Connecting Indigenous
Knowledges to the classroom

Indigenous STEM Education Resources

Traditional cooking methods

Physical 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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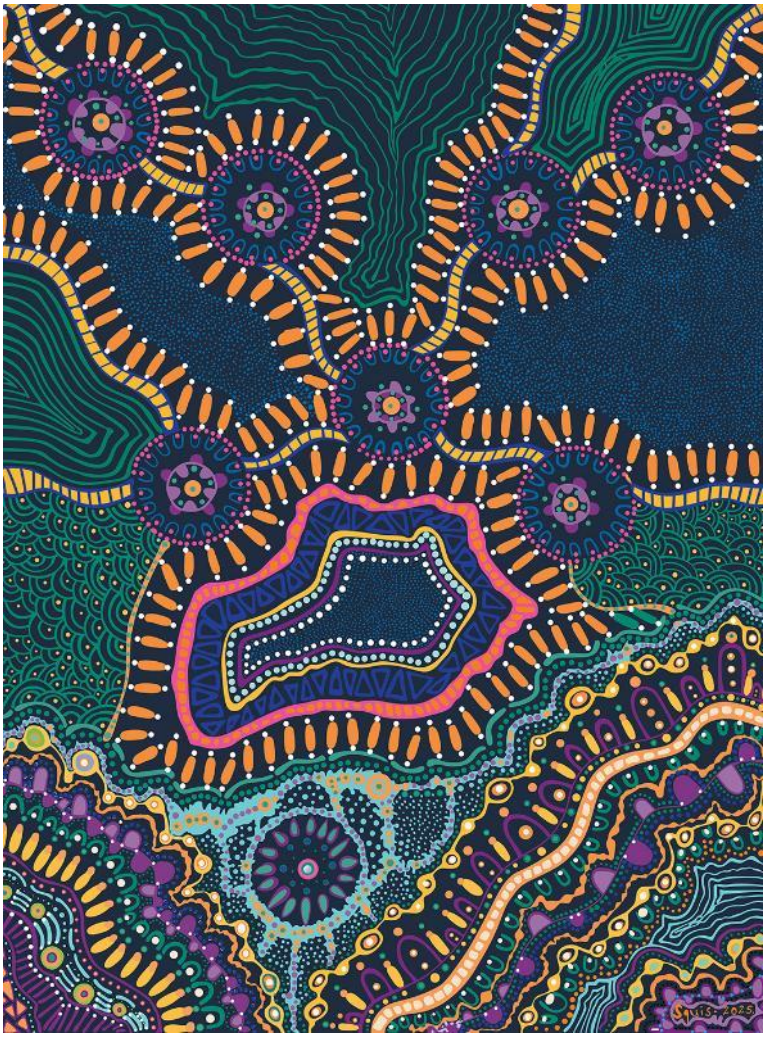
Aunty Sandra Angus is an acknowledged Elder and well respected Aboriginal leader in her community. She proudly identifies as an Australian 'Saltwater Murri' with ancestral roots that extend to the Wiradjuri and Wongaibon people in NSW, the Ngarrindjeri people in SA and the Gunggari and Jaggera people 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.
Ash	Is a soft powdery material left behind after something has been burned. In this context, ash is from the wood in the fire becoming burned, giving a grey, black or white appearance.
Boil	To heat a liquid until it bubbles and turns into steam
Change of state	The change of a substance from one physical state of matter (solid, liquid, gas) to another.
Condensation	The process where water vapour becomes liquid water
Country	The regional lands, waterways 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.
Custodian	A custodian is a Traditional Owner of the land and waters who carries the responsibility for caring for and looking after Country.
Energy	The ability to make things happen or cause change. Energy comes in many forms, including heat, light, sound, electrical, kinetic and potential, or stored energy such as gravitational, chemical and elastic potential energy.
Evaporation	The transfer of water from the surface of Earth to the atmosphere; heat energy from the sun causes liquid water to turn into water vapour and to rise up through the atmosphere
Flammable	Can catch fire easily.

Freeze	To make a liquid very cold until it turns into a solid
Freezing point	Is the temperature at which liquid changes into a solid
Gas	A state of matter that spreads out to fill any space or container. The particles move freely and are far apart
Ignite	To catch fire.
Liquid	A state of matter that can flow and take the shape of its container but still keeps the same amount.
Matter	A physical substance; anything that has mass and occupies space.
Melting	When a solid changes into a liquid because of heat
Moisture	Is the water that is in or on an object that makes it not dry.
Oven	A way of cooking food using heat
Properties	Attributes of an object or material, normally used to describe attributes common to a group
Roasting	Cooking food using dry heat, usually in an oven or fire
Solid	A state of matter that keeps its own shape and size. The particles are packed closely together.
Steam	The hot gas made when water is heated and changes from a liquid to a gas.
Temperature	The degree of heat present.
Texture	The way an object feels and appears. Examples: soft, hard, rough, smooth
Traditional Owner	An Aboriginal or Torres Strait Islander person who is recognised by their community as having ownership and knowledge of a particular area or Country.

Activity 1 – States of matter chalk talk

Lesson objectives

- Students will identify and describe the three main stages of matter (solid, liquid and gas).

Success criteria

- Can describe each state (solid, liquid, gas).
- Can give examples of each state of matter.

Equipment

- Three sheets of poster.
- Markers for writing at each station, minimum 15 markers.

Activity:

1. Write the prompts 'Solid', 'Liquid', and 'Gas' in the centre of the sheets of poster paper, so that each state of matter has its own sheet (you may wish to do two of each for large classes).
2. Prompt students to consider what they already know about each state of matter, what are some examples, how do they behave, what are some interesting facts they know.
3. Place the sheets on desks in clear spaces around the room.
4. Give students 5 - 10 minute to walk silently around the room and add their ideas and understandings to the sheets. Encourage them to add on to or give ticks or smiley faces to ideas they already knew or can add to.
5. Ask students to return to their seats.
6. Facilitate reflection discussion.

Reflection:

Collect sheets and facilitate discussion about the three main states of matter.

- What do we know about solids, liquids, gases?
- How do they behave?
- What are some examples you know?

Activity 2 – Being the states of matter

Lesson objectives

- Students will use the particle model to describe the three main stages of matter (solid, liquid and gas).

Success criteria

- Can use the particle model appropriately to describe the characteristics and motion of the three main states of matter.

Activity:

1. Explain to students that they each represent a particle of water.
2. Ask students to walk to a clear space in the room.
3. Ask students to stand closely packed together, so they are just touching the people in front, behind and beside them. Then instruct them to vibrate. The class is now a solid ice block.
4. Tell the class you are warming them up, so that the ice block begins to melt.
5. Ask students to move slightly apart but still touching some of the people around them. Instruct them to move slowly past each other, but without breaking away from the group. They are now liquid water.
6. Tell the class you are heating them further, so the liquid water begins to evaporate.
7. Ask students to move around the room in straight lines (if you're brave, have them try it while spinning). When they make contact with a wall, furniture or another person, they are to change direction. They are now a gas.
8. Alternate between cooling and heating the class, asking them to become solid, liquid and gas and switching between the three main states of matter with the addition or removal of heat.

Tip: finish with the class as a solid for a smoother transition back to seated.

Reflection:

- Facilitate discussion about changes in state.
- How did the movement of particles change as they were heated and cooled?
- How does this help us understand states of matter and their changes?

Activity 3 – Change in states: water

Lesson objectives

- Students will identify and describe the three main stages of matter (solid, liquid and gas) using water as an example.
- Students will observation and explain how water changes between states as energy is added or removed.
- Students will record their observations and connect them to scientific terms of evaporation, condensation, melting and freezing.

Success criteria

- Can describe each state (solid, liquid, gas).
- Can explain how energy added or removed affects state change.
- Students record observations in the activity planner.

Equipment

- Ice cubes
- Clear bowls or cups
- Spoons
- Tongs
- Kettle (teacher use only)
- Extra-large Ziplock bag
- Glass
- Heat proof gloves or oven mits

Per student:

- Activity 1 - Student worksheet and pen.

Safety

- Do not touch hot materials (kettle, hot water, etc.) as they may cause burns.
- Keep a safe distance from steam during boiling and condensation demonstrations.
- Make sure students do not put ice directly in their mouths. Use tongs to handle ice if needed.
- Teacher only to operate kettle and handle hot water.
- Wear safety glasses during boiling and condensation activities.
- Handle ice carefully and avoid prolonged skin contact.
- Keep work areas clean and dry to prevent slips.

Activity Stations:

Note: Ideally, set up multiple copies of each station around the classroom so students can begin at Station 1 and rotate through the activities in the correct order.

Station 1: Solid

Each student observes an ice cube. They observe and describe its shape, texture, and temperature.

Station 2: Liquid

Students place the ice cube in a clear bowl/cup and observe it melt. They can record how long it takes and what they notice about the water.

Station 3: Gas

Teacher uses a kettle to heat the water. Students observed and record what they see - the bubbles and steam forming (evaporation).

Station 4: Condensation

Teacher puts hot water into a glass cup and place it into a large clear plastic bag and seals it. Students observe the bag as water droplets form inside. They record their observations.

Station 5: Freezing

Students reflect in their worksheet about the cooling/freezing process.

Reflection and Discussion:

- After the stations, bring the class together. Discuss the whole cycle (solid → liquid → gas → liquid → solid) and how energy affects these changes.
- Draw the diagram as a class and get students to copy onto the worksheet.

Extension:

Connect the states of matter to the water cycle as a real-life example of these concepts and terminology:

- Ask students: How does the water cycle in nature relate to what you observed today?
- Get students to research the water cycle.
- Look at diagrams as a class and discussion how it relates to this activity.
- Create the water cycle in a Ziplock bag as a class activity.

Water in a Ziplock bag activity:

When the bag is taped to a sunny window, heat from the sun warms the coloured water at the bottom of the bag. Some of the liquid water changes state into an invisible gas (water vapour). As the water vapour rises and touches the cooler sides of the bag, it loses heat and changes back into liquid water droplets (condensation). When enough droplets join, gravity causes them to fall back down the bag, like rainfall in the natural water cycle.

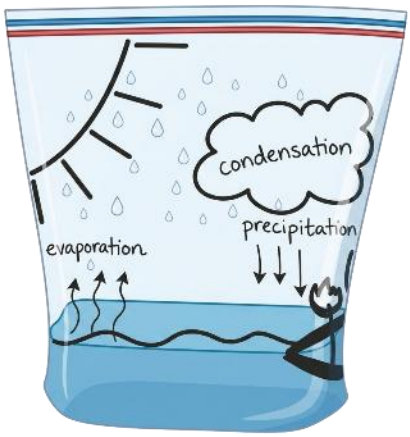


Figure 1 Diagram of the activity set up

Materials

- Ziplock bag
- Water
- Blue food colouring (optional)
- Permanent marker
- Tape.

Simple procedure:

1. Draw the sun, clouds and labels for the water cycle on the Ziplock bag.
2. Add a small amount of coloured water to the bottom of the bag.
3. Seal the bag tightly.
4. Tape the bag to a sunny window.
5. Observe the bag over several hours or days.
6. Record any changes that occur inside the bag.

Students observe:

- Evaporation: liquid water heats up and changes into water vapour.
- Condensation: water vapour cools and forms droplets on the inside of the bag.
- Precipitation: the droplets grow larger and run down the bag like rain.
- Collection: water gathers again at the bottom of the bag.

Classroom activity 3 - worksheet

In groups you will go through each station.

Station 1: Solid	
Observe the ice: Describe its shape, texture and temperature.	•

Station 2: Liquid	
What is causing the ice to melt?	•

Station 3: Gas	
Record observations	•

What is happening to the water particles as it boils?	•
Why does it turn into a gas?	•

Station 4: Condensation	
Record your observations	•
What process is happening inside the bag?	•
Why does water droplets form on the inside?	•

Station 5: Freezing	
If we put the water droplets from the bag into the freezer, what would happen?	•
Why is this the reverse of melting?	•

Reflection:

Draw and label a diagram showing how water changes through the different states of matter. Include the processes of melting, evaporation, condensation, and freezing using arrows and labels.

Activity 4 – Liquid to solid: making ice cream

Lesson objectives

- Observe and recognise changing states
- Identify how cooling (ice) removes heat energy from a substance (cream)
- Explain how salt helps ice become cooler by lowers the freezing point
- Use practical investigations and observations to explore changes in states of matter
- Employ safe work practices and manage risks using work health and safety (WHS) practices.
- Assemble and use appropriate equipment and resources to perform an investigation.

Success criteria

- Students accurately observe the change of state from a liquid to a solid and can explain the change in state that is occurring.
- Can explain the role of salt in lowering the freezing point of ice.

Equipment

One per group or class:

- Small resealable plastic bag (approx. 1L)
- Large resealable plastic bag (approx. 4L)
- ½ cup thickened cream or pouring cream
- 1 tablespoon vanilla extract
- 3 cups of ice
- ½ rock salt
- Towel or gloves to protect hands from the cold
- Measuring cups
- Measuring spoons
- Spoons for eating ice cream (per student).

Activity

1. Use measuring spoons and cups to carefully measure ½ cup thickened cream, 1 tablespoon sugar, ½ teaspoon vanilla extract.
2. Pour all ingredients into the small resealable bag (1 L capacity). Seal the bag tightly, removing as much air as possible. Check for leaks by squeezing the bag to see if any liquid comes out.

3. Use measuring cup to measure out 3 cups of ice and ½ cup rock salt and place both into the large resealable bag (4 L capacity).
4. Place the sealed small bag (cream mixture) inside the large bag with the ice and salt. Seal the large bag securely.

Figure 2 Illustration of step 4.

5. Wrap the bag in a towel or use gloves to protect your hands from the extreme cold.
6. Shake the bag continuously for 5–10 minutes. Students should take turns shaking if working in groups or as a class.
7. After 10 minutes, open the large bad and remove the small bag. The liquid cream should gradually change into a soft solid (ice cream).
8. Wipe the small bag dry and open carefully.
9. Observe texture, temperature, and appearance before eating (if allowed).

Reflection

- What change of state did you observe during the investigation?
- How did the cream change from a liquid into a solid?
- What role did the ice and salt play in the freezing process?
- How was heat energy transferred during the activity?
- Why did the bag become very cold while shaking the mixture?
- What would happen if we did not add salt to the ice? Why?

Activity 5 – Identifying states: tea demonstration

Lesson objectives

- Observe and identify states of matter.
- Identify how heating changes liquids into gases.
- Explore how plant oils and compounds move from solid (leaf) into liquid (water) via infusion.
- Use sensory observations (smell, sight) to describe changes.
- Follow safe handling practices (WHS) when handling hot liquids.

Success criteria

- Students accurately identify solid, liquid and gas from the demonstration.
- Can explain how heat causes flavour to move from the leaves into the water and creates aromatic vapours.
- Students can describe observations using scientific language.

Equipment

As a class:

- Native plant leaves: find local to your region
  - Lemon myrtle (QLD)
  - Native mint (SA)
  - Kinesia (VIC)
  - Gumbi gumbi (WA)
  - River mint (NSW)
  - Native sage bush (TAS).
- Kettle or hot water source
- Heat-safe cups or glass (Optional: additional cups for drinking)
- Metal spoon
- Bowl (optional for vapour demonstration)
- Optional: Sieve for straining leaves and ladle to scoop tea in cups for drinking.

Note: after completing this activity, we encourage you to plant the native plant in your school's garden.

Activity (teacher demonstration)

Part 1: Observe the leaves (solid)

1. Hold up the leaves, show the class. Pass some around so students can observe.
2. Ask students to describe what they see, smell and feel:
   - Texture (dry, crumbly, firm, bendy, rough, smooth).

- Shape and colour.
- Smell: sweet, strong, weak.

3. Ask the students what makes the leaf a solid? (it holds it shape and does not flow).

Part 2: Heat water (liquid)

4. Place the leaves into the glass cup or bowl
5. Slowly pour hot water over the leaves
6. Allow it to steep for 2-3 minutes
7. Ask students to observe:
    - Colour change of the water.
    - Leaves becoming softer (can mix the leaves to show how it is soft).
    - Smell becoming stronger (carefully waft water vapour towards nose).
    - Is the leaf still a solid? (yes) but it is releasing particles into the liquid water, making it a tea.

Part 3: Observe the gas

8. Direct students' attention to the steam rising from the cup
9. Demonstrate wafting the aroma towards your nose
10. Optional: get students to safely waft aroma towards their nose.
11. Ask students:
    - What can you see rising? (steam).
    - What is causing the steam to rise? (heat, causing particles to spread into the air).

Figure 3 Illustration of leaves steeping

Optional: Part 4: Taste the tea

12. Once tea has cooled to safe drinking temperature, safely pour water and leave mixture through a sieve into another bowl.
13. Once leaves are removed, use the ladle to pour into smaller cups for students to try (If allowed).
14. Get students to describe the taste.

Reflection

- What state of matter is the leaf? (solid, it keeps it shape).
- What changed when we added water?
- What state of matter is the water/tea? (liquid, it flowers and changes shape to the container it is in).
- Where did the smell come from?
- What state of matter is the aroma you smell? (gas, spreads through the air).
- Do you think cold water would've produced the same strength of aroma?

Activity 6 – Liquid to gas: cooking damper over hot coals

Lesson objectives

- Observe and recognise changing states of matter during cooking.
- Identify how heating causes water in dough to change from a liquid into a gas (steam).
- Explain how steam helps cook damper from the inside.
- Use practical investigations and observations to explore changes in states of matter.
- Employ safe work practices and manage risks using work health and safety (WHS) practices.
- Assemble and use appropriate equipment and resources to perform an activity.

Success criteria

- Students accurately observe the change of state from a liquid water to water vapour (steam) during cooking.
- Students can explain how heat changes water inside the dough to steam.
- Students can identify how wrapping the damper helps keep heat and moisture inside.

Equipment

Per class (24 students):

- 16 cups self-raising flour (~2.4 Kgs)
- 6 cups water
- 4 teaspoons salt
- 8 large mixing bowls (1 per group of 3 students)
- 8 wooden spoons
- Aluminium foil - enough for 24 small damper rolls
- Campfire with hot coals
- Heatproof gloves or long-handled metal tongs
- Measuring cups
- Measuring spoons
- Baking tray or preparation surface
- Pencils and paper for recording observations
- Campfire (made by teacher).

Additional:

- Native herbs or seeds (optional) – 8 tablespoons
- Extra flour for dusting hands and surfaces
- Extra water for adjusting dough consistency if needed.

Important points to note:

- Check fire safety ratings in your area.
- This experiment involves fire. This can result in burns and smoke inhalation. Complete a hazard and risk assessment before conducting and have appropriate safety measures in place.
- It is recommended that this activity is performed on a camp where rangers and camp staff can help facilitate.

Activity

1. Prepare a safe campfire area with hot coals (teacher to do).
2. Use measuring cups and spoons to combine flour, salt and water in a large mixing bowl to form a dough. Add native herbs or seeds if desired.
3. Use hands to gently knead the dough until combined.
4. Divide and shape the dough into small damper rolls or one large damper.
5. Wrap each piece of dough tightly in aluminium foil.
6. Using metal tongs, place the wrapped damper near the hot coals or over the fire (teacher to do).

Figure 4 Damper placed around the fire

7. Observe the damper while it cooks. Students may notice steam escaping from the foil and changes in smell and appearance.
8. After cooking, carefully remove the damper using heatproof gloves or tongs (teacher to do).
9. Allow the damper to cool slightly before carefully opening the foil.
10. Cut open the damper and observe the texture, firmness, smell and appearance of the cooked dough.
11. Record observations about:
    - Texture
    - Firmness
    - Moisture
    - Smell
    - Appearance
    - Evidence of steam or evaporation.
12. Allow students to taste the damper (if allowed).

Reflection

- What change of state occurred during the activity?
- How did heat change the water inside the dough?
- What evidence showed that water changed into a gas?

- How did steam help cook the damper?
- Why was the damper wrapped in foil?
- What would happen if water was not added to the dough?

Adaptation:

Can use an oven to cook damper.

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