs fire to survive, many of the plants in Arakwal National Park require fire to stimulate seed release, new growth, and complete their life cycle.

CSIRO worked with Traditional Owners and Park managers at Arakwal National Park. Researchers Cathy Robinson and Josie Carwardine co-developed guidelines on effective cross-cultural conservation planning for significant species, such as the orchid and heath.

This included developing cross-cultural decision-support science to enable Arakwal joint managers to undertake a cultural burn to restore the health of clay heaths which had not been burnt for over 30 years. This effort was supported by the NESP (National Environmental Science Program) threatened species hub and included the development of a seasonal planning calendar to guide and evaluate actions. This has attracted great interest from Indigenous co-managers around the world. (Cranney, 2020)

Case study 2: Protocols for non-Indigenous partners to support Indigenous landscape burning

These six key protocols for Indigenous fire management partnerships were developed in partnership with CSIRO, the Northern National Environmental Science Program (NESP) hub and Indigenous and non-Indigenous collaborators to ensure that non-Indigenous partners share knowledge appropriately:

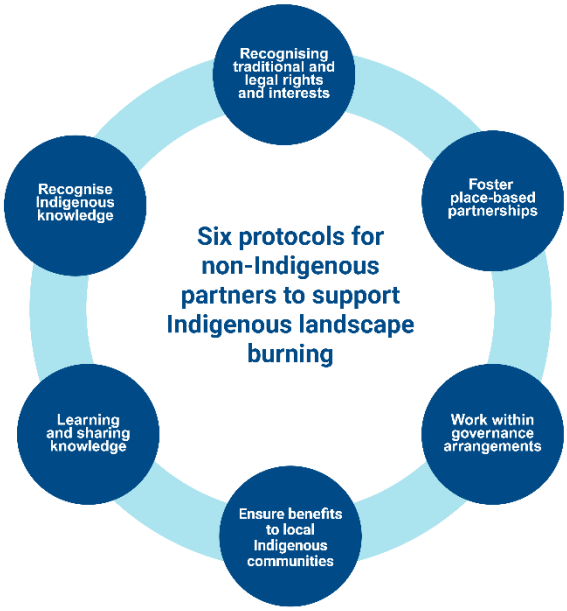


Figure 4. Diagram: Protocols for non-Indigenous partners to support Indigenous landscape burning.

1. **Recognising traditional and legal rights and interests.** Indigenous fire management projects and enterprise can be rekindled predominantly on the lands for which the project owners have some customary responsibility and often other legal rights.
2. **Recognise Indigenous knowledge.** Fire management partnerships must recognise and support Indigenous fire knowledge and fire management as part of local Indigenous governance systems.
3. **Learning and sharing knowledge.** Pursue the best methods for learning, sharing and passing on fire knowledge. Although other tools are needed to manage large areas, walking the Country together is the best way to learn about Indigenous fire knowledge
4. **Foster place-based partnerships.** Place-based partnership approaches are needed to design and deliver Indigenous fire management programs across Australia.
5. **Work within governance arrangements.** Partnerships that are established to support Indigenous fire knowledge and management activities need to work within contemporary institutional and governance arrangements.
6. **Ensure benefits to local Indigenous communities.** Indigenous fire management programs and partnerships can and should deliver environmental, social, cultural and economic benefits for local Indigenous communities. (Robinson, Barber, Hill, Gerrard, & James, 2016)

Case study 3: Ngadju kala: fire management in the Great Western Woodlands

Published in TERN newsletter January 2014

CSIRO partnered with Ngadju Conservation and other collaborators to produce a fire management report that challenges common beliefs about Aboriginal and Torres Strait Islander burning practices in Australia. Ngadju covers a large part of the Great Western Woodlands, the largest remaining area of intact Mediterranean-climate woodland on Earth. The area is globally unique in that nowhere else do tall woodlands occur at as little as 250 mm annual rainfall, making fire management in the region important and challenging.

Figure 5. Great Western Woodlands landscape

Contrary to the common assumption that Aboriginal burning was widespread and frequent, the Ngadju community from South-Western Australia were highly selective in where they burnt their country.

Some key findings are:

- The extensive old growth woodlands were rarely burnt deliberately, because they take hundreds of years to recover.
- The extensive sandplain shrublands were only occasionally burnt with planned fire. Mostly they burnt naturally by wildfires that were allowed to take their course.
- Ngadju used small fires as a cultural tool:
    - For keeping the Country clear around rock holes.
    - For encouraging grasses in open grasslands and mallee to grow.
    - To smoke out animals when hunting.
    - To protect important cultural sites and special plants such as water trees.
    - To maintain access along walking tracks and in coastal shrublands.
- Other activities such as firewood collecting around the edges of woodlands and rock holes, and sweeping and scraping up litter around individual trees, were undertaken to help control wildfire.

Ultimately these activities have led to a patchy area where Cultural Burning has been performed at different times and intensities also known as a fine-scale fire mosaic.

Another significant outcome of the report is that the documented knowledge will enhance Ngadju opportunities to be connected to and to work on Country, informing the ecological management of the Great Western Woodlands. (TERN News, 2014)

Case study worksheet: Cultural Burning

Case study group experts

Case study:	
Community involved:	
Location of study:	
Ecosystem type:	
Three ecosystem factors affected by cultural burns and how fire impacts them:	**1.**
	2.
	3.

Ecosystem factor	**Effect of fire**

Why is this research relevant?

Anything else that is interesting?

Case study reflection

1. What is the purpose of Cultural Burning in these case studies?	
2. Why is Cultural Burning different from bushfires?	
3. What does the case studies tell us about the importance of Indigenous knowledge?	
4. How is cultural knowledge a vital part of Australian conservation?	
5. Were there any ideas or concepts you hadn't considered before?	

Take it Further

Additional research activities

This could involve the students talking to local community members and using secondary sources including books and the internet.

- Research how fuel load changes through controlled burning.
- Research the different effects of low intensity and high intensity fires on ecosystems.
- Research how Cultural Burning has changed ecosystems.
- Research how Cultural Burning contributes to nutrient cycling in an ecosystem.

Local Indigenous knowledge

The above activities ideally start with Cultural Knowledge taught by a local Indigenous person. Schools and Indigenous community members should take the time to learn from each other and plan activities together. Learning on Country and the local Indigenous language should be used whenever possible in the learning program. When connecting in with a Knowledge Holder, it is important to listen actively to what they say and convey respect and value for their knowledge systems and traditions.

Knowledge Holder links

- Find Indigenous organisations such as Indigenous Ranger programs or cultural land management organisations that use fire to manage Country. Ask local Knowledge Holders if they will share their knowledge of fire with students.
- When do local cultural burns take place?
- What are the seasonal conditions that indicate when Country is ready to burn?
- How is fire used to benefit productivity? i.e. food for people and animals?

Assessment

Evidence that can assist teachers in making professional judgements about a student's progress and achievement of curriculum outcomes can be gathered in a variety of ways during the unit including:

- Teacher/student discussions.
- Observing student participation in the inquiries.
- Gathering student work samples including oral, written, and multimedia.
- Assessing students' application and use of knowledge and skills.
- Strategic questioning.

In the activities, students may be assessed on their ability to:

- Identify questions and problems that can be scientifically investigated.
- Plan and conduct safe investigations.
- Identify variables to be changed, controlled, and measured.
- Collect and record data, including appropriate use of digital technologies.
- Analyse data and information.
- Identify relationships and draw conclusions.
- Apply scientific understanding.

References

Cranney, K. (2020, February 25). *Three practical ways to support Indigenous landscape burning in Australia*. Retrieved from CSIRO: https://www.csiro.au/en/news/All/Articles/2020/February/three-practical-ways-to-support-indigenous-landscape-burning-in-australia

Robinson, C., Barber, M., Hill, R., Gerrard, E., & James, G. (2016). *Protocols for Indigenous fire management partnerships.* Brisbane: CSIRO.

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