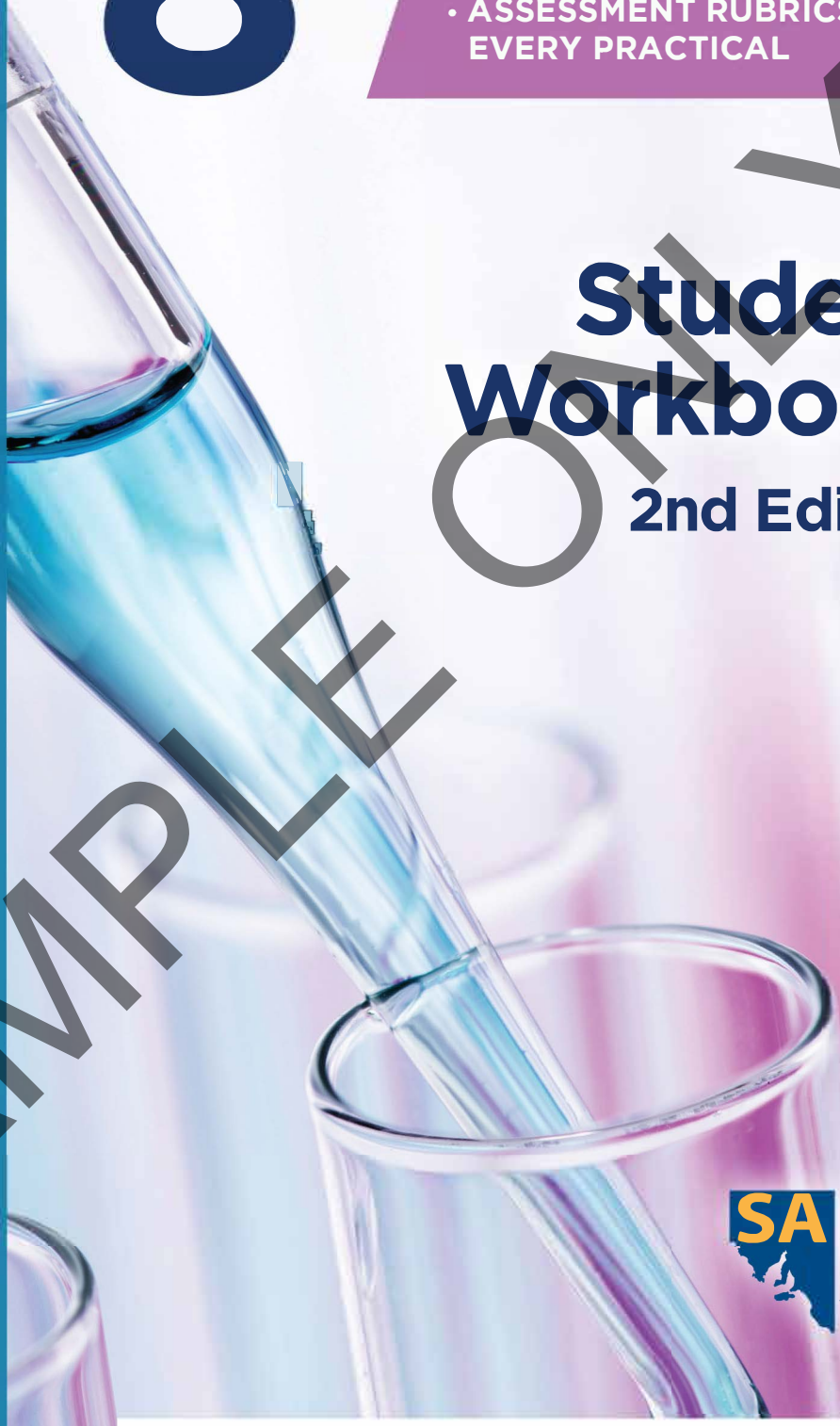
SCIENCE PRACTICAL INVESTIGATIONS

AUSTRALIAN CURRICULUM EDITION

YEAR 8

- 21 PRACTICAL INVESTIGATIONS
- 2 DESIGN CHALLENGES
- ASSESSMENT RUBRICS FOR EVERY PRACTICAL



Student Workbook

2nd Edition

SASTA South Australian Science Teachers Association

Name

Class

About this book

This student workbook provides a **hands-on program of science investigations.** It has been carefully written to ensure that students can work confidently and independently, developing and enhancing the understandings and skills of the **Australian Curriculum: Science.**

The **23 practical investigations** in the workbook are in four main sections; Biological sciences, Chemical sciences, Earth and Space science and Physical sciences. They cover the entire scope and sequence of the Year 8 Australian Curriculum: Science, with an emphasis on the **Science Inquiry Skills, including practical design.**

To reflect the emerging emphasis on **STEM** skills and dispositions, this workbook contains two **Engineering Design Challenges.** Each challenge asks students to apply their content knowledge and skills to create solutions to real world applications of science using an engineering design process.

- Practicals where students are asked to design their own procedure are designated as **design practicals.**
- Practicals that ask students to employ the engineering design process are designated as **Engineering Design Challenges.**

A Curriculum map is provided on pages 7 and 8.

An assessment rubric has been developed for each practical investigation. This rubric assesses students' level of achievement of the Science Inquiry Skills relevant to the practical and has been developed using the Australian Curriculum **Achievement Standards.**

The workbook includes introductory sections that build necessary skills and provide clear guidelines for **scientific literacy.**

Each practical has a **consistent format** with language that reflects that of the Australian Curriculum: Science.

Each investigation has been **tested by teachers and students** to ensure usefulness and feasibility.

Safety is always of utmost concern and we encourage students and teachers to develop safety procedures and risk assessments for each practical investigation and wear personal protective equipment at all times.

Contents

Curriculum Overview – SCIENCE UNDERSTANDING

Australian Curriculum	Practical																						
Science Understanding	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Biological sciences																							
Cells are the basic units of living things; they have specialised structures and functions			■	■	■	■	■																
Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce								■															
Chemical sciences																							
Properties of the different states of matter can be explained in terms of the motion and arrangement of particles									■	■	■												
Differences between elements, compounds and mixtures can be described at a particle level												■	■	■									
Chemical change involves substances reacting to form new substances															■								
Earth and space science																							
Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales																■	■	■					
Physical science																							
Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems																			■	■	■	■	■

Curriculum Overview – SCIENCE AS A HUMAN ENDEAVOUR

Australian Curriculum	Practical																						
Science as a Human Endeavour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Nature and development of science																							
Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available						■		■												■			
Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures								■										■	■		■		
Use and influence of science																							
Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations																■	■		■	■	■	■	■
People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity																	■	■					■

Curriculum Overview – SCIENCE INQUIRY SKILLS

Australian Curriculum	Practical																						
Science Inquiry Skills	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
Questioning and predicting																							
Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge	■	■																					
Planning and conducting																							
Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed	■	■				■																	■
Measure and control variables, select equipment appropriate to the task and collect data with accuracy	■	■																					
Processing and analysing data and information																							
Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Evaluating																							
Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements		■				■	■				■			■					■	■	■		■
Use scientific knowledge and findings from investigations to evaluate claims based on evidence								■	■					■	■		■	■	■			■	
Communicating																							
Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Safety in the Science Laboratory

1. You must not enter the laboratory unless a teacher is present.

You must not enter the preparation room or store room at any time.

2. Do not eat or drink in the science laboratory.

3. If there is an accident, inform your teacher immediately.

4. Never attempt unauthorised experiments. You must read and follow instructions exactly.

If you see another student using an incorrect procedure, point out the error.

5. Safety glasses and aprons must be worn for **all** practicals.

6. Do not handle hot objects; allow sufficient time for the apparatus to cool.

7. Treat ALL chemicals as poisonous. NEVER taste chemicals. Smell with care and only after being instructed to do so. Avoid skin contact or inhaling any chemicals.

8. Wash your hands thoroughly after using chemicals.

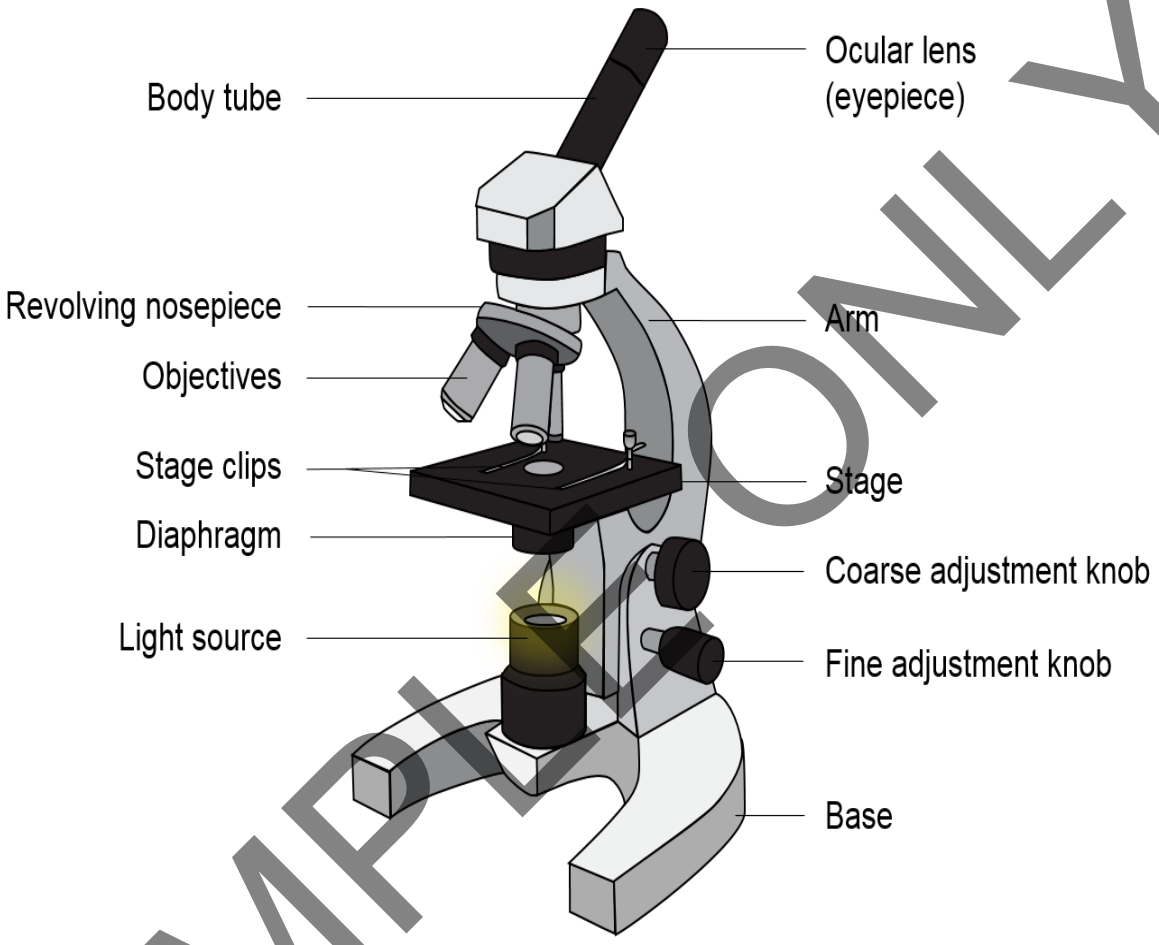
9. Handle glass with care. Broken glass should be reported to a teacher immediately.

Do not attempt to collect broken glass; this must be done by the teacher.

10. All apparatus should be examined carefully before use; it should be clean and in working order. Any damaged or dangerous apparatus must be reported immediately. Check all apparatus before putting it away. It should be undamaged and clean. Keep your work area clean and tidy.

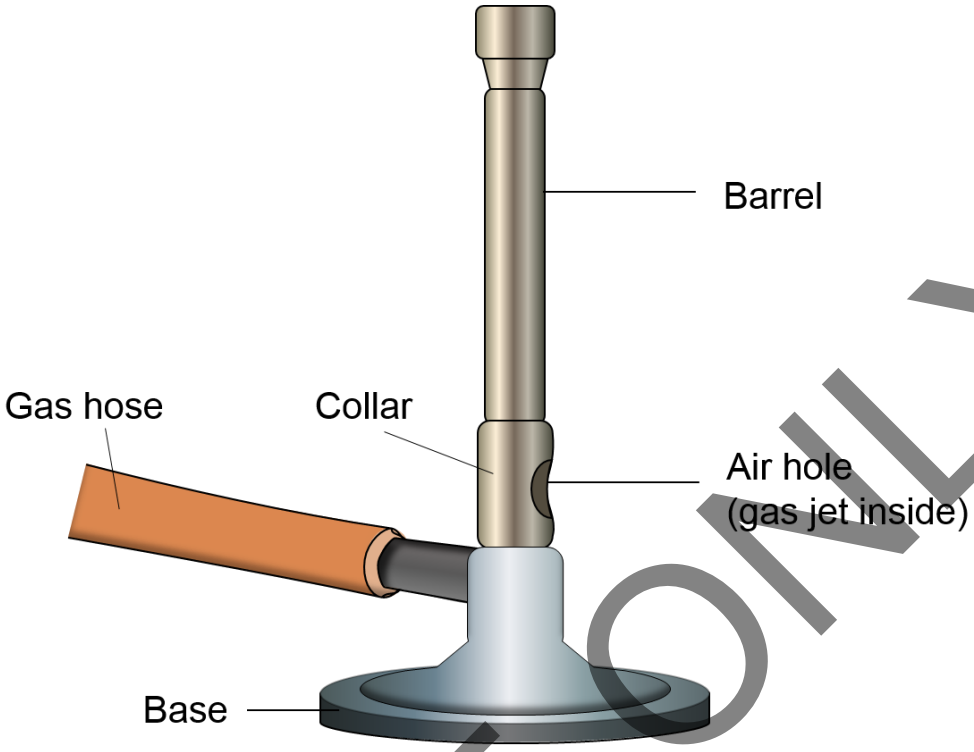
Add any extra rules below:

Light Microscope



Always collect a microscope by holding it with two hands, one on the arm and one under the base.

The Bunsen Burner



1. Put the Bunsen burner on a heat proof mat.
2. Connect the gas hose to the gas supply.
3. Use the ring to close the Bunsen burner air hole.
4. Get a match and light it.
5. Turn on the gas.
6. Hold the burning end of the match about 3 cm above the top of the burner barrel to light the gas.
7. Leave the air hole closed for a visible, yellow flame (the safety flame).
8. Open the air hole for a hotter, blue flame.

SAFETY

When you are not using the Bunsen burner, switch it off or close the air hole so that other people can see the yellow flame.

The burner gets hot! Leave it to cool down before picking it up.

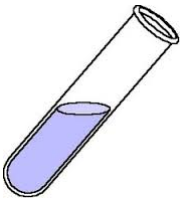
Always use a heat-resistant mat and wear safety glasses.

Other Laboratory Equipment

Beaker

Gauze Mat

Test Tube

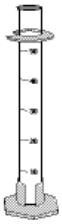


Evaporating Dish

Tongs

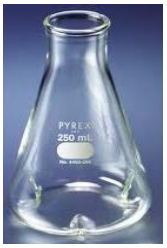
Mortar and Pestle

Measuring Cylinder



Bunsen Burner

Conical flask



Clamp

Watch Glass

Spatula

Filter Funnel

Teat Pipette

Dropper Bottle

Tripod

Retort Stand

Stirring Rod

Practical 1 – Sweet cuppa

Background

A **solute** is a substance that is dissolved into another substance. A **solvent** is a substance into which chemicals are dissolved. When a solute and solvent are mixed together, they form a **solution.** The solute is dissolved in the solvent.

When sugar and instant coffee are dissolved in a cup of hot water the sugar and coffee are the solutes and the hot water is the solvent; together they make a sweet coffee solution.

Purpose

To investigate the effect of water temperature on the solubility of sugar in water.

Note that water will be used instead of coffee because it may be too hard to observe the sugar dissolving in coffee.

From the information given in the Purpose and by reading through the Procedure, identify the variables in this investigation and construct a question for investigation.

Independent variable (include units of measure)

_____

Dependent variable (include units of measure)

_____

Question for investigation

What happens to (dependent variable) _____

When we change (independent variable) _____

What factors will you control to ensure this is a fair test?

(A detailed list of all the factors (things) that you expect to affect how fast the sugar dissolves except for the independent variable)

_____

_____

_____

Prediction

(This is a statement about what you expect to observe for the dependent variable as the independent variable is changed.)

_____

_____

Materials

- 4 x 250 mL beakers
- 4 thermometers
- 100 mL measuring cylinder
- glass stirring rod
- room temperature water (approx. 22 °C)
- refrigerated water (approx. 4 °C)
- Bunsen burner, heat proof mat, gauze mat, tripod
- stop watch
- matches
- kettle
- 4 sugar cubes
- tongs
- kettle

Procedure

(Note that you do not have to do the boiling water first. You can choose to do the water temperature treatments in any order)

1. Set up the heat proof mat, Bunsen burner, tripod and gauze mat ready to heat water.
2. Use the measuring cylinder to transfer 100 mL of tap water into one 250 mL beaker
3. Use the Bunsen burner (on blue flame) to heat the water until it boils.
4. Measure the temperature of the water using the thermometer and record this value in the results table.
5. Use the tongs to drop a cube of sugar into the boiling water and simultaneously start the stop watch.
6. Stir the boiling water with the stirring rod and continue timing until all the sugar from the sugar cube appears to have dissolved.
7. Stop the stop watch and record the time taken for the sugar to dissolve in the results table.
8. Repeat steps 2 – 7 until you have completed the experiments with all four water temperatures. This means that instead of boiling the water using the Bunsen burner at step 3 you will use the refrigerated water, room temperature water, and hot water (from the kettle).

Draw a properly formatted scientific diagram of your Bunsen burner set up to heat the water here:

Results

The effect of raising water temperature on sugar dissolution

Water temperature description	Measured water temperature (°C)	Time taken for sugar cube to completely dissolve (s)
Refrigerated		
Room temperature		
Hot (from kettle)		
Boiling (Bunsen burner)		

Graphing

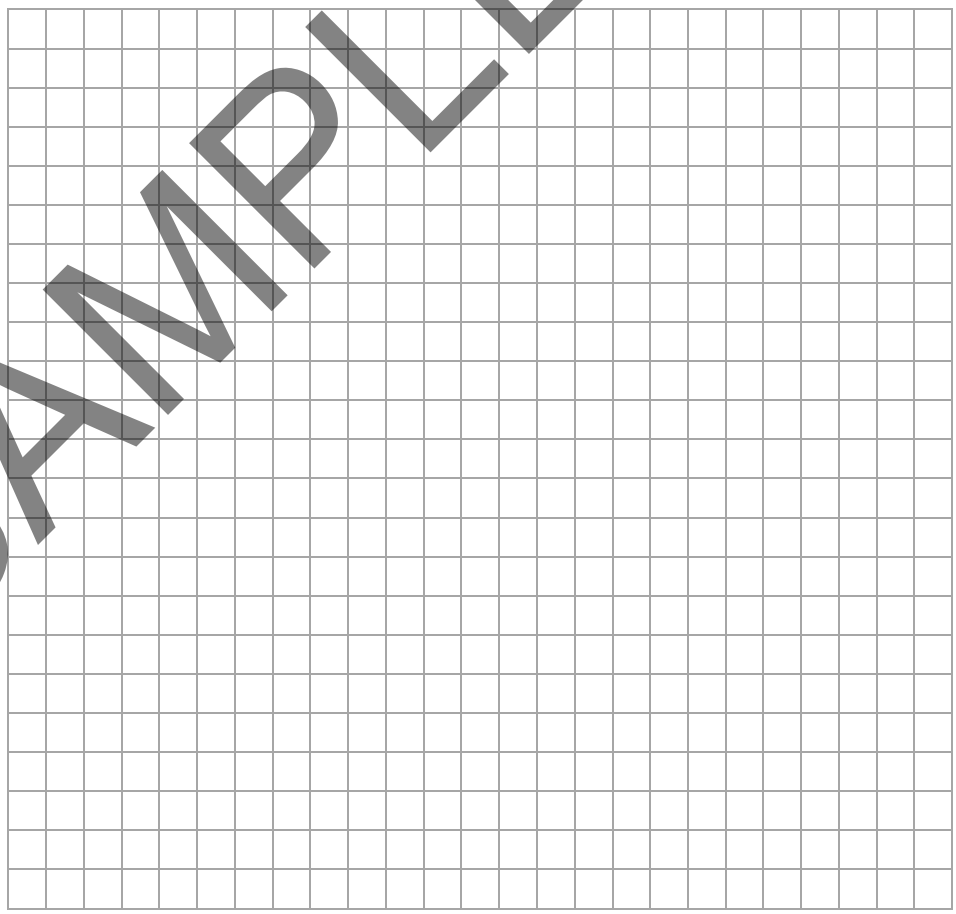
Draw a graph of your data. Make sure that it has an appropriate title and all axes are labelled correctly.

The y axis will be used for the factor that is being measured. What type of variable is this?

_____

The x axis will be used for the factor that is being changed. What type of variable is this?

_____



Conclusion

Write a statement that answers your question for investigation. **(Claim)**

(Hint: describe what happens to the time taken for the sugar to dissolve as the temperature of the water increases.)

Support your claim with a summary of your evidence. **(Evidence)**

Explain your results using the relevant scientific concepts. **(Reasoning)**

Assessment Rubric – Sweet Cuppa

		Achievement Standard	A	B	C	D	E
Science Inquiry Skills	Questioning and Predicting	Students identify and construct questions and problems that they can investigate scientifically.	**Constructs** a clear and correctly formatted question that can be investigated scientifically. Makes a **justified** prediction.	**C**onstructs correctly formatted question that can be investigated scientifically. Makes a **valid** prediction.	Constructs a question that can be investigated scientifically. Makes a **logical** prediction.	**With guidance**, constructs a question that can be investigated scientifically. Makes a **simple** prediction.	**Uses question given** investigation question. Does not make a prediction or makes an irrelevant or unclear prediction.
	Planning and conducting	Students identify variables to be changed, measured and controlled.	**Accurately** identifies the independent and dependent variables, including their units of measure where appropriate. Provides a **comprehensive list** of factors that need to be controlled to ensure the reliability of data collected.	**Accurately** identifies the independent and dependent variables, including their units of measure where appropriate. **Lists a range of** factors that need to be controlled to ensure the reliability of data collected.	Identifies the independent and dependent variables. **Lists several** factors that need to be controlled to ensure the reliability of data collected.	**Identifies, with guidance**, the independent and dependent variables. Acknowledges the need for a fair test by listing **one factor** to be controlled**.**	Lists variables **without** identifying the independent, dependent and controlled variables.
	Processing data	Students construct representations of their data.	**Accurately** organises and records data and observations, giving appropriate detail. Constructs an **appropriate graph** with an accurate title incorporating the variables, labels and measurements for the axes, an incremental scale and **accurate** plotting of data.	**Accurately** records data and observations. Constructs an **appropriate graph** with an accurate title incorporating the variables, labels and measurements for the axes, an incremental scale and plotting of data.	**Records** data and observations. Constructs a **graph** with a title, axes labels and measurements for the axes, an incremental scale and accurate plotting of data.	Records data and observation **simply.** . Constructs a **simple** graph with some **inaccuracies and/or key features omitted.**	**Uses provided tables** to organise and record data and observations with some inaccuracies. **Partially constructs** a simple graph with **many inaccuracies and/or key features omitted.**
	Analysing data	Students use representations to reveal and analyse patterns and trends in data and observations.	**Critically** and **logically** examines data to identify patterns and trends.	**Logically** examines data to identify patterns and trends.	**Examines** data to identify patterns and trends.	**Identifies** simple patterns in data. Has **attempted** to identify some trends in the data.	**Recognises** simple patterns in data. Has not independently identified any trends in the data.

Assessment Rubric – Sweet Cuppa

		Achievement Standard	A	B	C	D	E
		Students use patterns and trends in data and observations when justifying their conclusions.	**Critically** analyses data, making connections with **relevant** scientific concepts to formulate **an accurate conclusion based on evidence.**	Analyses data, making connections with **relevant** scientific concepts, to formulate **logical** conclusions.	**Analyses** data and their connections with scientific concepts, to formulate **simple** conclusions.	Draws a conclusion that **does not accurately relate to the data.**	If provided, the conclusion is **unclear and unconnected to the data**.
	Communicating	Students use appropriate language and representations to communicate science ideas, procedures and findings in a range of text types.	**Concisely and coherently** uses appropriate scientific language and representations to communicate science ideas, methods and findings in a range of text types	**Coherently** uses appropriate scientific language and representations to communicate science ideas, methods and findings in a range of text types	**Uses** appropriate language and representations to communicate science ideas, methods and findings in a range of text types	Uses **everyday language** and representations to communicate **simple** science ideas, methods and findings	**Limited** use of language and representations. **Ineffective** communication of ideas and results.

Practical 7 – Fantastic yeast (design practical)

Background

Yeast is a micro-organism that breaks down sugars to release energy in order for it to survive and grow. When there is oxygen in their environment (aerobic environment), they break the sugar down into carbon dioxide and water. Unlike us, yeast can survive in an environment without oxygen (anaerobic environment). When sugar is broken down in an anaerobic environment, the products are alcohol (ethanol) and carbon dioxide.

Purpose

To explore the metabolism of yeast by planning and carrying out an investigation into the **effects of temperature on cell activity.**

The yeast will **give off bubbles of carbon dioxide gas** as it respires (breaks down the sugar and produces energy). The better the conditions are for respiration; the more gas is produced. **This production of gas will be used as a measure of cell activity**.

Materials

These materials will be available to each group as well as a hot water bath and a refrigerator.

- 3 conical flasks (100 mL)
- 3 beakers (250 mL)
- 3 balloons (equal size)
- rubber bands
- packet of dried yeast
- hot tap water
- 3 teaspoons of glucose
- spatula
- electronic balance
- thermometer
- stirring rod
- measuring cylinders (100 and 250 mL

From the information given in the Purpose, identify the variables in this investigation and construct a question for investigation.

Independent variable

_____

Dependent variable

_____

Question for investigation

What happens to (dependent variable)

_____

When we change (independent variable)

_____

Controlled factors

_____

_____

_____

Prediction

Procedure

Design a procedure that will generate data/observations that will help you answer your question for investigation.

Make sure you consider:

- How you will set up your equipment.
- What temperatures you will use and how you will measure them.
- How you will measure the yeast.
- How you will collect and measure the gas.
- How long you will leave each flask (must be more than 30 mins).
- How you will record your results.

Results

Record your results below:

Draw a labelled scientific diagram of the 3 conical flasks and their contents after fermentation.

Conclusion

Write a statement that answers your question for investigation. **(Claim)**

Support your claim with a summary of your evidence. **(Evidence)**

Explain your results using the relevant scientific concepts. **(Reasoning)**

Evaluation

1. Explain why a balloon could be used to indicate that fermentation had occurred.

2. Discuss any differences that were noticed in the **rate** of fermentation of the glucose at different temperatures.

3. The data collected in this experiment was qualitative. Explain what this means and then comment on why quantitative data would be more useful.

4. Devise and describe an experimental system that might allow you to collect quantitative (number) data for this experiment instead (Include a labelled diagram to help you with your description).

Assessment Rubric – Fantastic yeast

		Achievement Standard	A	B	C	D	E
Science Inquiry Skills	Questioning and Predicting	Students identify and construct questions and problems that they can investigate scientifically.	**Constructs (or identifies) a clear a correctly formatted** question that can be investigated scientifically. Makes a **justified** prediction.	**Constructs (or identifies)** a correctly formatted question that can be investigated scientifically. Makes a **valid** prediction.	Constructs **(or identifies)** a question that can be investigated scientifically. Makes a **logical** prediction.	**With guidance**, constructs **(or identifies)** a question that can be investigated scientifically. Makes a **simple** prediction.	**Uses given** investigation question. **Does not make a prediction** or makes an irrelevant or unclear prediction.
	Planning and Conducting	Students design field or experimental procedures.	Constructs a **detailed and logical** step-by-step procedure. Gives a diagram where required. The procedure is **the most suitable** and can be replicated.	Constructs a **clear and logical** step-by-step procedure. Gives a diagram where required. The procedure is **appropriate** and can be replicated.	Constructs a **simple** step-by-step procedure. Gives a diagram where required.	Constructs an **incomplete and/or simple** procedure with some key steps omitted.	If provided, the procedure is **disorganised, unclear and/or omits** large parts.
		Students identify variables to be changed, measured and controlled.	**Accurately** identifies the independent and dependent variables, including their units of measure where appropriate. Provides a **comprehensive list** of factors that need to be controlled to ensure the reliability of data collected.	**Accurately** identifies the independent and dependent variables, including their units of measure where appropriate. **Lists a range of** factors that need to be controlled to ensure the reliability of data collected.	Identifies the independent and dependent variables. **Lists several** factors that need to be controlled to ensure the reliability of data collected.	**Identifies, with guidance**, the independent and dependent variables. Acknowledges the need for a fair test by listing **one factor** to be controlled**.**	Lists variables **without** identifying the independent, dependent and controlled variables.
	Processing data	Students construct representations of their data.	**Accurately** organises and records data and observations, giving appropriate detail. **Constructs a data table** that incorporates the independent and dependent variables and uses appropriate conventions and formats such as column and row headings. **Includes the most suitable units.**	**Accurately** records data and observations. **Constructs a data table** that incorporates the independent and dependent variables and uses appropriate conventions and formats such as column and row headings. **Includes units.**	**Records** data and observations. **Constructs a data table** that uses appropriate conventions and formats such as column and row headings.	**Uses provided tables** to organise and record data and observations **simply.**	**Uses provided tables** to organise and record data and observations with **some inaccuracies.**

Assessment Rubric – Fantastic yeast

		Achievement Standard	A	B	C	D	E
	Analysing data	Students use representations to reveal and analyse patterns and trends in data and observations.	**Critically** and **logically** examines data to identify patterns and trends.	**Logically** examines data to identify patterns and trends.	**Examines** data to identify patterns and trends.	**Identifies** simple patterns in data. Has **attempted** to identify some trends in the data.	**Recognises** simple patterns in data. Has not independently identified any trends in the data.
		Students use patterns and trends in data and observations when justifying their conclusions.	**Critically** analyses data, making connections with **relevant** scientific concepts to formulate **an accurate conclusion based on evidence.**	Analyses data, making connections with **relevant** scientific concepts, to formulate **logical** conclusions.	**Analyses** data and their connections with scientific concepts, to formulate **simple** conclusions.	Draws a conclusion that **does not accurately relate to the data.** .	If provided, the conclusion is **unclear and unconnected to the data**.
	Evaluating Processes	Students explain how modifications to procedures could improve the quality of their data.	Reviews the method. Provides relevant, specific **suggestions** for modifying the procedure. **Thoroughly** explains how **these** modifications **will** improve the quality of the data.	Reviews the method. Provides **a** relevant, specific **suggestion** for modifying the procedure. Explains how this modification **will** improve the quality of the data.	Reviews the method. Provides a **reasonable** suggestion for modifying the procedure. Explains how this modification could improve the quality of the data.	**States** that the procedure could be improved, but the suggestion provided is not related to the purpose of the investigation.	**States** that the procedure could be improved.
	Communicating	Students use appropriate language and representations to communicate science ideas, procedures and findings in a range of text types.	**Concisely and coherently** uses appropriate scientific language and representations to communicate science ideas, methods and findings in a range of text types	**Coherently** uses appropriate scientific language and representations to communicate science ideas, methods and findings in a range of text types	**Uses** appropriate language and representations to communicate science ideas, methods and findings in a range of text types	Uses **everyday language** and representations to communicate **simple** science ideas, methods and findings	**Limited** use of language and representations. **Ineffective** communication of ideas and results.