Connecting Indigenous
Knowledges to the classroom

Experiment Procedure and Planner

Fire-starting topic

Fire by friction

Student activities



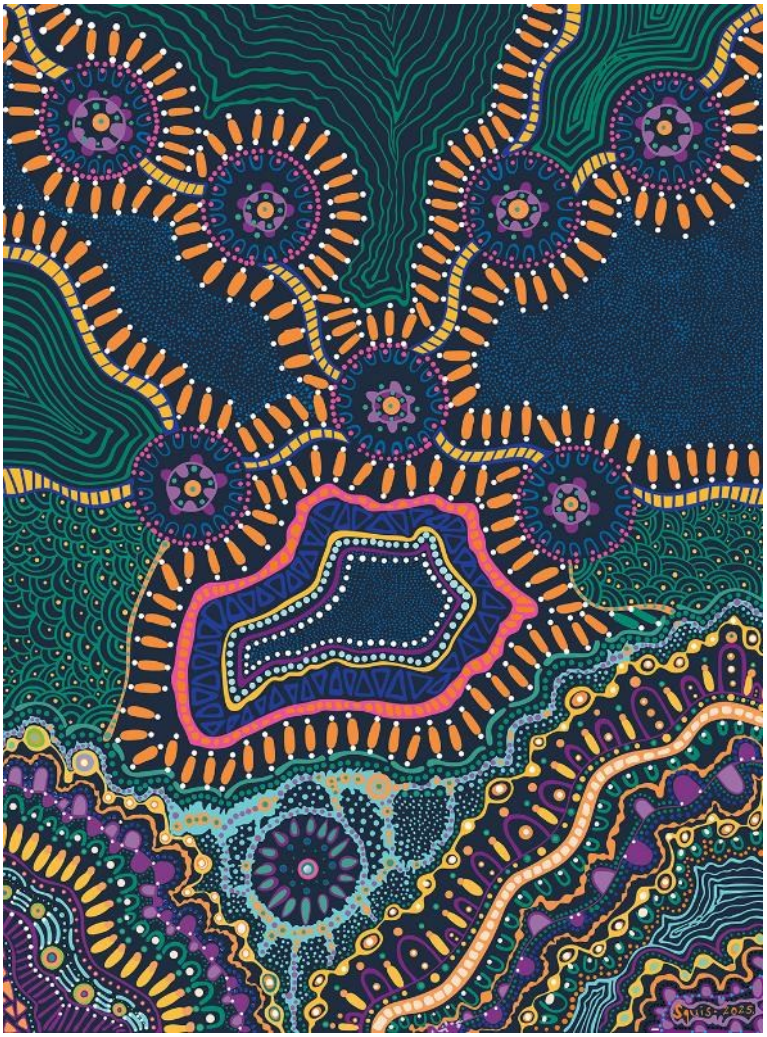
Acknowledgement of Country

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

Contents 3

Introduction 4

Experiment procedure 6

Which method produces visible smoke faster: the hand drill or the fire saw? 6

Experiment planner 9

Fire-starting – Fire by friction 9

Safety precautions 11

Observations and results 12

Introduction

In this experiment, you will learn how Aboriginal and/or Torres Strait Islander Peoples traditionally started fires and how this shows energy changing from one form to another. For thousands of years, fire has been very important to Aboriginal and Torres Strait Islander cultures. Fire connects people to Country, culture, and community. It is used in ceremonies and traditions and helps to care for the land through cultural burning practices. Fire has also been used in everyday life for cooking food, keeping warm, hunting, and smoke signalling.

Traditional fire-starting uses knowledge of the environment, and of how to transform movement energy into heat energy using friction. People choose the right dry materials, such as wood and tinder to help start a fire. When these materials are rubbed together, friction and force change movement energy (kinetic energy) into heat energy. This heat can start a fire. Common tinder includes dry grass, leaves, bark, coconut fibre, and dried animal dung.

This experiment focuses on two common traditional fire-starting methods: the hand drill and the fire saw. You will test which method is easier to use. As you work through these experiments, consider:

- Why are there different fire-starting methods?
- What is common between the two methods?
- What are the basic materials to start a fire?
- Where does the heat come from?
- Why does the wood need to be dry?

Safety note: This experiment involves fire, sawdust and an electric drill.

Hand drill

The hand drill is a traditional fire-starting method used across Australia and the Torres Strait Islands. It works by spinning a straight wooden stick known as the 'drill stick' between the hands in a small hole in a flat piece of wood called a 'hearth board'.

When the stick is spun, movement (kinetic) energy from your hands is transferred into the wood. The friction between the drill stick and the hearth board changes this kinetic energy into heat energy. As the heat builds up, fine wood dust becomes very hot and forms a small glowing ember. This ember can then be placed onto tinder to start a fire.

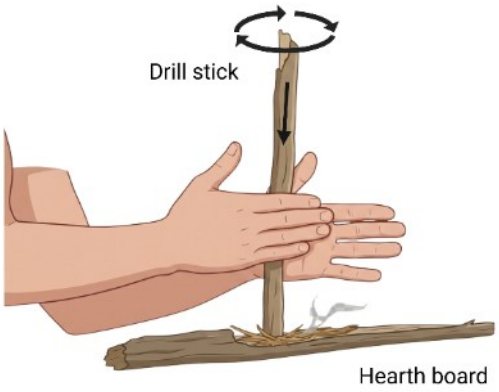


Figure 1 Hand drill method

Different types of wood help this energy transfer work well. A harder wood is used for the drill stick, and a softer wood is used for the hearth board, so enough friction is created. The wood must be dry and not rotten, otherwise energy will be lost, and not enough heat will be produced. The drill stick needs to be straight, usually about 30–70 cm long and around 1 cm in diameter.

Fire saw

The fire saw is another traditional fire-starting method used by Aboriginal and Torres Strait Islander Peoples, especially in central Australia, north-western coastal areas, and parts of Victoria.

This method works by rubbing the sharp edge of a hard piece of wood known as a 'saw stick' back and forth across a softer wooden base known as a 'hearth stick' that sits over tinder. The movement energy (kinetic energy) from the hands is transferred into the wood. Friction changes this kinetic energy into heat energy. As the wood heats up, fine wood dust begins to smoulder, which can then light the tinder.



Figure 2 Fire saw method

The fire saw is efficient and does not need much preparation. It can be used by one or two people. One advantage of this method is that it is very practical. Everyday wooden tools, such as spear throwers, boomerangs, and wooden dishes, could also be used as fire saws. This shows how energy and resources were used efficiently, without needing extra tools, to start a fire.

Experiment procedure

Which method produces visible smoke faster: the hand drill or the fire saw?

PART A – Hand drill

Equipment

For each group:

- Base plate (dressed pine)
- Drill stick (*Eucalyptus grandis* – flooded gum (dowel))
- Hearth board (Tasmanian Oak)
- 2 x 80 mm metal bolts and wing nuts (for attaching hearth board to base plate)
- G-clamp
- Safety glasses
- Timer (stopwatch)

Safety

- Do not touch the materials, as they could be hot. The heat produced can cause burns.
- Wear safety glasses. Sawdust could fly into your eyes.
- Keep your working area clean. Flammable materials can catch on fire.
- Have a fire blanket, fire extinguisher or fire bucket on hand.

Equipment set-up



Figure 3 Set-up for hand drill experiment

Method

1. Secure the hearth board to the base plate using the bolt and wing nuts, ensuring it is firmly fastened.
2. Use the G-clamp to attach the base plate to a workbench. Position the base plate so that the hearth board is close to the edge of the bench. Tighten the clamp securely to hold the hearth board

and base plate steady. It should not move.

3. Position the drill stick vertically in the notch of the hearth board.
4. Have the timer ready to start at the beginning of step 5.
5. Place both hands at the top of the stick and use a quick back-and-forth motion, moving the hands down the stick while exerting downward pressure on stick.
6. When the hands reach the bottom of the stick, reposition them to the top and continue spinning (or change operators if there are two people).
7. Continue using the hand drill until you observe clear signs of ignition such as visible smoke or a distinct burning smell. Stop the timer when you notice this. The wood may have started to darken or char.
8. Record observations and timing Part A of the Experiment planner.
9. Repeat steps 3–8 at least two more times, making sure to make observations as you go.

PART B – Fire saw

Equipment

For each group:

- Base plate (dressed pine)
- Hearth stick (Tasmanian Oak)
- 2 x 80 mm metal bolts and wing nuts (for attaching hearth stick to base plate)
- Saw stick (*Eucalyptus grandis* – flooded gum)
- G-clamp
- 2 pairs of gloves (gardening type)
- Safety glasses
- Timer (stopwatch)

Safety

- Do not touch the materials, as they could be hot. The heat produced can cause burns.
- Wear safety glasses. Sawdust could fly into your eyes.
- Keep your working area clean. Flammable materials can catch on fire.
- Have fire blanket, fire extinguisher or fire bucket on hand.

Equipment set-up



Figure 4 Set-up for fire saw experiment

Method

1. Secure the hearth stick to the base plate using the bolt and wing nuts, ensuring it is firmly fastened.
2. Use the G-clamp to attach the base plate to a workbench. Position it so that the hearth stick is close to the edge of the bench. Tighten the clamp securely to hold the hearth stick and base plate steady. It should not move.
3. Position the saw stick across the top of the hearth stick.

4. Get timer ready to start when completing step 5.
5. Wearing gloves, place one hand on each end of the stick (or one person on each side if there are two operators) and use a back and forward sawing motion, exerting some downward pressure on stick. Start slowly and increase pace and pressure. This creates a groove in the hearth where the dust will collect and heat up.
6. Continue using the fire saw until you observe clear signs of ignition such as visible smoke or a distinct burning smell. Stop the timer when you notice this. The wood may have started to darken or char.
7. Record observations and timing in Part B of the Experiment planner.
8. Repeat steps 3–7 at least two more times.

Analyse the results

Use your data and observations to determine which fire-starting method was more efficient in producing smoke. Record your analysis in the Experiment planner.

Reflect

Write a conclusion based on the experimental results, reflecting upon whether your hypothesis was validated. Conclusions are recorded in the Experiment planner.

Experiment planner

Fire-starting – Fire by friction

Student name:	
Partner's name/s:	

1. Experiment question. I am trying to find out...

2. Hypothesis. I think the most effective method will be…

3. All the things that could affect this experiment are:

Type of wood used for drill stick, saw, hearth boards

Amount of moisture in the wood

Speed of twirling the drill stick

Force of twirling the drill stick

Speed of sawing

Type of tinder

Number of people working

Weather

4. The one thing (independent variable) I will change is…

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5. I will measure (dependent variable):

Time it takes to produce smoke

How much effort is needed to produce smoke

The temperature of the sawdust

I will make my measurements using:

---

6. The variables I will keep the same (control):

Use dry wood

Same wood for drill stick and saw stick

Same tinder

Same number of operators

Work in a sheltered area

Safety precautions

Add any additional safety precautions

What are the risks in doing this activity?	How can I manage the risks to stay safe?
Heat produced could cause burns.	• Do not touch material • Wear gardening gloves
Other materials could catch on fire.	• Removal all flammable materials from the work area. • Have fire bucket, fire blanket or fire extinguisher on hand
Using the drill stick could cause splinters and/or blisters.	• Wear gardening gloves
Bit of sawdust or ember could fly into the eye.	• Wear safety glasses
	•
	•
	•

Observations and results

Part A – Hand drill

Draw a labelled diagram of the hand drill experiment set up:

Describe your observations:

Record your results:

Part B – Fire saw

Draw a labelled diagram of the hand drill experiment set up:

Describe your observations:

Record your results:

Reflections and conclusions

1. How did the results compare to what you predicted? Do the results support your hypothesis? Why/why not?
•
2. Which method did you find to produce visible smoke faster? Why?
•
3. Was this a fair test? Why/why not?
•

4. Do you think the experiment question was fair and clear? Why/why not?
•
5. What could be changed to improve the experiment?
•
6. What forms of energy were used in the fire-making process?
•

7. Describe one energy transfer and one energy transformation which occurred in the fire making process:

-

8. Draw an energy chain for one of the fire-making methods:

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