Fire-starting – Example Teaching Sequence (Year 8)

Physical sciences

Students investigate traditional fire-starting methods used by Aboriginal and/or Torres Strait Islander Peoples to develop their understanding of energy and energy transformations. For thousands of years, fire has been a deeply connected practice linking culture, Country and community. These fire-starting practices are based on deep ecological knowledge, including the careful selection of materials based on local environments and available resources. Through this topic, students explore different traditional fire-starting techniques and how they utilise **friction**, **force** and **motion** to transform kinetic energy into heat energy which can produce smoke and potentially ignite fire. Students make connections between scientific concepts and real-world applications of energy transfer.

Students will develop and exhibit a range of **science inquiry** skills, such **as questioning and predicting**, **planning and conducting, processing, modelling and analysing, evaluating** and **communicating**. Students recognise that Aboriginal and/or Torres Strait Islander Peoples have applied these scientific principles for thousands of years across diverse regions of Australia.

Before you start:

1. All documents and resources are available via our website: Fire-starting education resources.
2. Review the following teacher documents:
    - *Context PPT (Fire-Starting)* and *Classroom Activities Guide (Fire-Starting)*
    - *Experiment PPT (Fire-Starting)*, *Teacher Experiment Procedures (Fire-Starting)* and *Equipment List and Hazard Management (Fire-Starting)*
    - *Curriculum Links (Fire-Starting).*
3. The classroom activities have been designed to break information into manageable sections and provide opportunities to check understanding.
4. Familiarise yourself with the central investigation: Which method produces smoke more quickly using friction: the hand drill or the fire saw?
5. Review the example teaching sequence below and adjust based on the needs of your class. This example assumes sixty-minute lessons.

Lesson	Lesson objectives	Resources	Australian Curriculum
1	• 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.	• Classroom activities: Activity 1 – modelling energy forms, transfers and transformations. • Classroom activities: Activity 2 – investigate energy forms, transfers and transformations; OR • Classroom activities 3, 4 and 5 – marble roll, pom-pom shooter, spoon conductor.	*AC9S8U05*

2	• Use practical investigations and representations to illustrate energy transformations in a system:
	  ○ Explore traditional fire-starting methods used by Aboriginal and/or Torres Strait Islander Peoples.
	  • Explain how energy is transferred and transformed during traditional fire-starting methods, including how movement and friction are used to transform kinetic energy into heat energy to ignite fire.
		• Fire-starting context PowerPoint.
		• Fire-starting video link.
		• Fire drill equipment (see equipment list).
			AC9S8U05
			AC9S8H02

3	• Fire-starting experiment: Hand drill/Fire saw • Identify the question to be investigated: Which method produces smoke more quickly using friction: the hand drill or the fire saw? • Make predictions based on scientific knowledge and observations. • Identify independent, dependent and control variables. • Students can use the concept of 'fair test' when explaining variables. • Follow a planned procedure to undertake safe and valid investigation. • Identify the type of data that needs to be collected.	• Fire-starting experiment procedure. • Fire-starting experiment PowerPoint. • Fire-starting experiment planner (Student). • Fire-starting experiment planner (Teacher). • Fire-starting equipment list and hazard management document.	*AC9S8U05* *AC9S8H02* *AC9S8I01* *AC9S8I02*

	• Assemble and use appropriate equipment and resources to perform an investigation. • Follow the planned procedure, including the measurement and control of variables. • Employ safe work practices and manage risks using work health and safety (WHS) practices. • Make a series of observations and measurements that are appropriate to answer the question. • Record observations and measurements accurately, using correct units.		

4	• Use scientific understanding to identify and draw conclusions on which fire-starting method produce smoke more quickly based on students' data.
	• Evaluate the method used to investigate the question:
	  ○ Evaluate the quality of the data collected.
	  • Identify improvements to the investigation.
	• Identify and classify different forms of energy involved in fire-starting, including kinetic energy, heat energy, chemical energy and potential energy, using appropriate scientific language.
	• Use flow diagrams to clearly communicate the sequence of energy transfers and transformations involved in traditional fire-starting methods.
		• Fire-starting experiment procedure.
		• Fire-starting experiment PowerPoint.
		• Fire-starting experiment planner (Student).
		• Fire-starting experiment planner (Teacher).
		• Fire-starting equipment list and hazard management document.
			AC9S8U05
			AC9S8H02
			AC9S8I04
			AC9S8I06
			AC9S8I08

Lesson 1

Prior knowledge: Introduction to energy.

Learning intentions: (select 3–5)

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

Resources: See example teaching sequence above on page 2.

Classroom activities

1. Share learning intentions and Success criteria: Fire-starting context PowerPoint slide 2.
2. Recap energy: Fire-starting context PowerPoint slides 3 – 6:
    a. What is energy?
    b. What can energy look like?
    c. What forms can energy take?
    d. What are the similarities/differences between kinetic and potential energy?
3. Discussion and note-taking – energy transfers and transformations: Fire-starting context PowerPoint slide 8:
    a. What energy form does the bat have when it strikes the ball? (kinetic).
    b. What change in the ball does that energy cause in the ball? (change in direction, change shape).
    c. What energy goes into the light bulb when it is switched on? (electrical).
    d. What forms of energy does the electrical energy transform into? (light, heat).
4. Classroom activity 1: modelling energy systems, transfers and transformations:
    a. What are some examples of energy systems?
    b. Where can you see these energy systems?
    c. Where is the energy coming from?
    d. Knowledge check:
        i. Where did we observe energy being transferred or transformed?
        ii. What forms of energy were transferred to and from each system?

5. Classroom activity 2: investigating energy systems, transfers and transformations OR Activities 3, 4 and 5: marble roll, pom-pom shooter and spoon conductor.
6. End of lesson knowledge check: Fire-starting context PowerPoint slide 12:
    a. Which energy form were we trying to observe in each system?
    b. Were there other forms of energy produced?
    c. What do we call energy that is not useful within the system?
    d. Which systems seemed more efficient? Why?

Next lesson – Traditional fire-starting knowledge.

Lesson 2

Prior knowledge: Introduction to energy transfer and energy transformations at the appropriate stage level.

Learning intentions:

- Explore traditional use of fire and fire-starting techniques by Aboriginal and/or Torres Strait Islander Peoples.
- Identify and classify different forms of energy involved in fire-starting.
- Explain how energy is transferred and transformed during traditional fire-starting methods, including how movement and friction are used to transform kinetic energy into heat energy, which can produce smoke and potentially ignite fire.
- Use flow diagrams to clearly communicate the sequence of energy transfers and transformations.

Success criteria:

- Describe how Aboriginal and/or Torres Strait Islander Peoples have traditionally used fire and explain at least one traditional fire-starting method.
- Correctly identify and classify the different forms of energy involved in fire-starting.
- Explain how energy is transferred and transformed during traditional fire-starting, including how movement and friction change kinetic energy into heat energy, which can produce smoke and potentially ignite fire.
- Create a clear and logical flow diagram that shows the correct sequence of energy transfers and transformations using a traditional fire-starting method as an example.

Resources: See example teaching sequence above on page 2.

Classroom activities

1. Recap energy systems, energy transfers and energy transformations.
2. Share learning intentions and success criteria.
3. Discussion and note-taking: Fire-starting context PowerPoint slides 12–15.

   Check your understanding: Fire-starting context PowerPoint slide 16.
4. Traditional fire-starting methods discussion and note-taking: Fire-starting context PowerPoint slides 17 – 22:
   a. Why were different fire-starting methods used?
   b. What are the basic requirements for each method?
   c. Where does the heat come from?
   d. Why does the wood need to be dry?
5. Check your understanding – Think – Pair – Share: Fire-starting context PowerPoint slide 23:
   a. What is common between the techniques?
   b. Where do the heat and smoke come from?

    c. How is the energy coming into the system to create heat?

6. Check your understanding – Multiple choice question: Fire-starting context PowerPoint slide 24.
7. Hand drill exploration
    a. Explain that students will be given the materials to explore the hand drill method in small groups (3 or 4)
    b. Discuss safety precautions and dispense equipment
    c. Instruct students to create smoke as quickly as possible; time and record each group's result
    d. Invite groups to share their fire-starting methods and techniques
    e. How did the techniques differ between groups?
    f. What made it more successful?
    g. Are there changes to the techniques we've seen that could create smoke even faster?
    h. If time permits, allow students to alter their method and report back.
8. Facilitate an energy flow diagram: Fire-starting context PowerPoint slide 26–28:
    a. What energy forms did you observe?
    b. Were the energy forms being transferred or transformed within the system?
9. End of lesson knowledge check: Fire-starting context PowerPoint slide 29.

Next lesson – Fire-starting investigation.

Lesson 3

Prior knowledge: Introduction to energy systems, introduction to Aboriginal and/or Torres Strait Islander fire-starting technologies.

Learning intentions: (select 3 – 5)

- Identify the question to be investigated: Which method produces smoke more quickly using friction: the hand drill or the fire saw?
- Make predictions based on scientific knowledge and observations.
- Identify independent, dependent and control variables.
- Follow the planned procedure, including the measurement and control of variables.
- Make a series of observations and measurements that are appropriate to answer the question.

Success criteria:

- Can generate a hypothesis.
- Can safely conduct an experiment.

Resources: See example teaching sequence above on page 2.

Safety

- This investigation involves physical exertion and heat generation.
- Use appropriate PPE (gardening gloves, safety goggles, lab coats).
- Have fire bucket, fire extinguisher and/or fire blanket ready.

Classroom activities

1. Review: energy types, systems, transfers and transformations, Aboriginal and/or Torres Strait Islander context – fire-starting strategies.
2. Share Learning intentions and Success criteria.
3. Introduce the question to be investigated: Which method produces smoke more quickly using friction: the hand drill or the fire saw?
4. Review hand drill and fire saw methods if required.
5. Develop experiment question and hypothesis:
    a. Can smoke be produced more quickly using the hand drill method or the fire saw method?
    b. Why do you think that fire-starting method will produce smoke more quickly?
6. Hand out the Fire-starting experiment planner, record investigation question and hypothesis.
7. Ask students to suggest how they will determine which fire-starting method will be most efficient and discuss how valid these measurements would be:
    a. How will we determine which fire-starting method will produce smoke more quickly?

b. How will you decide if the fire-starting method is efficient?

c. What could you look, listen, feel or smell for?

d. How would you measure it?

8. Define dependent, independent and control variables:

    a. What will your group change?

    b. What will your group measure?

    c. What data is going to be collected?

    d. How is the collected data going to be recorded?

    e. What will your group control or keep the same to ensure a fair test? (type of wood used, moisture in the wood, speed of twirling the drill stick/sawing, force of twirling the drill stick or sawing, number of people working, weather conditions).

9. Discuss and record safety considerations.

10. Conduct investigation:

    a. What data and observations are you recording?

    b. How are you going to record the data and observations?

Next lesson – Finish investigation, analyse results and draw conclusions.

Lesson 4

Prior knowledge: Introduction to energy systems, introduction to Aboriginal and/or Torres Strait Islander fire-starting technologies.

Learning intentions: (select 3–5)

- Use scientific understanding to identify and draw conclusions about which fire-starting method was more effective at producing smoke, based on students' data.
- Evaluate the method used to investigate the question.
- Identify and classify different forms of energy involved in fire-starting, including kinetic energy, heat energy, chemical energy and potential energy, using appropriate scientific language.
- Use flow diagrams to clearly communicate the sequence of energy transfers and transformations involved in traditional fire-starting methods.

Success criteria:

- Can explain which fire-starting method was more efficient, using data to support conclusions.
- Can use flow diagrams to communicate energy transfers and transformations within the system.
- Can identify examples of kinetic and potential energy.

Resources: See example teaching sequence above on page 2.

Safety

- This investigation involves physical exertion and heat generation.
- Use appropriate PPE (gardening gloves, safety goggles, lab coats).
- Have a fire bucket, fire extinguisher and/or fire blanket ready.

Classroom activities

1. Review investigation questions and progress: Which method produces smoke more quickly using friction: the hand drill or the fire saw?
2. Share learning intentions and success criteria.
3. Facilitate data representation discussion:
    a. What data was collected during observations of the experiment?
    b. How can the data and observations collected during the experiment be represented effectively?
4. Allow time for groups to decide on an effective way to represent data and record it in their fire-starting experiment planner.
5. Conclusion:
    a. What patterns did your group identify from the data?
    b. Which fire-starting method was the most efficient or produced smoke most quickly?
    c. Do the results support your hypothesis? Why/why not?
    d. How did different groups' observations compare to yours?

e. What factors (e.g., speed, pressure, materials) affected how efficiently heat was produced, and how could you improve the system's efficiency?

6. Explain to students that reflection is an important part of the experiment process to identify areas of the investigation that need to be changed to improve the investigation. These could include possible changes to the method, equipment list or data gathering techniques:
    a. What worked well during the investigation? Why?
    b. What challenges did your group encounter during the investigation?
    c. Was it a fair test? Why?
    d. What could you change to improve the investigation?
7. Link back to Aboriginal and/or Torres Strait Islander knowledges and Western science contexts:
    a. What forms of energy were involved in operating the hand drill, and how were these forms transferred or transformed during the activity?
    b. Draw an energy flow diagram to demonstrate understanding:
        i. What needs to be included in energy flow diagrams?
        ii. How will the energy flow diagrams for both traditional fire-starting methods be different?
    c. What does this investigation highlight about Aboriginal and/or Torres Strait Islander Peoples' understanding of energy transfers and transformations?
    d. How is this knowledge applied?
    e. Why is understanding energy transfer important when learning about traditional fire-starting techniques used by Aboriginal and/or Torres Strait Islander Peoples?

Take it further – Consider classroom activities for suggestions.