Connecting Indigenous
Knowledges to the classroom

Indigenous STEM Education Resources

Fire-starting

Traditional fire-starting techniques

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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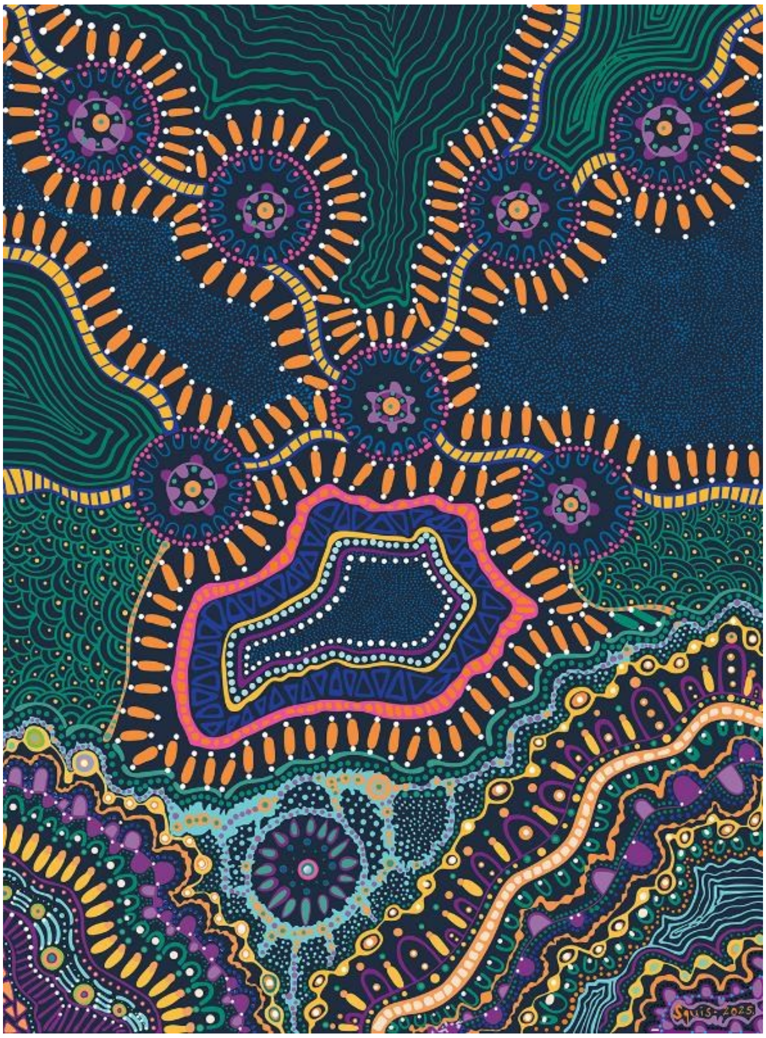
Aunty Sandra Angus is an acknowledged Elder and well respected Aboriginal leader in her community. She proudly identifies as an Australian ‘Saltwater Murri’ with ancestral roots that extend to the Wiradjuri and Wongaibon people in NSW, the Ngarrindjeri people in SA and the Gunggari and Jaggera people 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.
Chemical energy	Chemical energy is a form of potential energy. It is stored in the bonds of molecules which can be released during chemical reactions e.g. chemical potential energy in wood can convert into heat and light energy when it burns.
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.
Combust	To catch fire.
Conductor	A substance that transfers heat or electricity to another substance that is in direct contact.
Cultural burning/Fire-stick farming	A traditional land management practice used by First Nations People that involves slow, controlled, and low-intensity fire to burn the land. This practice encourages native plants to regenerate, grow, and thrive while removing dead plants and non-native plants from a habitat.
Custodian	A custodian is a Traditional Owner of the land and waters who carries the responsibility for caring for and looking after Country.
Efficiency	The ratio of work done, or energy developed by a machine or engine, to the energy supplied to it.
Ember	A small piece of burning or glowing coal or wood.

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. Energy is never lost but can be transferred or transformed.
Energy chain	The visual representation of the transfer and transformation of energy in a system. It often looks like a flow diagram, with the arrows indicating the direction of energy movement.
Energy form	A general term used when discussing a type of energy.
Energy transfer	The movement of one energy form within or across objects or mediums in a system. When energy transfers, it stays in the same form and moves from one object to another. For example, when hitting a ball with the bat, the kinetic energy of the bat is transferred to the ball, causing the ball to change direction.
Energy transformation	Occurs when energy changes from one form to another. For example, when turning on a light, the electric potential energy transforms into light and thermal energy.
Flammable	Can catch fire easily.
Friction	The force that resists the motion that occurs when two surfaces rub against each other.
Force	A push or pull between objects, which may cause one or both objects to change speed, and/or direction of their motion, and/or their shape.
Gravitational energy	The energy possessed by a mass due to its position in a gravitational field.
Gravity	The force of attraction that objects with mass exert on each other.
Hearth	The base of a fireplace. In this context, the hearth is the piece of wood that the ember forms in.
Ignite	To catch fire.
Ignition	The act of starting something burning.
Kinetic energy	The energy that an object possesses by virtue of its motion; the energy an object gains by being in motion.
Mass	The amount of matter in an object.

Mechanical energy	The energy of an object due to its kinetic energy and potential energy.
Potential energy	The energy stored in an object, that when released will make things happen. This includes chemical, gravitational and elastic.
Smoulder	When wood slowly burns without flames. It produces heat and smoke but little or no light. Smouldering can turn into flames if it gets more oxygen.
Temperature	The degree of heat present.
Thermal	Properties of phenomena (events) associated with heat, temperature, or the transfer of energy due to temperature differences.
Timber	Wood from trees that has been prepared for use.
Tinder	Dry, flammable material that is used for starting a fire.
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.
Vegetation	Plant life in an area.

Activity 1 - Modelling energy systems, transfers and transformations

Lesson objectives

- Observe and recognise forms of potential and kinetic energy.
- Identify examples of how energy can change from one form into another.
- Use representations to illustrate energy transformations, including how radiant energy from the Sun can be transformed into a different form of energy.

Success criteria

- Can identify examples of kinetic and potential energy.
- Can use flow diagrams to communicate the transfer and transformation of energy within a system.

Equipment

Teacher demonstration:

- sparkler
- lighter/matches
- M&Ms
- potted plant.

Activity

Check for prior knowledge

Display sparklers, M&Ms, and a plant:

- What do we want from a sparkler?
- How do we get them to work the way we want?
- What energy is stored in the sparkler?
- How do we access the energy in an M&M?
- What do we use the energy for?
- How does a plant use and transform energy?

Safety

- Do not touch the materials as they could be hot. The heat produced can cause burns.
- Wear safety glasses when observing the sparkler demonstration. Sparks may fly into your eyes.
- Keep your work area clean. Flammable materials can catch on fire.
- Have a fire bucket, fire extinguisher and/or fire blanket on hand.

Model energy transfer and transformation

Model 1: Sparklers

1. Have up to four students hold sparklers while the teacher sets them alight (or go outside for a whole class activity).
2. What evidence can you see that energy is being released?
3. Explicitly identify:
    a. Energy input: chemical potential energy, thermal (heat) energy.
    b. Energy outputs: light energy and thermal (heat) energy.
4. Introduce the terms energy transfer and transformation.
5. Model an energy flow diagram on the board:

    chemical potential + thermal (heat) → light + thermal (heat) + sound
6. Students copy and label their own diagram in their activity sheet or science book.

Model 2: M&Ms

1. Distribute M&Ms (or similar food item).
2. Discuss:
    a. Energy stored in food as chemical potential energy.
    b. How the body uses this energy.
3. Explicitly identify:
    a. Energy input: chemical potential energy.
    b. Energy output: kinetic energy and thermal (heat) energy.
4. Model the energy flow diagram on the board:

    chemical potential → kinetic + thermal
5. Students copy and label their own diagram in their activity sheet or science book.

Model 3: Plant

1. Display a potted plant and prompt discussion:
    a. Where does the plant's energy come from?
    b. Is the plant moving? How do we know it still needs energy?
2. Discuss:
    a. Energy input: light energy from the Sun.
    b. Energy output: chemical potential energy stored as sugars.
3. Explicitly explain that this is also an energy transformation, even though it is slower and less visible.
4. Model the energy flow diagram, reinforcing consistent diagram conventions:

    light → chemical potential.

Reflection

- Which system had the most obvious energy transformation?
- Which system had the least obvious transformation?
- Energy transformation occurs when the type of energy changes within the system, while energy transfer refers to energy moving from one part of the system to another without changing form. Did any of the systems demonstrate energy transfer and transformation?
- Which form of energy were we trying to observe in each system?
- Were there other forms of energy produced?
- What do we call energy that is not useful in the system? (wasted energy)
- Which systems seemed more efficient? Why?

Activity 2 – Investigate energy systems, transfers and transformations

Lesson objectives

- Observe and recognise forms of potential and kinetic energy.
- Recognise energy transfers and transformations.
- Use practical investigations and representations to illustrate energy transformations in a system.
- 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

- Can safely participate in investigations.
- Can use flow diagrams to communicate energy transfers and transformations within a system.
- Can identify examples of kinetic and potential energy.

Equipment

One per station:

- set of dominoes
- rubber bands
- torch
- bouncy ball
- simple musical instrument (e.g. maracas, xylophone)
- heatproof mat.

One per group:

- party poppers
- match in a matchbox (teacher use only).

Activity

Students rotate through investigation stations.

At each station, students:

- Identify the energy source entering the system.
- Identify energy outputs.
- Decide whether energy is transferred, transformed, or both.
- Draw a labelled energy flow diagram.
- Identify any wasted energy.

Example stations:

- Dominoes: gravitational potential → kinetic → sound/heat.
- Rubber band: elastic potential → kinetic → sound + heat.
- Torch: chemical potential → electrical → light + heat.
- Bouncy ball: gravitational potential + mechanical → kinetic → sound.
- Instrument: mechanical → sound + heat.
- Party poppers: chemical potential + mechanical → kinetic + sound + heat.
- Matches: chemical potential + mechanical → heat + light + sound.

Reflection

- Which form of energy were we trying to observe in each system?
- Were there other forms of energy produced?
- What do we call energy that is not useful in the system? (wasted energy)
- Which systems seemed more efficient? Why?

Classroom activity 2 - worksheets

In groups you will rotate between the following activity stations: dominoes, rubber bands, torch, bouncy ball, musical, party popper, match.

Station:	
Identify the energy source entering the system:	
Identify energy outputs:	
Decide whether energy is transferred, transformed, or both:	
Draw a labelled energy flow diagram	
Identify any wasted energy:	

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Decide whether energy is transferred, transformed, or both:	
Draw a labelled energy flow diagram	

Identify any wasted energy:	

Reflection questions

Which energy form were we trying to observe in each system?	
Were there other forms of energy produced?	
What do we call energy that is not useful in the system?	
Which systems seemed more efficient? Why?	

Activity 3 – Marble roll

Lesson objectives

- Observe and recognise forms of potential and kinetic energy.
- Recognise energy transfer and transformation.
- Use practical investigations and representations to illustrate energy transformations in a system.

Success criteria

- Can use flow diagrams to communicate the transfer and transformation of energy within a system.
- Can identify examples of kinetic and potential energy.

Equipment

For each group:

- 3 marbles (different sizes and/or weights)
- cardboard tube
- 2 x empty boxes or containers
- masking tape
- ruler.

Equipment set-up

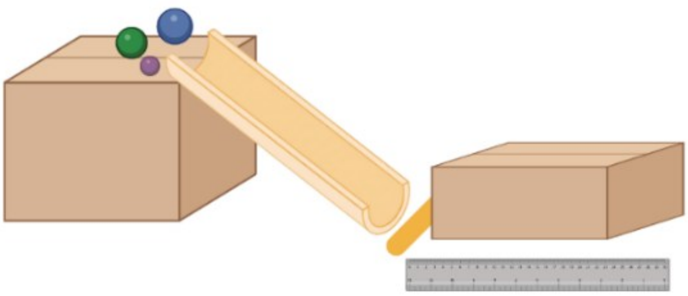

Figure 1 Experimental set-up: side view.

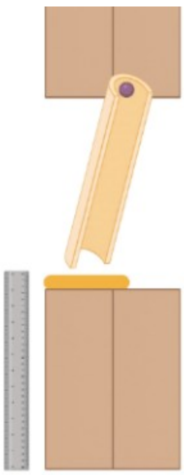

Figure 2 Experimental set-up: bird's-eye view.

Method

1. Use masking tape to attach the cardboard tube to an empty box or container to create a ramp.
2. Place a piece of masking tape on the bench a few centimetres away from the end of the ramp and align the second empty box with the tape (Figure 1).
3. Place the ruler alongside the tape to measure the distance the box is moved by the marbles.
4. Roll the smallest/lightest of the three marbles down the ramp (Diagram 2).
5. Measure the distance the empty box moves and record the results in a table.
6. Repeat the activity for remaining two marbles increasing in size or weight.
7. Use your table of results to draw an appropriate graph in your workbook.

Reflection

- Which marble had the most potential energy? Why?
- What would happen if the smaller marble was let go at twice the height of the larger one?
- Use an energy flow diagram to demonstrate the energy system transfers and transformations observed during this investigation.

Activity 4 – Pom-pom shooter

Lesson objectives

- Observe and recognise forms of potential and kinetic energy.
- Recognise energy transfers and transformations.
- Use practical investigations and representations to illustrate energy transformations in a system.

Success criteria

- Can use flow diagrams to communicate energy transfers and transformations within a system.
- Can identify examples of kinetic and potential energy.

Equipment

For each group:

- pom-pom craft balls
- balloons
- plastic cups
- scissors.

Equipment set-up

Figure 3 Experimental set-up: side view.

Figure 4 Illustration of step 5.

Method

1. Cut the bottom third off the plastic cup.
2. Tie balloon shut with no air inside, then cut off the top of the balloon (Figure 3).
3. Stretch the balloon around the wider end of the cup (Figure 3).
4. Place the pom-pom inside cup.
5. Pull back the knotted end of the balloon and let go (Figure 4). Record your observations.

Reflection

- What made the pom-pom move?
- How could you make the pom-pom propel further?
- Use an energy flow diagram to demonstrate the energy systems transfers and transformations observed during this investigation.

Activity 5 – Spoon conductor

Lesson objectives

- Observe and recognise heat energy.
- Recognise efficient energy transfer.

Success criteria

- Can use flow diagrams to communicate energy transfers and transformations in the system.
- Can identify examples of kinetic and potential energy.
- Can identify the most efficient material for transferring heat.

Equipment

For each group:

- plastic spoon
- metal spoon
- kettle
- jug for hot water
- paper towel
- stopwatch or timer
- chocolate chips.

Equipment set-up

Figure 5 Step 2 set-up.

Figure 6 Step 5 set-up.

Method

1. Carefully fill a cup or pan with boiling water from the kettle.
2. Place both spoons into the hot water at the same time (Figure 5).
3. Leave the spoons in the water for 1 minute.
4. Remove the spoons from the water, quickly wipe dry and place on bench.

5. Put a chocolate chip onto each spoon (Figure 6).
6. After one minute, gently press the chocolate chip with your finger.
7. Record your observations.

Reflection

- Which spoon transferred heat more efficiently?
- Why did the chocolate chip melt faster on one spoon than the other?
- Use an energy flow diagram to demonstrate the energy system transfers observed during this investigation.

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