



Connecting Indigenous
Knowledges to the classroom

Indigenous STEM Education Resources

Traditional separation techniques
Chemical 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



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Glossary

Term	Definition
Aboriginal/ Torres Strait Islander	<p>The Aboriginal and 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.</p> <p>A person is considered Aboriginal and/or Torres Strait Islander if they:</p> <ul style="list-style-type: none"> • 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.
Atoms	The smallest particle of an element that can exist.
Cold-pressing	A method used to extract oils from plants by pressing them without heat.
Compounds	A pure substance made when two or more different elements are chemically bonded together.
Concentrated	A solution that has a large amount of solute dissolved in a smaller volume of solvent.
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.
Density	A measure of how tightly packed the particles in a substance are. Density is calculated by dividing the mass of the substance by its volume (measured as grams per centimetre cubed, or g/cm^3).
Dilute	A solution that has a small amount of solute dissolved in a large volume of solvent.

Dissolve	A substance (solute) mixes evenly into a liquid (solvent) to form a solution.
Distillation	A separation technique used to separate liquids based on their different boiling points.
Elements	One of a class of substances which consists entirely of atoms of the same atomic number, and which cannot be further divided by chemical methods.
Evaporation	The process by which a liquid, such as water, changes into a gas or vapour state, usually due to an increase in temperature.
Filtration	A separation technique used to separate an insoluble solid from a liquid.
Insoluble	A substance that is not capable of being dissolved.
Matter	Substance in the form of elements, compounds, or mixtures.
Mixtures	Made when two or more substances are combined but not chemically bonded.
Particle theory	The kinetic theory of matter that all matter consists of tiny indivisible particles that are constantly moving.
Pure substances	A material that is made of only one type of particle. There are two types of pure substances: elements and compounds.
Saturated	A chemical solution which contains the maximum amount of solute that can be dissolved in a solvent.
Sieving	A separation technique used to separate solid particles of different sizes.

Soluble	A substance that is capable of being dissolved.
Solution	A mixture made up of a solvent and a dissolved solute.
Solute	A substance that is dissolved by a solvent.
Solvent	A substance, especially a liquid, that can dissolve other substances.
Substance	Matter in the form of elements, compounds, or mixtures.
Winnowing	A traditional separation technique used to separate lighter materials from heavier ones using wind.
Yandying	A traditional separation technique that uses movement to separate materials of different masses using a shallow wooden dish called a yandy.

Activity 1 – Separating solid materials

Learning intention

- Identify different physical properties of substances.
- Understand how to separate mixtures using appropriate separation techniques.

Success criteria

- Can identify and describe the physical properties of each substance.
- Can predict which separation technique will be most effective based on those properties.

Safety

- Wear appropriate PPE (safety glasses, enclosed shoes, hair tied back etc.)

Equipment

For each student:

- Prepared page in workbook.

For each group:

- Sand
- Popcorn kernels
- Seeds/beads
- Small polystyrene balls
- Small metal nuts/washers/screws
- 6x bowls
- Magnet
- Forceps
- Sieve.

Adaptations

Use alternative mixtures relevant to student interest or their local environment, such as:

- Bush tucker mixes
- Lollies and sprinkles
- Riverway debris
- Ocean debris
- Emu feathers (can demonstrate winnowing technique by blowing lightly on the feathers placed on top of the mixture).

Activity

Ask students to examine the different substances that have been provided and record the properties of each one. Prompt them to

think about particle size, weight, and magnetism.

Substance	Properties
Sand	Very small, heavy
Popcorn kernels	Small, smooth, light
Seeds/beads	Small, round, (hole in centre)
Small polystyrene balls	Small, round, very light
Small metal nuts/washers/screws	Small, heavy, magnetic

1. Combine all the objects into one bowl and mix well.
2. Ask students to separate each substance from the bowl using their knowledge of each substance's properties. The suggested order, is as follows:
 - Washers/nuts/screws
 - Polystyrene balls
 - Sand
 - Popcorn kernels
 - Seeds/beads.

Reflection

- What separation techniques did you use (e.g. magnetic separation, sieving, handpicking, sorting using forceps)?
- How did particle size affect your ability to separate the substances?
- How did magnetism help in separating the mixture?
- Were any substances difficult to separate? Why?
- If two substances had very similar properties, what could you do differently?

Extension questions

- If water were added to the mixture, how might this change the way you separate the substances?
- Can you think of another property (besides size, weight, and magnetism) that could be used to separate this mixture.

Activity 2 – Water under the microscope

Learning intention

- Define what pure substances and mixtures are.
- Understand that water from natural environments contain dissolved and suspended particles.
- Understand how to use a microscope to observe particles not visible to the naked eye.

Success criteria

- Can define a pure substance and mixture.
- Can correctly prepare and observe a wet mount slide using a microscope.
- Can record scientific observations using labelled diagrams.

Equipment

For each student:

- Prepared page in workbook or *Student activity 2 worksheet: water under the microscope*

For each group:

- Pond water sample
- Stereoscopic microscope and petri dish or
- Light microscope with concave glass slide and cover slip
- Plastic pipette
- Petri dish/beaker

Safety

- Wear protective clothing and gloves when collecting and handling pond water sample.
- Do not drink the water sample.

Activity

1. Use your pipette to place a few drops of pond water onto your petri dish or one drop of pond water into your concave glass slide and cover with a cover slip.
2. View pond water under the microscope.

3. Record observations of what you can see under the microscope in *Student activity 2 worksheet: water under the microscope*.

Reflection

- What did you notice in the pond water when you looked under the microscope?
- How did increasing the magnification change what you could see?
- Based on your observations, do you think pond water is a pure substance or a mixture?
- Why might natural water contain particles that are not visible to the naked eye?
- Does clear-looking water mean it's pure? Why or why not?
- How do your observations help you understand why water is filtered and treated before drinking?

Student activity 2: worksheet

Definitions

Pure substance:	
Mixture:	

Results

Record your observations.

-

Analyse the results

What did you observe in the pond water? Use a **labelled diagram** to help describe what was observed.

Draw a labelled diagram.

What type of mixture is this? Is it heterogenous or homogenous mixture?

Describe how you can determine this.

-

Reflect

Brainstorm what separation techniques you could use to make the pond water drinkable.

Brainstorm.

-

Take it further

Model your pond water as a particle diagram. Would all pond water look the same? Why/why not?

Draw a particle diagram.

-

Activity 3 – Saltwater separation

Learning intention

- Understand how heat can be used to separate dissolved substances from water (evaporation).
- Identify that saltwater is a mixture and that its components can be recovered through physical processes.

Success criteria

- Can explain what happens when salt dissolves in water
- Can safely set up a stove to heat a liquid
- Can explain why water evaporates and salt remains
- Can use scientific vocabulary such as evaporation, homogenous mixture, solution, mixture, solute, solvent and residue.

Safety

- Wear appropriate PPE (safety glasses, gloves, hair tied back etc.)
- Follow safety procedures for using a stove.

Equipment

For each student:

- Prepared page in workbook

For each group:

- Portable hot plate/stove
- Small saucepan
- Spoon or spatula
- 2 teaspoons of salt
- 100 mL measuring cylinder
- 30 mL water
- Measuring jug (500ml)
- Stopwatch/Timer

Activity

1. Measure out salt and water and place in the measuring jug and stir using spoon until salt has completely dissolved.
2. Follow safety precautions to place the saucepan on the stove.
3. Pour jug of saltwater into the saucepan.
4. Turn stove on medium heat. Start 3-minute timer.
5. Observe and record what happens to the mixture during and after the 3 minutes. Turn off stove when timer is finished.

Reflection

- What did you observe when you stirred the salt into the water?
- What changes did you see as the water was heated over the stove?
- Why do you think the water disappeared, but the salt remained in the beaker?
- How does this process show that saltwater is a mixture and not a pure substance?
- How do these results tell us if this mixture is heterogenous or homogenous?
- What other ways could you separate a mixture like saltwater?
- How could this process be useful in real life (e.g. getting fresh water from seawater)?

Activity 4 – Separating sand from seeds

Learning intention

- Understand how the physical properties of substances (e.g. size, mass) can be used to separate mixtures.
- Identify which separation techniques (yandying, hand-picking, sieving) are effective for different materials.

Success criteria

- Can identify the physical properties of sand and seeds that affect separation.
- Can use yandying, hand-picking, and sieving techniques to separate mixtures.
- Can compare and evaluate the effectiveness of each separation technique.

Safety

- Wear appropriate PPE (e.g. safety glasses).
- Handle loose materials carefully to avoid inhalation or accidental ingestion.

Equipment

For each student:

- Prepared page in workbook.

For each group:

- Mixture of sand and seeds
- Large shallow tray (e.g. polystyrene meat tray)
- Three containers to store separated components
- Sieve
- Tweezers.

Activity

- Test each separation technique on a mixture of sand and seeds.
- Record observations in your workbook and create a graph to visually represent your findings.
- 2. Gently rock the tray back and forth at an angle.
- 3. Observe how the heavier sand moves differently from the lighter seeds.
- 4. Collect separated seeds in a labelled container and record observations.

Yandying:

1. Pour the sand-seed mixture into a shallow tray.

Hand-picking

1. Spread the mixture in a thin layer on a tray.
2. Use tweezers or fingers to pick out seeds from the sand.
3. Collect the separated seeds and record observations.

Sieving

1. Place a sieve over an empty container.
2. Slowly pour the mixture through the sieve. Shake gently to help separation.
3. Collect what remains in the sieve (seeds) and what passes through (sand).
4. Record observations.

Reflection

- What did you observe when using yandying to separate the mixture?

- How effective was hand-picking compared to yandying?
- How did sieving help in separating the sand and seeds?
- Which technique was the most efficient and why?
- Which technique was the least effective and why?
- How could you improve your separation process if you did the experiment again?
- How does yandying relate to historical methods used to separate gold and minerals from other materials?

Extension question

- Research: How do traditional Aboriginal and/or Torres Strait Islander techniques for obtaining ores or minerals use the same principles you observed in this experiment?

Activity 5 – Filtering tea

Lesson objectives

- Observe and identify states of matter (solid, liquid, gas).
 - Identify how heating changes liquids into gases.
 - Understand how tea is a mixture that can be separated using the traditional separation technique of straining.
 - Explore how plant compounds move from a solid (leaf) into a liquid (water) to form a solution (tea infusion).
 - Recognise how steeping time affects concentration (strength of tea).
 - Use sensory observations (smell, sight) to describe changes.
 - Follow safe handling practices (WHS) when handling hot liquids.
- Can use scientific language such as mixture, solution, concentration, and filtering.
 - Can explain how leaving tea to steep longer changes its concentration.

Equipment

As a class:

- Native plant leaves - find local to your region. Some examples include:
 - 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 or cup (optional for vapour demonstration)
- Sieve or strainer
- Ladle and cups (optional for serving for students to try).

Success criteria

- Can accurately identify solid, liquid and gas from the demonstration.
- Can explain how tea is a mixture that can be separated using a sieve (filtering technique).
- Can describe how heat helps dissolve substances from the leaves into water.

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:
 - a. texture (dry, crumbly, firm, bendy, rough, smooth)
 - b. shape and colour
 - c. smell: sweet, strong, weak.
3. Ask the students 'what makes the leaf a solid?' (it holds its shape and does not flow).
4. Get students to crush and tear up the leaves with their hands.

Part 2: Heat water and form a mixture (liquid + solid)

1. Place the leaves into the glass cup or bowl.
2. Slowly pour hot water over the leaves.
3. Allow it to steep for 2-3 minutes.
4. Ask students to observe:
 - a. Colour changes of the water.
 - b. Leaves becoming softer - but still being a solid (can mix the leaves to show how it is soft).
 - c. Smell becoming stronger (carefully waft water vapour towards nose).
 - d. Tea forming as particles from the leaves mix into the water.
5. **Discuss:** Is this a mixture? Yes, because solid leaves are combined with liquid water. Some of the plant particles

dissolve into the water to form a solution (tea).

Part 3: Observe the gas

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



Figure 1 Illustration of leaves steeping

Part 4: Separation using filtration

1. Place a sieve or strainer over another cup or bowl.
2. Slowly pour the tea through the sieve.
3. Ask the students, what is being left behind in the sieve? (Solid leaves) What passed through? (Liquid tea/solution).

Part 5: Optional - Taste the tea

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

Reflection

- What state of matter is the leaf? (Solid)
- What state of matter is the tea? (Liquid)
- What state of matter is the steam/aroma? (Gas)
- Is tea a mixture or a pure substance? (Mixture)
- How did we separate the mixture? (Filtering/sieving)
- What happens if tea is left longer in water? (Higher concentration, stronger flavour)
- Would cold water produce the same result? Why or why not?

Extension: Experimenting concentration

- Make two cups of tea:
 - a. Cup A: steep for 1 minute
 - b. Cup B: steep for 5 minutes
- Ask students:
 - a. Which tea is darker?
 - b. Which has a stronger smell or taste?
- Explain:
 - a. Longer steeping = more particles dissolve
 - b. This creates a higher concentration solution (stronger tea).



Figure 2 Illustration of the difference in concentration between the tea steeped for 1 min (left) and for 5 mins (right)

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 your local area and, where possible, go on Country to support students in exploring and identifying traditional separation techniques that may have been used in that environment. For example, near a riverbank or ocean, students might consider techniques such as sieving or filtering to separate solids from liquids, collecting fresh water, or the use of fish traps to separate and catch food.
- Research local grasses, plants, and natural materials that could be used in traditional separation practices. For example, a yandy (traditionally made from a local tree trunk) used for winnowing; manglik grass for fish traps; and native grasses such as mulga and wiry wattle for weaving baskets that function as sieves.
- Explore native grains and their connection to trade and exchange. Examine how traditional harvesting and separation techniques (such as winnowing and grinding) enabled communities to process seeds and grains efficiently, supporting food production, storage, and trade networks.
- Create a mind map linking traditional separation techniques to their everyday applications. Encourage students to consider connections to food collection and preparation, water purification, medicine preparation, and sustainable resource management.

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 local experts, Elders, Knowledge Holders who have experience with traditional separation methods (e.g. sieving, winnowing, yandying, filtration). Ask if they are willing to share their knowledge and demonstrate techniques to students.

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 activities.
- Gathering student work samples including oral, written, and multimedia.
- Assessing student 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 experiments.
- 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.

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Contact us

1300 363 400
+61 3 9545 2176
csiro.au/contact
csiro.au

For further information

CSIRO Education and Outreach
1300 363 400
education@csiro.au
csiro.au/education