Science Stage 5 (Year 9) – sample assessment task

Energy

**Creation date:** 4 September 2024.

Contents

[About this assessment task 2](#_Toc179468424)

[Purpose of the resource 2](#_Toc179468425)

[When and how to use 2](#_Toc179468426)

[Assessment task notification 3](#_Toc179468427)

[Task description 4](#_Toc179468428)

[Marking rubric 5](#_Toc179468429)

[Teaching notes 10](#_Toc179468430)

[Prior learning 10](#_Toc179468431)

[Facilitating the task 10](#_Toc179468432)

[DS.1 Explaining the task and data collection 12](#_Toc179468433)

[DS.2 Conducting classroom energy use audit 18](#_Toc179468434)

[DS.3 Analysing collected data 24](#_Toc179468435)

[DS.4 Exploring options for action 28](#_Toc179468436)

[DS.5 Identifying constraints and selecting an idea for action 31](#_Toc179468437)

[DS.6 Developing your action proposal 33](#_Toc179468438)

[DS.7 Communicating your proposal 36](#_Toc179468439)

[DS.8 Reflecting on the proposed actions and evaluating plans 38](#_Toc179468440)

[Evidence base 40](#_Toc179468441)

# About this assessment task

## Purpose of the resource

This assessment task is linked to the learning in the Energy program for Year 9 students. Students undertake data collection and problem-solving to develop and evaluate a proposal that addresses the inquiry question: **How can we optimise energy use at our school?**

## **When and how to use**

**Note:** this assessment task is integrated with a depth study. Teachers might modify the assessment activity to be independent of the depth study.

The task is designed to assess students understanding of:

* current and alternative energy use
* skills in selecting suitable problem-solving strategies and evaluating proposed solutions to identified problems
* using data to make informed, evidence-based decisions.

The assessment task is part of an 8-hour depth study that can be run parallel to the Energy program. It is designed to run over 8 weeks, starting in Week 3 as identified in the [Stage 5 Scope and sequence](https://education.nsw.gov.au/teaching-and-learning/curriculum/science/planning-programming-and-assessing-science-7-10#showhide84667537). The suggested timelines for the activities are included in the [Teaching notes](#_Teaching_notes).

Refer to Depth Study (DS.1 to 9 in the Energy program).

The [Common Grade Scale](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/awarding-grades/common-grade-scale) can be used to report student achievement in NSW’s primary and junior secondary schools.

When grading students’ level of achievement in Stage 5, refer to the [course performance descriptors](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/assessment#course-performance-descriptors-science_7_10_2023). Course performance descriptors provide holistic descriptions of typical achievement at different grade levels in a specific course.

# Assessment task notification

**Name of task**: optimising energy use

**Type of task:** depth study

**Weighting**: [the weight of the assessment task is a school-based decision].

**Submission details:** [schools complete this section – include any important details about submission, format of the task, word limits and submission procedures].

**Outcomes**

A student:

* evaluates current and alternative energy use based on ethical and sustainability considerations **SC5-EGY-01**
* selects and uses scientific tools and instruments for accurate observations **SC5-WS-01 (Observing)**
* follows a planned procedure to undertake safe, ethical, valid and reliable investigations **SC5-WS-04 (Conducting investigations)**
* selects and uses a range of tools to process and represent data **SC5-WS-05 (Processing data and information)**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07 (Problem-solving)**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08 (Communicating)**

[Science 7–10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2023.

## Task description

**Inquiry question**: How can we optimise energy use at our school?

You will collect, process and analyse data, and develop strategies to optimise energy use in your school.

You will:

* work in a group to prepare and present an action proposal for your school executive that includes an explanation of energy use issues and sustainable solutions
* individually reflect on the proposal and evaluate it
* maintain a learning journal to guide and document your investigation.

The task will run over [X] weeks starting [Start date]. [X] periods of class time will be provided to complete this task. It is not designed to be completed at home.

### Submission items

Two items should be submitted for assessment:

* a **slide deck presentation** or **poster** (determined by your teacher), developed as a group
* a **learning journal**, completed individually.

**Group component**

Design a **slide deck presentation or a poster** outlining your proposal for optimising energy use at school:

* maximum 5 slides (excluding title and reference slides) OR A3/digital poster
* minimum font size 14.

**Individual student component**

Complete the supplied **learning journal,** including:

* a personal reflection answering key questions about your proposal (maximum 400 words)
* raw data and calculations to support your proposal and reflection
* evidence of planning, research and data collection.

## Marking rubric

Table 1 is the slide deck presentation or poster rubric, while Table 2 is the rubric for the learning journal and personal reflection.

Table 1 – group marking rubric for the slide deck/poster proposal

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criteria | Level 1 | Level 2 | Level 3 | Level 4 |
| Evaluates current and alternative energy use **(SC5-EGY-01)** | Identifies examples of energy use without supporting evidence. | Outlines current energy use and partially supports it with evidence. | Evaluates current energy use and supports it with relevant evidence. | Thoroughly evaluates current energy use and supports it with extensive evidence. |
| Extract information from a wide range of reliable secondary sources and acknowledge these sources using an accepted referencing style **(SC5-WS-04)** | There is little or no evidence that information sources have been consulted. Minimal or incorrect use of referencing style. | Information has been gathered from a limited range of sources and uses a basic referencing style. | Information has been gathered from appropriate sources and consistently uses an accepted referencing style. | n/a |
| Selects suitable problem-solving strategies to identified problems and proposes solutions **(SC5-WS-07)** | Identifies strategies that might improve energy use.The reasoning is often flawed. | Describes strategies that might improve energy use.The reasoning might be simplistic. | Describes effective strategies for improving energy use.Outlines the costs and an action plan while identifying how impact will be measured.Demonstrates sound reasoning. | Clearly explains highly effective strategies that:* optimise the energy use
* address the identified problem statement.

Outlines the costs and an action plan while identifying how impact will be measured.Demonstrates strong reasoning skills (critical thinking and creativity) and the use of causal language. |
| Communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **(SC5-WS-08)** | Does not clearly communicate an argument for action.Uses minimal scientific language and terminology. | Communicates an argument for action with some clarity.Uses basic scientific language and terminology. | Communicates arguments for action clearly.Uses scientific language and terminology appropriate to the audience. | Communicates arguments for action concisely and coherently, providing evidence and reasoning.Uses scientific language and terminology appropriate to the audience. |

Table 2 – individual marking rubric for the learning journal, including personal reflection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Criteria | Level 1 | Level 2 | Level 3 | Level 4 |
| Follows a planned procedure to undertake safe, ethical, valid and reliable investigations **(SC5-WS-04)** | The learning journal includes limited data and information to support the investigation.Obtains Information from unreliable sources. | The learning journal includes some relevant data and information.Obtains information from some reliable sources. | The learning journal includes relevant data and information.Obtains information on energy use and standards from reliable sources. | n/a |
| Selects and uses a range of tools to process and represent data **(SC5-WS-05)** | Data and information are not clearly and/or logically organised. | Uses an appropriate tool such as software like MS excel or Google Sheets or data logging software or app to organise some collected data. | Uses tools to organise collected data and information.Some calculations are used to support conclusions. | Effectively uses a range of tools to organise collected data and information (for example, tables, graphs and diagrams).Calculations are used to support evidence-based scientific conclusions. |
| Evaluates proposed solutions to identified problems **(SC5-WS-07)** | Provides little to no evaluation. | Provides a limited evaluation, including a strength and/or a weakness.The reasoning might be simplistic. | Evaluates solutions, including strengths and weaknesses.Demonstrates sound reasoning. | Thoroughly evaluates solutions, including strengths and weaknesses and suggestions for improvement.Demonstrates clear and logical reasoning. |
| Communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **(SC5-WS-08)** | Does not communicate arguments clearly.Uses minimal scientific language and terminology.Limited use of communication forms. | Communicates arguments with some clarity.Uses basic scientific language and terminology.Uses a limited range of communication forms. | Communicates arguments clearly.Uses appropriate scientific language and terminology.Uses a range of communication forms. | Communicates arguments concisely and coherently.Uses appropriate scientific language and terminology.Effectively uses a wide range of communication forms such as tables, graphs, diagrams, pictures. |

[Science 7–10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2023.

# Teaching notes

This depth study is designed to take 8 hours of instruction time. The DS numbers below indicate the sequence of activities to be completed during that time.

In this task, students prepare a proposal for the school’s executive. Teachers should invite members of the executive to attend the students’ presentations, as this will add authenticity to the task.

## Prior learning

In earlier lessons in this focus area, students should have developed knowledge, skills and understanding in the following areas:

* understand energy efficiency (1.3 to 1.5)
* be able to apply and convert units and prefixes for describing electrical energy (1.4,1.5 and 2.2)
* be able to tabulate data, plot graphs and perform basic calculations (1.4, 2.3, 3.3, 3.5 and 3.6).

This learning will enhance students’ readiness to engage in the depth study and assessment task activities.

## Facilitating the task

Each class should select a room to collect data for this task. This could be the usual rooms where science lessons are conducted. Once data collection is complete, the data from all classes should be combined into a larger data set that students analyse. Temperature and humidity data can be collected manually at regular intervals. Alternatively, data loggers can be set up to collect some of the required information.

**Teacher note**: the various data collection activities in this task have been collated into Excel workbooks – Thermal comfort recording sheet for teachers.xlsx and Energy audit and Budget template.xlsx. These files might assist in developing data processing and analysis skills in students. They replace the corresponding tables in this assessment task document, and the **EGY Student Learning Journal**.

# DS.1 Explaining the task and data collection

Table 3 – learning intentions and success criteria for DS.1

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to make accurate observations and measurements. | I can identify tools for measuring temperature and humidity. |
| We are learning to systematically collect and record data, information, evidence and findings. | I can:* record a series of measurements over time
* organise data in a table.
 |

### Equipment

To collect data, each class will need:

* a clipboard with a printed copy of the [thermal comfort monitoring sheet](#_Thermal_comfort_monitoring)
* thermometer, hygrometer or digital sensor for recording temperature and humidity
* printed copy of a [Relative Humidity Table (PDF 43 KB)](https://scied.ucar.edu/sites/default/files/media/documents/relative_humidity_chart.pdf) (if using a hygrometer).

Teachers might use online versions of the data collection sheets if they suit the classroom context better.

### Background information

Residential and office buildings, including schools, require energy to run heating/cooling systems, lighting, equipment and domestic hot water. Heating, ventilation and air conditioning are generally used to maintain **thermal comfort.** Those systems are often responsible for most of a building’s total energy consumption.

**Thermal comfort** describes the comfort a person feels with the overall warmth or coolness of their indoor environment. It involves finding a balance between temperature, humidity and airflow to make people feel neither too warm nor cold, thus allowing them to focus and perform their routine activities comfortably. Achieving thermal comfort often involves managing factors like heating, cooling, ventilation and clothing.

Different ways of staying comfortable use different amounts of energy. By changing our habits and adjusting to our school environment, we can stay comfortable and reduce our environmental impact.

### Instructions

#### Introducing the task

**Inquiry question:** How can we optimise energy use at our school?

1. Read through the assessment task notification with the class and describe the key features of the depth study they will conduct.
2. Read the section on ‘Using this learning journal’ (**EGY Student Learning Journal)** and outline how students should use it to record their work throughout the depth study.
3. Divide students into small groups of 3-4 to develop a proposal.
4. Complete the [Pre-survey – energy use at our school](#_Pre-survey:_Energy_use).

#### Introducing thermal comfort

1. Use the teaching prompts in Table 1 to gauge students’ knowledge of thermal comfort and introduce this concept. Students conduct research and respond to these questions in their learning journal (DS.1 Exploring thermal comfort).

Table 4 – teaching prompts for the Exploring thermal comfort questions in the learning journal DS.1

|  |  |
| --- | --- |
| Learning journal question | Teaching prompts |
| What is thermal comfort? | Use the background information above to define thermal comfort. |
| What is thermal discomfort, and why might it be a problem? | Prompt students to think about the conditions that make them uncomfortable and how this affects them. For example, being too hot might make them less focused in class. |
| What factors can affect my thermal comfort? | A range of factors could be considered, including but not limited to:* air temperature – higher temperatures generally cause discomfort if they are not regulated
* radiant temperature – the temperature of surrounding surfaces like walls, ceilings and floors, which can be hot or cold and affect comfort
* humidity – higher humidity reduces the body’s ability to cool down through evaporation of sweat, making it feel warmer
* health – when we are unwell, we might have a fever, which affects our thermal comfort.
 |

#### Monitoring temperature and humidity in the classroom

1. Set up a thermometer and a hygrometer or other measuring devices, such as a temperature and humidity sensor, at bench height in the classroom, along with a clipboard and the thermal comfort monitoring sheet.

**Note:** the teacher might record the relative humidity data from the weather apps on their phones if the hygrometer is not available.

1. Observe and record data when practical once during each class period over the next 2 weeks.
2. Collate data collected from each classroom into a spreadsheet.

**Note:** each depth study class collects data for one room. This data might be collated and shared between the classes for analysis. To complete activities in [DS-3 – analysing collected data](#_DS-3_Analysing_collected), students should have access to a copy of the dataset as they work in small groups to process and analyse data collectively. Each student should record their work in their learning journal as evidence to support their reflections at the end of this depth study.

### Classroom materials

#### Pre-survey – energy use at our school

Complete the following pre-survey questions in your learning journal and compare your responses to those of your group members.

1. Which of the following do you think uses the most energy daily at our school? Rank in order of most energy usage to least.
2. Lights
3. Air conditioning/heating
4. Computers and technology
5. Cooking in the canteen
6. Why do you think managing energy use is important for schools?
7. To save money
8. To reduce environmental impact
9. To keep the school comfortable for learning
10. All of the above
11. How could schools use less energy or use energy more efficiently?

#### Thermal comfort monitoring sheet

Room number: \_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Date | Outside temp (°C) | Class period | Room temp (°C) | Relative humidity (%) | Appliances running (AC, fans, heaters) | Windows (open/closed) | Blinds (open/closed) | Thermal comfort rating (count) |
| **1 – too cold** | **2 – OK** | **3 – too hot** |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |

**Note**: observations are to be recorded during class over 2 weeks. Use local weather data to estimate outside temperature. Survey students to tally class thermal comfort ratings. Relative humidity can also be estimated using a [Relative Humidity Table](https://scied.ucar.edu/sites/default/files/media/documents/relative_humidity_chart.pdf) (PDF 43 KB) comparing wet/dry bulb temperatures.

# DS.2 Conducting classroom energy use audit

Table 5 – learning intentions and success criteria for DS.2

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to make accurate observations and measurements. | I can read a wattmeter and record measurements. |
| We are learning to systematically collect and record data, information, evidence and findings. | I can organise data in a table. |

### Equipment (per class)

Students will need the following materials for this lesson:

* wattmeter (a plug power meter)
* energy audit worksheets (one per group).

### Instructions

1. Direct students to their learning journal’s classroom energy audit section. Lead a class discussion by brainstorming all the factors that might impact the room’s energy use, such as the number of windows, ventilation and electrical appliances. Students should make predictions about which areas or activities in the school use the most energy.
2. Show students [How to Use a Wattmeter (1:47)](https://www.youtube.com/watch?v=O9HBpKx9IW0) to measure and record the power (wattage) of electrical appliances and devices in the classroom.

**Note:** if a wattmeter is unavailable, refer to the DS.2 Energy audit slide in **EGY PPT.**

1. Students conduct an audit of the appliances in the room and then do calculations to estimate the energy use and cost. For further details, see [Classroom energy audit](#_Classroom_energy_audit).

Table 6 – teaching prompts for Exploring thermal comfort questions in the learning journal DS.2

|  |  |
| --- | --- |
| Learning journal question | Teaching prompts |
| How does thermal comfort influence energy use? | Prompt the students to think about their actions when they are cold. Do they reach for a jumper, or turn the heater up? What do they do when it is too hot? |
| What behaviours help us to be comfortable when the weather is too warm or cold? | Unpack with the students the following considerations:* clothing – discuss how an individual’s choice of clothing affects their personal thermal comfort
* behaviour – discuss how an individual’s behaviour affects their personal thermal comfort
* structures, fittings and vegetation – discuss how structures such as windows and louvres, fittings such as blinds and awnings, and vegetation such as trees affect thermal comfort
* technology – list the types of technology used to manage indoor thermal comfort in the school.
 |
| What does it mean to manage thermal comfort responsibly? | Additional question prompts to help students determine what they should research to respond to this question include:* How can we stay comfortable and reduce energy consumption?
* What sustainable technologies or strategies help us maintain thermal comfort while reducing energy use?
* How does the design of a building affect its energy efficiency and thermal comfort?
 |

**Useful resources for student research**

* [Maintaining thermal comfort in indoor work environments](https://www.safework.nsw.gov.au/resource-library/heat-and-environment/maintaining-thermal-comfort-in-indoor-work-environments)
* [Six factors indicating thermal comfort](https://www.hse.gov.uk/temperature/thermal/#six_factors)
* [Energy Rating Calculator](https://calculator.energyrating.gov.au/)

#### Classroom energy audit

Before conducting the energy audit, students use the guiding questions below to explore factors that might impact energy use at school.

1. List all the factors that might impact energy use in your room, such as the number of windows, ventilation, air conditioning and/or heating units and other electrical appliances.
2. Predict which areas or activities in the school use the most energy.

To determine an appliance’s energy usage, plug the wattmeter into the powered electric outlet and then the device into the meter. Wait for a few minutes until the reading becomes constant. Students record the name of the appliance and the power (converted into kilowatts) in the energy audit table in their learning journal (Table 7). Refer to the [Energy Rating Calculator](https://calculator.energyrating.gov.au/) to find out energy usage for hardwired (no power point available) appliances, such as air conditioners. Use the information on the light label to determine the wattage. According to the [YourHome](https://www.yourhome.gov.au/energy/heating-and-cooling) Australian Government website, ceiling fans with DC motors use about 30 Watts.

**Note: DS.2 Energy audit in the EGY PPT contains typical power in watts for common appliances.**

Students complete the energy audit table for their room, including taking notes on other room features that might affect thermal comfort (for example, location, aspect, number of windows and so on) in their learning journals. The method for calculating each column is included in Table 7. The row for lighting has been completed as an example. Students are not required to include the working out in their table, it has been included for demonstration purposes. Students should complete their working in the space provided in their learning journal.

The following formula can be used to estimate the energy use of an appliance from their power and time used:

$$Energy used per week (kWh)=\left(number of devices\right)×\left(hours used per week\right)×\left(power kW\right)$$

**Note**: power is in kilowatts (kW) where $1 kW=1000 W$.

Next, use the following formula to estimate the cost for a week:

$$Cost for a week=\left(kWh per week\right)×\left(cost per kilowatt hour\right)$$

**Note**: assume the cost per kilowatt hour is $0.5432. However, if you have your school’s current cost per kilowatt hour, use that information instead.

Table 7 – energy audit for a room with sample measurements and calculations.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Electrical devices that affect thermal comfort | Number of devices | Total hours used per week | Power (kW) per device | Energy used (kWh/week) | Energy used (kWh/year) | Cost for a week ($) | Cost for a year ($) |
| Method of calculating | Count the devices | Calculate (estimate) the hours of use | Wattmeter reading/1000 to convert to kW | Power per device ⨯ hours used per week | kWh/week ⨯ 52 (or 41 if you only include term time). | kWh/week ⨯ cost of power per kilowatt hour ($0.5432) | Cost for a week ⨯ 41 (term time) |
| Lights | 4 | 4 lights ⨯ 8 hours ⨯ 5 days = 160 | 36 W = 0.036 kW | 0.036 ⨯ 160= 5.76 | 5.76 ⨯ 52 = 299.5 | 5.76 ⨯ 0.5432 = 3.13 | 3.13 ⨯ 41 = 128.28 |
| [Add additional rows for other appliances.] |  |  |  |  |  |  |  |

# DS.3 Analysing collected data

Student groups analyse thermal comfort and energy audit data in previous lessons.

Table 8 – learning intention and success criteria for DS.3

|  |  |
| --- | --- |
| Learning intention | Success criteria |
| We are learning to represent and organise data and information to find patterns and calculate useful values. | I can:* create a visual representation of data
* describe trends observed in temperature and humidity.
 |

### Preparation

Ensure students have access to:

* thermal comfort recording sheet for all classrooms
* a computer or laptop.

### Instructions

1. Students download a copy of the Thermal comfort recording sheet.
2. In groups, students select which room(s) they will analyse to inform their proposal.

**Note: some students** might need assistance downloading, filtering and organising data from the shared spreadsheet before beginning their analysis.

1. Use the guiding questions below to lead data analysis discussion on thermal comfort and classroom energy audit. Students complete the responses in their learning journal.

|  |  |
| --- | --- |
| Learning journal question | Teaching prompts |
| Temperature – How often was the room temperature outside the optimal range (20 to 26°C)? | Use the data sort function in Microsoft Excel to sort data in the ascending or descending order of temperature. Highlight the cells that have temperatures outside the optimal range.What can you say about the difference between the room and outdoor temperatures? Support your answer with data. |
| Humidity – What is the range of relative humidity? How often were the relative humidity measurements outside the optimal range (40–70%)? | Sort the data by the humidity values and highlight the cells that are outside the optimal humidity range (40–70%).How different were the indoor and outdoor humidity measurements? |
| Thermal comfort – which class periods were typically too hot or too cold? | Look for trends and patterns in the collected data.For example, during the sampling period, how many days felt hot, cold and OK (consider how this data might be displayed, such as plots of counts or frequency plots)? |
| Rooms – compare the data for your room with that of another room – are there significant differences? Suggest a reason. | Student responses should include quantitative (temperature, humidity, use of heating and cooling appliances) and qualitative (airflow, aspect and insulation) data. |
| Based on the data you collected, describe any relationships between the temperature and thermal comfort in classrooms. | A table in a Word document or an Excel spreadsheet can be used to organise data, and Excel tools can be used to plot the relevant graphs and identify and analyse the trends and patterns in temperature and humidity in different locations and at different times of the day. |
| Which devices use the most energy? | Use the data sort function in Excel to sort data in the ascending or descending order of energy consumption.How do the energy consumption levels of different appliances compare?Are there specific appliances contributing disproportionately to the total energy usage? |
| What patterns or trends can you identify in energy consumption? | Look for trends and patterns in the collected data.Are there certain times of day or specific periods when energy consumption spikes?How does the usage of appliances vary throughout the day or week? |

1. Students assess their current situation and investigate management strategies using the guiding questions below. Students should engage in peer discussions on the following questions and enter their responses in their learning journals. At the end of the allotted time, conduct a whole-class discussion on the main themes that emerged during the group activity.
* How are people in your school managing thermal comfort?
* How much energy is consumed for lighting, maintaining thermal comfort or running other equipment?
* What might be some issues associated with using too much energy? Why is this important to understand?
* What steps can be taken to reduce energy consumption for the identified high-energy-use appliances?
* Describe some simple changes in usage habits that could lead to significant energy savings.
* Suggest better ways of tracking or controlling the energy use of appliances.
* What are the potential benefits of optimising energy use in terms of cost?
* How much could you potentially save on energy costs by implementing the optimisation strategies?
* How can you increase thermal comfort in our school while reducing or not increasing energy consumption?
1. Students use the following guiding questions to determine what needs to change and why.
* What do we need to change in our school?
* How can we communicate our ideas?
* Do we know enough about thermal comfort to move to the next step?

### Identify the problem statement

1. Students revisit the inquiry question: How can we optimise energy use at our school?
2. Students use the following guiding questions to identify the problem statement. The problem statement should address each of the following questions:
* From your data, what key issue regarding thermal comfort and/or energy use have you identified?
* Why does this issue need to be addressed?
* What impact does managing your thermal comfort have on energy use?
* What are the issues with using too much energy? Why is this important?

# DS.4 Exploring options for action

Student groups explore case studies about how businesses and industries have reduced their energy usage and apply the information to their context.

Table 9 – learning intention and success criteria for DS.4

|  |  |
| --- | --- |
| Learning intention | Success criteria |
| We are learning to use energy more efficiently. | I can outline strategies to improve energy efficiency. |

### Equipment

* A computer/laptop
* Access to internet

### Preparation

Ensure that students analyse the collected data before this lesson. This will enable them to apply the information from the case studies to their school context.

### Instructions

This is a student-centred activity. However, based on the school context, students might need different levels of support.

1. Students work in groups to explore 2 to 3 case studies about how businesses or industries have reduced energy usage. They then apply the information to their school context.
2. Students use the issue-action-impact scaffold to summarise the information on the selected case studies and report back to the class.

**Issue**: identify the key energy use issues from the selected case studies, such as the amount of energy consumed and the activities or processes that contribute most to the energy consumption.

**Action**: outline the change(s) that improved energy efficiency and identify any resources required to make the change.

**Impact**: explain how the improvements benefited the business or industry.

Student reflections could be collected using a [silent debate](https://www.nate.org.uk/wp-content/uploads/2020/04/8_Silent_debate.pdf) as an alternative to sharing their summary of the case studies with the class.

A list of relevant [case studies](https://www.energy.gov.au/publications?field_publication_type_taxonomy_target_id_1%5b%5d=386&sort_by=title) can be found below. Links to these case studies can be found in the [Student Learning Journal](https://education.nsw.gov.au/teaching-and-learning/curriculum/science/science-curriculum-resources-k-12/science-7-10-curriculum-resources/science-s5-energy).

* [Energy and water efficiency and waste reduction - Alto Hotel](https://www.energy.gov.au/publications/energy-and-water-efficiency-and-waste-reduction-alto-hotel)
* [Energy assessment - Footscray Community Arts Centre](https://www.energy.gov.au/publications/energy-assessment-footscray-community-arts-centre)
* [Energy assessment and efficient lighting - ABC Castings](https://www.energy.gov.au/publications/energy-assessment-and-efficient-lighting-abc-castings)
* [Energy efficiency - University of Queensland](https://www.energy.gov.au/publications/energy-efficiency-university-queensland)
* [Energy efficiency assessment - Bendigo Access Employment](https://www.energy.gov.au/publications/energy-efficiency-assessment-bendigo-access-employment)
* [Energy efficiency improvements - Indulge Chocolates](https://www.energy.gov.au/publications/energy-efficiency-improvements-indulge-chocolates)
* [Energy efficiency improvements - Mandurang Nursery](https://www.energy.gov.au/publications/energy-efficiency-improvements-mandurang-nursery)
* [Energy efficiency improvements - The Chocolate Lily B&B](https://www.energy.gov.au/publications/energy-efficiency-improvements-chocolate-lily-bb)
* [Implementing energy efficiency and sustainability measures - Cafe Lua](https://www.energy.gov.au/publications/implementing-energy-efficiency-and-sustainability-measures-cafe-lua)
* [Solar PV system installation - Drury Orchards](https://www.energy.gov.au/publications/solar-pv-system-installation-drury-orchards)
* [Upgrades and behaviour change - Multicultural Services Centre WA](https://www.energy.gov.au/publications/upgrades-and-behaviour-change-multicultural-services-centre-wa)
1. Students work in their groups to research options for improving energy efficiency and thermal comfort and reducing energy use at school.
2. Based on the room data analysis, students should identify a change needed to reduce energy usage and maintain thermal comfort.

**Note:** for example, minimising heat loss/gain might be the identified change action. There are several options to achieve this, such as improving insulation in the ceiling, walls and floors, installing double-glazed windows and sealing gaps and cracks to avoid drafts. Provide students with a limit for the maximum cost of the changes ($10,000 per classroom).

1. The students might use the following guiding questions to explore options for action
* What action should the school take to address the identified problem?
* What data or indicators will tell you if your suggested changes have successfully optimised energy use at your school?

# DS.5 Identifying constraints and selecting an idea for action

Table 10 – learning intentions and success criteria for DS.5

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to:* use energy more efficiently
* select strategies to solve scientific problems and evaluate our solutions.
 | I can:* identify resources and constraints
* identify strategies for the action plan.
 |

In this activity, student groups plan and shortlist ideas for:

* improving thermal comfort at school by reducing energy demands.

### Equipment

* A computer/laptop
* Access to internet

### Instructions

1. Student groups use the guiding questions below to identify resources and constraints for their action plan. These questions are also provided in the learning journal.
* Who could help with your planning or implementing your proposal?
* What time and finances are available for the project?
* What factors might limit your action plan?
1. In groups, students use the guiding questions below to plan and develop ideas for sustainably managing thermal comfort and optimising energy use at school.
* What type of actions in our school will optimise energy use?
* What roles do student behaviour and habits play in managing thermal comfort and reducing energy consumption?
1. After students have engaged in peer discussions and answered the questions in their learning journals, teachers might ask them to describe their ideas in whole-class discussions.

**Useful resources**

* [Passive cooling](https://www.yourhome.gov.au/passive-design/passive-cooling)
* [The shift to renewables](https://www.energy.nsw.gov.au/nsw-plans-and-progress/major-state-projects/shift-renewables)
* [Being more energy efficient](https://www.energy.nsw.gov.au/households/guides-and-helpful-advice/being-more-energy-efficient)
* [Warning over ‘heat island’ effect in cities as tree coverage declines](https://www.abc.net.au/news/2020-02-13/climate-warning-over-heat-island-effect-as-city-greenery-decline/11923890)
* [Climate change, green cover and open spaces](https://www.climatechange.environment.nsw.gov.au/impacts-climate-change/built-environment/green-cover-and-open-spaces)

# DS.6 Developing your action proposal

Student groups develop an action proposal that includes budgets, resourcing and a plan to measure the impact of their proposed actions.

Table 11 – learning intentions and success criteria for DS.6

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to:* use energy more efficiently
* select strategies to solve scientific problems and to evaluate our solutions.
 | I can:* make informed decisions about reducing energy use
* make informed decisions about improving thermal comfort
* use data I have collected to support my group’s proposal
* describe how I could measure the impact of proposed actions.
 |

### Preparation

* Book computers/laptops
* Send a reminder to the senior executive member(s) of the proposed presentation date and time (for DS.6)

### Instructions

1. Students work in groups to finalise their proposal on optimising energy use at school.
2. Students prepare their presentation/poster to present their proposal:
* maximum 5 slides (excluding title and reference slides) OR A3/digital poster
* minimum font size 14.
1. Students address the following guiding questions in their presentation. These are also provided in the student learning journal.
* What is the energy optimisation action that you have planned?
* How will you evaluate the success of our improvements? What evidence will you provide to support your evaluation?
* Outline the individual steps that will be required.
* What budget or resources are required for each step?
* Refer to the sample table below:

Table 12 – sample budget table

|  |  |  |  |
| --- | --- | --- | --- |
| Replacement item | Number of items | Cost per item ($) | Cost ($) |
| Name of item | Number of items per room | Cost of one item | Multiply the cost of one item with the number of items |
| LED light | 6 | 20 | 120 |
| Double-glazed windows (900 mm x 1200 mm) | 4 | 1000 | 4000 |
| Thermal insulation blinds | 4 | 300 | 1200 |
| Total cost |  |  | 5320 |

**Note**: students can use Excel to list resources they need (for example, changing room lights to LED) and track the budget. Populate the spreadsheet with the number of items and cost of items (from a hardware store website).

* Who would be responsible for these actions?
1. Instruct students to include the following in their group proposal:
* an action plan
* the success criteria and how they could record evidence to measure the impact of their actions.
1. Provide guidance to students on the use of connectives and evaluative language in developing their proposal. Refer to scaffolds and templates in **EGY PPT.**

**Note**: remind students to include data from thermal comfort surveys and energy audits to help justify their proposals. Encourage students to communicate their ideas using photographs and diagrams.

# DS.7 Communicating your proposal

Students present their proposal explaining thermal comfort issues and sustainable solutions to the school executive and class.

Table 13 – learning intentions and success criteria for DS.7

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to:* use energy more efficiently
* communicate scientific arguments with evidence, using scientific language and terminology appropriate to the audience.
 | I can:* outline a plan for improving energy efficiency
* clearly communicate arguments for action
* use terminology appropriate to the audience.
 |

### Preparation

* Ensure you have access to a projector connected to a laptop for the PowerPoint presentation and a wall/board for displaying the posters.
* Students should upload their presentations on platforms like Google Classroom or Microsoft Teams to save time during group changeovers.

Provide the attending senior executive member(s) with a recording sheet with the students’ names in each group and their proposal titles. They might adopt some of the suggestions presented by students for improving energy efficiency at school.

Table 14 – recording sheet for feedback

|  |  |  |
| --- | --- | --- |
| Student names | Proposal title | Comments |
|  |  |  |
|  |  |  |
|  |  |  |

**Note:** print the relevant number of feedback recording sheets to collect peer feedback on presentations from 2 student groups.

Table 15 – feedback recording sheet

Group number \_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| Student names | Comments |
|  |  |

### Instructions

1. Student groups present their proposal to their peers and/or other school community members.
2. Each student group completes feedback for 2 groups in the feedback recording sheet and returns it to their teacher. For example, when student group 1 presents their proposal, all the other groups complete their comments on the recording sheet and return it to the teacher at the end of the presentation. This peer feedback is passed on to group 1 students to collate their reflections.
3. Students begin reflecting on the strengths and weaknesses of their proposals by taking notes in their learning journals.

# DS.8 Reflecting on the proposed actions and evaluating plans

Students reflect on their group’s proposed plan and submit their completed journal for marking.

Table 16 – learning intentions and success criteria for DS.8

|  |  |
| --- | --- |
| Learning intentions | Success criteria |
| We are learning to:* use energy more efficiently
* select strategies to solve scientific problems and to evaluate our solutions
* communicate scientific arguments with evidence, using scientific language and terminology appropriate to the audience.
 | I can:* outline the strengths and weaknesses of my group’s proposal
* make suggestions for how the proposal could be improved
* communicate arguments using scientific language and terminology.
 |

### Preparation

Ensure that:

* each student has access to their group’s proposal and their learning journal
* the room is set up so that students can work independently
* adequate time is provided for students to complete the reflection.

### Instructions

1. Each student individually completes a reflection by responding to the guiding questions:
* What were the strengths and weaknesses of your group’s plan?
* How could the proposal and action be improved? (Link to equipment/technologies for measuring and monitoring success.)
* How else could you communicate to engage others to try our ideas?
1. **Before students submit their journals, each student is to:**
* reflect on their learning by completing the table in the student learning journal
* outline some new knowledge and skills they have developed in this task.
1. Provide guidance to students on the use of connectives and evaluative language in developing their proposal. Refer to scaffolds and templates in **EGY PPT.**

# Evidence base

This resource contains NSW Curriculum and syllabus content. The NSW Curriculum is developed by the NSW Education Standards Authority. This content is prepared by NESA for and on behalf of the Crown in right of the State of New South Wales. The material is protected by Crown copyright.

Please refer to the NESA Copyright Disclaimer for more information <https://educationstandards.nsw.edu.au/wps/portal/nesa/mini-footer/copyright>.

NESA holds the only official and up-to-date versions of the NSW Curriculum and syllabus documents. Please visit the NSW Education Standards Authority (NESA) website <https://educationstandards.nsw.edu.au> and the NSW Curriculum website <https://curriculum.nsw.edu.au>.

[Science 7–10 Syllabus](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2023.

AdaptNSW (n.d.) [*Climate change, green cover and open spaces*](https://www.climatechange.environment.nsw.gov.au/impacts-climate-change/built-environment/green-cover-and-open-spaces), AdaptNSW website, accessed 15 July 2024.

ARENA (Australian Renewable Energy Agency) (2024) [*What is renewable energy?*](https://arena.gov.au/what-is-renewable-energy/), ARENA website, accessed 15 July 2024.

Australian Government (2024) [*Energy Rating Calculator*](https://calculator.energyrating.gov.au/) *[website]*, energyrating.gov.au, accessed 15 July 2024.

Brookhart SM (2018) ‘[Appropriate Criteria: Key to Effective Rubrics](https://www.frontiersin.org/articles/10.3389/feduc.2018.00022/full)’, Frontiers in Education, volume 3(22):1–12, doi:10.3389/feduc.2018.00022, accessed 15 July 2024.

CESE (Centre for Education Statistics and Evaluation) (2020a) [*What works best: 2020 update*](https://education.nsw.gov.au/about-us/educational-data/cese/publications/research-reports/what-works-best-2020-update), NSW Department of Education, accessed 15 July 2024.

CESE (2020b) [*What works best in practice*](https://education.nsw.gov.au/about-us/educational-data/cese/publications/practical-guides-for-educators-/what-works-best-in-practice), NSW Department of Education, accessed 15 July 2024.

CESE (2021) [*Growth goal setting – what works best in practice*](https://education.nsw.gov.au/about-us/educational-data/cese/publications/practical-guides-for-educators/growth-goal-setting), NSW Department of Education, accessed 15 July 2024.

Fisher D and Frey N (1 November 2009) ‘[Feed Up, Back, Forward](https://www.ascd.org/el/articles/feed-up-back-forward)’, ASCD (Association for Supervision and Curriculum Development): Educational Leadership magazine, 67(3), accessed 15 July 2024.

Griffin P (2017) Assessment for Teaching, Cambridge University Press, Port Melbourne, Victoria.

Hattie J and Timperley H (2007) [‘The Power of Feedback’](https://journals.sagepub.com/doi/abs/10.3102/003465430298487), Review of Educational Research, 77(1): 81–112, doi:10.3102/003465430298487, accessed 15 July 2024.

HSE (Heath and Safety Executive) (n.d.) [*Six factors indicating thermal comfort*](https://www.hse.gov.uk/temperature/thermal/#six_factors), HSE website, accessed 15 July 2024.

NSW Climate and Energy Action (n.d.a) [*Being more energy efficient*](https://www.energy.nsw.gov.au/households/guides-and-helpful-advice/being-more-energy-efficient), NSW Climate and Energy Action website, accessed 15 July 2024.

NSW Climate and Energy Action (n.d.b) [*The shift to renewables*](https://www.energy.nsw.gov.au/nsw-plans-and-progress/major-state-projects/shift-renewables), NSW Climate and Energy Action website, accessed 15 July 2024.

Panadero E and Jonsson A (2013) ‘[The use of scoring rubrics for formative assessment purposes revisited: A review](https://www.sciencedirect.com/science/article/abs/pii/S1747938X13000109?via%3Dihub)’, Educational Research Review, 9:129–144, doi:10.1016/j.edurev.2013.01.002, accessed 15 July 2024.

SafeWork NSW (n.d.) [*Maintaining thermal comfort in indoor work environments*](https://www.safework.nsw.gov.au/resource-library/heat-and-environment/maintaining-thermal-comfort-in-indoor-work-environments), SafeWork NSW website, accessed 15 July 2024.

Sherrington T (2019) Rosenshine’s Principles in Action, John Catt Educational Limited, Melton, Woodbridge.

Wiliam D (2017) Embedded Formative Assessment, 2nd edn, Solution Tree Press, Bloomington, IN.

Wood P (13 February 2020) ‘[Warning over ‘heat island’ effect in cities as tree coverage declines](https://www.abc.net.au/news/2020-02-13/climate-warning-over-heat-island-effect-as-city-greenery-decline/11923890)’, ABC News Breakfast website, accessed 15 July 2024.

**© State of New South Wales (Department of Education), 2024**

The copyright material published in this resource is subject to the Copyright Act 1968 (Cth) and is owned by the NSW Department of Education or, where indicated, by a party other than the NSW Department of Education (third-party material).

Copyright material available in this resource and owned by the NSW Department of Education is licensed under a [Creative Commons Attribution 4.0 International (CC BY 4.0) license](https://creativecommons.org/licenses/by/4.0/).



This license allows you to share and adapt the material for any purpose, even commercially.

Attribution should be given to © State of New South Wales (Department of Education), 2024.

Material in this resource not available under a Creative Commons license:

* the NSW Department of Education logo, other logos and trademark-protected material
* material owned by a third party that has been reproduced with permission. You will need to obtain permission from the third party to reuse its material.

**Links to third-party material and websites**

Please note that the provided (reading/viewing material/list/links/texts) are a suggestion only and implies no endorsement, by the New South Wales Department of Education, of any author, publisher, or book title. School principals and teachers are best placed to assess the suitability of resources that would complement the curriculum and reflect the needs and interests of their students.

If you use the links provided in this document to access a third-party's website, you acknowledge that the terms of use, including licence terms set out on the third-party's website apply to the use which may be made of the materials on that third-party website or where permitted by the Copyright Act 1968 (Cth). The department accepts no responsibility for content on third-party websites.