 Cooling rate of water

Stage 4 Working Scientifically & Chemical World

Outcomes

Values and attitudes

SC4-1VA student appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them

Working scientifically

SC4-5WS collaboratively and individually produces a plan to investigate questions and problems

* WS5.1 Students identify data to be collected in an investigation by:

1. proposing the type of information and data that needs to be collected in a range of investigation types, including first-hand and secondary sources

* WS5.2 Students plan first-hand investigations by:

1. outlining a logical procedure for undertaking a range of investigations to collect valid first-hand data, including fair tests
2. identifying in fair tests, variables to be controlled (held constant), measured and changed

* WS5.3 Students choose equipment or resources for an investigation by:

1. identifying suitable equipment or resources to perform the task, including safety equipment and digital technologies
2. selecting equipment to collect data with accuracy appropriate to the task (ACSIS126, ACSIS141)

SC4-6WS follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually

* WS 6 Students conduct investigations by:

1. selecting equipment to collect data with accuracy appropriate to the task (ACSIS126, ACSIS141)

Knowledge and understanding

SC4-16 CW describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles

CW1 The properties of the different states of matter can be explained in terms of the motion and arrangement of particles. (ACSSU151)

* 1. describe the behaviour of matter in terms of particles that are continuously moving and interacting
  2. relate an increase or decrease in the amount of heat energy possessed by particles to changes in particle movement
  3. use a simple particle model to predict the effect of adding or removing heat on different states of matter
  4. relate changes in the physical properties of matter to heat energy and particle movement that occur during observations of evaporation, condensation, boiling, melting and freezing

Learning across the curriculum

Cross-curriculum priorities

☐Aboriginal and Torres Strait Islander histories and cultures

☐Asia and Australia's engagement with Asia

☐Sustainability

General capabilities

☒Critical and creative thinking

☐Ethical understanding

☒Information and communication technology capability

☐Intercultural understanding

☐Literacy

☒Numeracy

☐Personal and social capability

Other areas of learning

☐Civics and citizenship

☐Difference and diversity

☐Work and enterprise

Teacher notes

This task is intended to be a formative skill based task which aims at providing feedback to students as well as allowing students the opportunity to self-reflect on the completion of a practical task.

There is opportunity to use the planning sheet as a brainstorming activity to differentiate for some learners.

Teachers can use the materials check sheet as either a shopping list or bring items to class so students can see what they may use when planning.

The rubric uses syllabus outcomes and outlines expectations for students for each of the outcomes. Teachers can assess student achievement level as low, satisfactory and high. The rubric is duplicated for students to assess their peers and complete a self-reflection. The assessment rubric does not include presentation of data. The task is aimed at observing and giving feedback to students for following through a plan. Presentation of data, writing scientific reports and planning investigations can be added into the rubric. Collection of the results is a good opportunity to clarify the difference between qualitative and quantitative data.

This task can be extended beyond an in-class assessment to create a project based learning task within a unit of work where students can create a feasible product or device to increase the efficiency of energy conversions (Physical World strand).

Introduction

Heat can be lost in three ways, each involving heat moving from a hot object to a cold one. Heat will always transfer from hot to cold. Teachers could have students write definitions of these terms prior to the activity.

1. Conduction – the transfer of energy in a solid object by rapid vibration of atoms.

2. Convection – the transfer of heat energy through a liquid or gas by the movement of atoms.

3. Radiation – the emission of electromagnetic radiation from a source.

Keeping warm involves reducing the transfer of heat. This can be done by insulating the object. Substances can either be conductors or insulators of energy.

1. Conductors allow energy to flow through them, for example metals.

2. Insulators decrease the flow of energy through them, for example plastics.

Task introduction

Have you ever had to put up with a warm tea rather than a hot one? Or been disappointed by the quality of a hot chocolate because it’s gone cold?

Brainstorm some of the things which may affect how fast hot water cools down. Choose one to investigate during your practical assessment. You will need to choose the equipment for your investigation, identify your dependent and independent variables, variables that need controlling and the data to be collected. Decide how you will record and present this data appropriately. Discuss how you will make your investigation safe by identifying any risks and how they will be addressed.

Task

Instructions:

1. You will have one lesson to plan your investigation, followed by one lesson to perform your investigation.
2. You do not have to write an experimental report, but will need to provide reasons for all your choices. Use the scaffold provided to cover the skills outcomes being developed.
3. Record information about your investigation and what you have learnt.

The school will provide the following range of materials. Tick which ones you would like to use, also indicating the quantity you will need.

* Foam cups
* Plastic cups
* Paper cups
* 50 mL glass beakers
* 100 mL glass beakers
* 50 mL conical flasks
* Cotton wool
* Aluminium foil
* Silk
* Flannel or similar material
* Sticky tape
* Masking tape
* Thermometers
* Stopwatches
* Measuring cylinders
* Other (to be negotiated with your teacher, please discuss this option)

Planning sheet

The following questions can be used with students to help them plan their investigation.

Brainstorming

1. What things might affect the way water cools down?
2. Which one will you be investigating? What is your dependent variable?
3. What will you be comparing to improve your understanding of how this affects the way water cools down?
4. What will you be measuring? What is your independent variable?
5. What types of data or information will you be collecting? Is it qualitative or quantitative?
6. What things are you keeping the same to make your investigation fair? What are your controlled variables?

Investigation Record

1. Outline the procedure you are using. You can use a flow chart, labelled diagram or standard procedure format.
2. What steps are you taking to make sure the investigation is safe?
3. Record the data and information you have collected.

Marking guideline/rubric

This marking rubric can be replicated for student self-reflection and peer review.

| Outcomes description | Task expectation | Achievement Level |
| --- | --- | --- |
| Proposing the type of information and data that needs to be collected | Clearly states relevant information/data to be collected for the identified factor | Low  Satisfactory  High |
| Identifying in fair tests, variables to be controlled (held constant), measured and changed.  Identifying dependent, independent and controlled variables. | Identifies a single variable to change.  Identifies the related variable to measure.  Maintains a fair test by identifying factors to be kept the same. | Low  Satisfactory  High |
| Selecting equipment to collect data with accuracy appropriate to the task | Equipment matches the stated factor being investigated and allows for fair comparison.  Only the previously identified equipment was needed when carrying out the investigation. | Low  Satisfactory  High |
| Identifying suitable equipment or resources to perform the task, including safety equipment | Equipment identified.  Safety features correctly identified. | Low  Satisfactory  High |
| Outlining a logical procedure for undertaking a range of investigations to collect valid first-hand data, including fair tests | Outlines a procedure consistent with the purpose and variables identified.  Information presented could allow for its replication.  Observed investigation followed this procedure. | Low  Satisfactory  High |