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National Assessment Program – Science Literacy Year 6 School Release Materials

2009

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NAP-SL 2009 Project Staff

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Contents

List of Tables

List of Figures

Preface

In July 2001, the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA, now the Ministerial Council for Education, Early Childhood Development and Youth Affairs, MCEECDYA) agreed to the development of assessment instruments and key performance measures for reporting on student skills, knowledge and understandings in primary science. It directed the newly established Performance Measurement and Reporting Taskforce (PMRT), a nationally representative body, to undertake the national assessment program.

The PMRT established a number of national committees to advise it on critical aspects of the study and ensure that the assessments and results were valid across the states and territories. The main function of these committees was to ensure that the scientific literacy assessment domain was inclusive of the different state and territory curricula and that the items comprising the assessments were fair for all students, irrespective of where they attended school.

The National Assessment Program – Science Literacy measures scientific literacy. This is the application of broad conceptual understandings of science to make sense of the world, understand natural phenomena and interpret media reports about scientific issues. It also includes asking investigable questions, conducting investigations, collecting and interpreting data and making decisions. The construct evolved from the definition of scientific literacy used by the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA):

> *... the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.*
>
> *(OECD 1999, p. 60)*

The first national assessment of science literacy was conducted in October 2003. The Primary Science Assessment Program (PSAP) – as it was then known – tested a sample of Year 6 students.

The second national assessment of scientific literacy was conducted in October 2006 with a sample of Year 6 students as the National Assessment Program – Science Literacy (NAP-SL). The third cycle of the National Assessment Program – Science Literacy was conducted by Educational Assessment Australia in October 2009. The public report 'National Assessment Program – Science Literacy Year 6 Report' describes the latest findings and provides comparisons in student performance over the three cycles in the scientific literacy of Year 6 Australian students.

These School Release Materials enable schools to replicate and conduct their own assessment by using a set of items from the actual Science Literacy assessment. Schools can then compare their students' scores with the national Proficiency Levels allowing them to monitor the effectiveness of their teaching programs and to determine the capabilities of individual students.

Chapter 1
Overview of the National Assessment

Introduction

In 1999, the State, Territory and Commonwealth Ministers of Education agreed to the new Adelaide Declaration on National Goals for Schooling in the Twenty First Century. The National Goals were superseded in December 2008, when the State, Territory and Commonwealth Ministers of Education released the new Melbourne Declaration on the Educational Goals for Young Australians. The new Educational Goals for Young Australians set the direction for Australian schooling for the next 10 years (Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA] 1999 and 2008, now the Ministerial Council for Education, Early Childhood Development and Youth Affairs [MCEECDYA]) (available online at www.mceecdya.edu.au).

The National Goals and now the Educational Goals provide the framework for reporting on student achievement through the annual MCEECDYA publication, the *National Report on Schooling in Australia* (*ANR*).

In July 2001, MCEETYA agreed to the development of assessment instruments and key performance measures for reporting on student skills, knowledge and understanding in primary science. It directed the Performance Measurement and Reporting Taskforce (PMRT) to undertake the national assessment program.

The PMRT set the policy objectives and established a Steering Committee to manage the assessment and a Consultative Committee to facilitate discussion among the jurisdictions and school sectors. The Consultative Committee also

provided feedback about the appropriateness of the conceptual framework and reviewed the assessment items to ensure that they were inclusive of all the state and territory curricula.

The National Science Assessment was the first assessment program designed specifically to provide information about performance against the National Goals (now the Educational Goals). MCEECDYA also endorsed similar assessment programs to be conducted for Civics and Citizenship and Information and Communications Technology Literacy. Each assessment program is repeated every three years so that performance in these areas of study can be monitored over time.

Of the three subject areas, science is the only program that focuses entirely on primary school performance. This is because MCEECDYA has agreed to use the Program for International Student Assessment (PISA) as the measure of performance for secondary science literacy.

In January 2008, PMRT awarded the contract for the third cycle of science testing, due in 2009, to Educational Assessment Australia (EAA). The Benchmarking and Educational Measurement Unit (BEMU) was nominated by the PMRT to liaise between the contractor and PMRT in the delivery of the project. BEMU was incorporated into the Australian Curriculum, Assessment and Reporting Authority (ACARA) during 2009 and at the end of 2009 the PMRT was disbanded and its work has been undertaken by ACARA.

Implementation of the National Assessment Program – Science Literacy involved a large number of separate but related steps, including the development of items and instruments to assess the assessment domain; the trialling of those items and assessment instruments; the administration of the assessment to a sample of students; and the marking, analysis and reporting of the results. For the first time in 2009, students also completed a Student Survey which sought to elicit students' perceptions of and attitudes to science; students' interest in science beyond the classroom; and students' experiences of science at their school.

What does the National Assessment Program – Science Literacy measure?

The National Assessment Program – Science Literacy measures scientific literacy.

Scientific literacy has been defined by OECD–PISA as:

> *… the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.*
> *(OECD 1999, p. 60)*

This definition has been adopted for the 2009 National Assessment Program –

Science Literacy in accordance with the Ball et al. 2000 report recommendation.

The science items and instruments therefore assess outcomes that contribute to scientific literacy, such as conceptual understandings, rather than focusing solely on facts. They also assess student competence in carrying out investigations in realistic situations.

The National Assessment Program – Science Literacy relates to the ability to think scientifically in a world in which science and technology are increasingly shaping children's lives.

A Scientific Literacy Progress Map (see Appendix A) has been developed based on the construct of scientific literacy and on an analysis of the state and territory curriculum and assessment frameworks. The Progress Map describes the development of scientific literacy across three strands of knowledge which are inclusive of Ball et al.'s concepts and processes and the elements of the OECD–PISA definition.

What aspects of scientific literacy were assessed?

Three main areas of scientific literacy were assessed:

Strand A: formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence.

Strand B: interpreting evidence and drawing conclusions from their own or others' data, critiquing the trustworthiness of evidence and claims made by others, and communicating findings.

Strand C: using science understandings for describing and explaining natural phenomena, and for interpreting reports about phenomena.

A conscious effort was made to develop assessment items that related to everyday contexts.

The scientific literacy domain is detailed in Appendix A. In addition, the items drew on four concept areas: Earth and Space (ES); Energy and Force (EF); Living Things (LT); and Matter (M). The major scientific concepts found most widely in state and territory curriculum documents were used by item developers to guide test development. The list of endorsed examples for each of these major concept areas is in Appendix B.

The intention was to ensure that all Year 6 students were familiar with the materials and experiences to be used in the National Assessment Program – Science Literacy and so avoid any systematic bias in the instruments being developed.

Who participated in the 2009 National Assessment Program – Science Literacy?

Approximately 5 per cent of the total Australian Year 6 student population was sampled randomly and assessed. The sample was drawn from all states and territories. Government, Catholic and independent schools participated.

A grade-based population of students enrolled at schools was chosen. This is consistent with the other strands of the National Assessment Program. The '2009 National Assessment Program – Science Literacy Year 6 Report' provides detailed information about the participating sample and the results of the testing. Table 1.1 shows the number of schools and students in the final sample for which results were reported.

Table 1.1 Number of schools and students by state and territory in the final sample

State/ Territory	Number of schools in target sample	Number and percentage of schools in final sample	Number of students in target sample	Number and percentage of students in final sample
ACT	56	55 (98.2%)	1311	1199 (91.5%)
NSW	92	91 (98.9%)	2258	2092 (92.6%)
NT	50	38 (76%)	831	743 (89.4%)
QLD	92	92 (100%)	2228	2043 (91.7%)
SA	95	93 (97.9%)	2005	1848 (92.2%)
TAS	63	63 (100%)	1276	1167 (91.5%)
VIC	93	93 (100%)	2243	2040 (90.9%)
WA	94	93 (98.9%)	2208	2030 (91.9%)
AUST	**635**	**618 (97.3%)**	**14 360**	**13 162 (91.7%)**

Note: the student participation percentage calculation includes within-school exclusions.

How are the National Assessment Program – Science Literacy results reported?

The results of the National Assessment Program – Science Literacy are reported as mean scores and distributions of scores across Proficiency Levels. They are also described in terms of the understandings and skills that students demonstrated in the assessment. These understandings and skills are mapped against the scientific literacy assessment framework.

Five levels of proficiency are defined and described for scientific literacy. Further details of the proficiency levels, including results in relation to the levels by state and territory, are contained in Chapter 6.

Results for groups such as males and females, Indigenous and non-Indigenous students and students from different language backgrounds and geographic locations are presented in the 2009 Public Report.

The National Assessment Program – Science Literacy was designed to provide as much information as possible about student performance in scientific literacy at the Year 6 level. To achieve this, a rotational design was implemented. Items were first organised in clusters. Each cluster consisted of between 11 and 13 items. The clusters were then placed into seven different test forms. Each cluster appeared in three test forms, either in the first, second or third section of the booklet. This methodology was adopted so that the greatest number of items possible could be assessed and also to mitigate against any bias in item performance due to its placement within a test booklet. In order to produce comparable results among students who had completed different forms, statistical analyses were performed and scaled scores generated for all students.

The tables produced in Chapter 6 enable the raw scores achieved by students in the Science Literacy School Assessment to be converted into equivalent scaled scores and compared with the standards framework developed to report the performance of students in the National Assessment Program – Science Literacy.

Chapter 2
Use of the School Release Materials

Overview

Some assessment items from the 2009 National Assessment Program – Science Literacy have been released, to enable teachers to administer these items under similar conditions and gauge their own students' proficiency in relation to the national standards. These are the Science Literacy School Release Materials.

The remaining 2009 assessment items have been secured for the purpose of equating the next National Assessment Program – Science Literacy (which is to be undertaken in 2012) and, together with the 2003 and 2006 assessments, will allow longitudinal data on student performance to be obtained.

Assessment tasks

The Science Literacy School Release Materials comprise two parts:

- an objective assessment, with 37 multiple-choice and open-ended questions; these items assess Levels 2, 3 and 4 of the national scientific literacy assessment domain (Appendix A)
- a practical task from the Living Things concept area requiring students to carry out an investigation in groups of three and then respond individually to a set of questions about the investigation.

Teachers can decide whether they want to administer both the objective assessment and the practical task (as in the National Assessment Program – Science Literacy) or only the objective assessment.

A summary of the assessment structure, including the unit topics, the science concept areas and a brief description of the processes being assessed, is provided in Table 2.1 and Table 2.2.

Table 2.1 Items assessing individual student work – Objective Assessment

Q no	Unit topic	Concept area	Item descriptor
1	Native and introduced animals	LT	interprets information from a food web
2	Energy efficient light bulbs	EF	identifies an item which conducts electricity
3	Water resources	ES	identifies the impact of pollutants on a town's water supply
4	Water resources	ES	identifies a strategy for reduction in water usage
5	Lifting weights	EF	identifies where children should sit for a seesaw to balance
6	Lifting weights	EF	identifies lever that will lift a weight with the least push
7	Separating mixtures	M	identifies a method for collecting water after boiling a mixture of water and chocolate
8	Separating mixtures	M	identifies a method for separating a mixture into its parts
9	Separating mixtures	M	identifies a method for separating a mixture into its parts
10	Separating mixtures	M	identifies two methods for separating a mixture into its parts
11	Cola fountain	M	makes non-standard measurements and limited records of data
12	Cola fountain	M	identifies the variables that need to be controlled for fair testing
13	Cola fountain	M	identifies the variable to be changed and the variable to be measured
14	Heating and cooling	EF	explains that the rise in temperature is related to the amount of substance being heated
15	Heating and cooling	EF	predicts that different objects left in a room will reach the same temperature
16	Heating and cooling	EF	given initial temperatures of water in two containers, predicts the temperature of combined water
17	Greenhouse gas emissions	ES	interprets information from a table
18	Greenhouse gas emissions	ES	identifies a plausible reason for the difference in two households' carbon footprints
19	Phases of the Moon	ES	identifies the pattern in data that show the shape of the Moon on different days in a month
20	Phases of the Moon	ES	predicts from known timeline of the moon phases what the Moon will appear like at specific times in the next cycle
21	Phases of the Moon	ES	identifies the position of the Moon in its orbit around Earth for which a full moon would be seen on Earth
22	Phases of the Moon	ES	identifies which object will not be seen in the sky as the Moon rises

23	Using and saving energy	EF	identifies an energy source for a water heater and explains why it contributes least to global warming
24	Using and saving energy	EF	describes what renewable sources of energy are and provides an example of a source of renewable energy
25	Climate change	ES	identifies an observation not linked to global warming
26	Climate change	ES	identifies and explains a consequence of global warming
27	Collecting ants	LT	identifies the variable/s that need/s to be controlled for fair testing
28	Collecting ants	EF	identifies the effect of differences in air pressure in an insect pooter
29	Collecting ants	LT	relates a feature of an ant to its function
30	Tomato plants	LT	explains patterns in the data
31	Tomato plants	LT	interprets data from a column graph
32	Tomato plants	LT	interprets data from a column graph
33	Tomato plants	LT	makes a suggestion for collecting additional data to decide the best method for growing plants
34	Burning foods	EF	compares aspects of data in a simple supplied table of results
35	Burning foods	EF	links the temperature increase in a cup of water to the heat (energy) transferred to the water from burning foods
36	Burning foods	EF	explains the low efficiency of energy transfer from burning foods to water in terms of heat loss to the environment
37	Burning foods	M	identifies changes as reversible or non-reversible

Table 2.2 Items assessing individual student work – Practical Task

Q no	Task	Concept area	Item descriptor
Prac Q1	Which beak works best?	LT	identifies the number of beads in a simple table of results
Prac Q2	Which beak works best?	LT	identifies similarities between a model beak and the beak type it represents
Prac Q3	Which beak works best?	LT	identifies differences between a model beak and the beak type it represents
Prac Q4	Which beak works best?	LT	concludes whether the best type of model beak to collect floating weed is a sieve based on collected data
Prac Q5	Which beak works best?	LT	provides labels for axes
Prac Q6	Which beak works best?	LT	constructs scale for vertical (horizontal) axis with an appropriate range of values and with intervals of equal measure
Prac Q7	Which beak works best?	LT	plots data accurately on column (bar) graph
Prac Q8	Which beak works best?	LT	draws conclusion about the relationship between shape of bird beak and type of food bird eats
Prac Q9	Which beak works best?	LT	explains why using a clock would be a better timing method than counting
Prac Q10	Which beak works best?	LT	identifies reason for using repeated trials

Resource materials

This document contains the released items required to conduct the Science Literacy School Assessment. Conducting the assessment will enable schools to analyse the performance of their students and gauge their proficiency against the national science literacy standards. The materials may be reproduced freely.

The print assessment materials include:

- two assessment tasks – objective assessment and practical task
- assessment administration guidelines
- marking guidelines for the objective assessment and practical task
- class record sheet
- item analysis sheet
- class analysis sheet.

Using test materials at the classroom and whole-school levels

At the classroom level, the Science Literacy School Release Materials can be used to:

- diagnose individual students' strengths and weaknesses in terms of their demonstrated skills and understandings in science
- ascertain the strengths and weaknesses in science of the class as a whole
- help teachers to analyse the effectiveness of their own science teaching and the learning strategies employed
- provide models of sound assessment tasks; and
- moderate individual teachers' judgements with those of the National Assessment Program – Science Literacy.

At the whole-school level, they can be used to:

- infer levels of student science achievement in the particular state or territory's curriculum framework
- make comparisons between science performance in the school and the national mean; see Tables 7.4 and 7.5 in Chapter 7
- make comparisons between the range in science performance in the school and the range achieved nationally
- report to the school community on students' achievements in science

- report to school authorities on students' achievements in science
- set priorities for school development planning; and
- provide continuity for students moving from other schools.

In using the test materials, it should be noted that:

- the National Assessment Program – Science Literacy is a comprehensive assessment but cannot assess all science knowledge and skills
- test results are one source of information about students' progress, and information from other sources is necessary for accurate assessments to be made; and
- the materials cannot be used to compare teachers and schools.

In order to ensure consistency in the delivery of the assessment, the Assessment Administration Guidelines (see Chapter 3) must be followed carefully.

Using the results from the Science Literacy School Assessment

Although the major concept areas tested – Earth and Space, Energy and Force, Living Things, and Matter – are common to all jurisdictions, the manner in which they are taught varies according to the teaching strategies used in individual classrooms, teachers' own science backgrounds and enthusiasm for science, and the student outcomes established by the curriculum frameworks in use in particular states and territories.

Also, due to differences between jurisdictions in the way in which primary schooling is structured, there are variations in the average ages of students and the length of prior schooling at the time of testing.

However, although the ways in which these test materials are used will inevitably vary, they can provide very valuable information at the classroom, school and system levels.

It is important to remember that these tests were developed through a rigorous consultative process that included input from educational experts from all jurisdictions and reference groups. The items and tasks were subjected to intensive development and were trialled and administered under strict conditions to ensure the soundness of the National Assessment Program. Users can therefore be confident that these tests meet the highest possible professional and ethical criteria.

The tests are standards-based. They allow inferences to be made about students' levels of achievement in the domain, the mean level of performance of a class

and/or cohort, and the range of levels that a class or cohort achieves.

Some teachers may use the tests to obtain information about students' existing skills or understandings: for example, a Year 7 teacher might use the Year 6 materials for diagnostic purposes. This information could then assist the teacher's planning for the year. However, before doing so, the teacher should determine whether students have previously sat the National Assessment Program – Science Literacy. If they have, their results could be inflated and therefore not an accurate estimation of performance, or they might not engage with the test for a second time and so the results may not reflect student ability.

Chapter 3
Assessment Administration Guidelines

This assessment of scientific literacy comprises two tasks:

Part A: objective assessment (a pencil and paper test), with 37 multiple-choice and open-ended questions.

Part B: practical task requiring students to carry out an investigation in groups of three and then respond individually to a set of questions about the investigation.

Teachers can decide whether they want to administer both the objective assessment and the practical task (as in the National Assessment Program – Science Literacy) or only the objective assessment. No provision has been made for using the results of the practical task alone.

When photocopying the test in Chapter 4 of this document for the class, it is important to ensure that the format displayed in the resources is maintained in the back-to-back mode, and with second and third pages facing one another. This maintains the test conditions and format allowing students to refer to the stimulus or background information whilst answering the accompanying items.

Before conducting the Assessment

Make yourself familiar with these Guidelines. They must be followed closely if the results of testing in your school are to be comparable with the national data.

The assessment has an objective component and a practical task component. The objective (pencil and paper) session is completed by students working on their own. The practical task involves students working in groups of three at a table. A normal classroom should be suitable for both sessions.

Time allocation

The two tests will take approximately three hours in total to complete, including time to read the instructions, distribute the materials and allow for a short student break between the objective and practical task sections of the assessment. The recommended test administration times are listed in Table 3.1.

Table 3.1 Time allocation for objective assessment and practical task

Objective (pencil and paper) test	**Time allowed**
Reading the instructions and distributing the test booklets, completing/checking the student information on the cover page and completing the practice questions	15 minutes
Students undertake the test	60 minutes
Collecting the materials and ending the session	5 minutes
	Total: approximately 1 hour 20 minutes
Allow a break of approximately 20 minutes before starting the practical task	
Practical task	**Time allowed**
Placing the practical materials on a table before the test, reading the instructions and distributing the packaged materials to each group of students	15 minutes
Students undertake the test	45 minutes
Collecting the materials and ending the session	15 minutes
	Total: approximately 1 hour 15 minutes
Total assessment session: approximately 3 hours	

Materials required

Students

- 2B or B pencil, ruler and eraser
- one test booklet per student
- set of practical task materials for every group of three students

Teachers

- Administration Guide
- watch or clock
- clock visible to students
- set of practical task materials (see page 16 for practical task materials)
- reading materials for students who finish the Assessment early

Assistance

You may read questions to individual students if asked but you must not help the students with the interpretation of any of the items in the test booklet.

Students should be encouraged to attempt all questions to demonstrate their understandings. If a student finds a question difficult, suggest that he or she leave it and move on to other questions. The student can return to the question if time permits.

Preparing for the practical task

The practical task (Which beak works best?) comprises:

Part A: Group activity: students work in groups of three; 25 minutes.

Part B: Students work individually to answer questions on the group activity; 20 minutes.

Before the practical task, the teacher should:

- organise a classroom where students will not be disturbed, and where furniture can be arranged into a sufficient number of work stations to accommodate each group of three students;
- set up the practical task materials in groups on a table at the side of the room beforehand. One student from each group can then collect the materials when told to do so.

Practical task materials (per group of three students)
• Plastic plate • Plastic cup • 30 beads (in a bag) • One A5 sheet of paper, marked in 2 cm squares • Two craft sticks • Toothpick • Plastic spoon

Arranging groups for the practical task

For the practical task, groups of three students should be constructed by random assignment so that there is no bias caused by 'friendship' or 'similar-ability' groups working together on the practical task. Students could be assigned to groups according to alphabetical order by family name. Leftover students can then be allocated to groups of two.

Reading the script

To ensure that the assessment is conducted in the same way as the national test that was conducted throughout Australia, it is important that all students hear the same instructions.

The only text to be read to the students is in the shaded boxes, and to ensure test administration consistency it should be read WORD-FOR-WORD without omissions or additions. The unshaded text is instructions and background information for the test administrator. Please follow these instructions.

Distribute the test booklets, if you have not done so already.

Say:

You should have a test booklet on your desk. Please do not open it yet. Put up your hand if you do not have a test booklet. Please put up your hand if you do not have a 2B or B pencil, a ruler and an eraser.

Give students who do not have all the materials additional items as necessary.

You should not have anything on your desk apart from your test booklet, a pencil, a ruler and an eraser.

Beginning the session

To make sure that all students doing this test receive exactly the same instructions, I will be reading them to you.

If you need another pencil or you have difficulty in reading the questions during the session, please raise your hand and I will assist you.

Please look at the cover page of the test booklet.

Completing the student information on the front page of the test booklet

Please print your name neatly in pencil in the space provided on the front cover of your test booklet.

Ensure that students do not move on to the practice questions at the back cover until all students have completed writing their name and you are ready to commence the assessment.

Completing the practice questions

In this test booklet you will find questions about science.

Read each question carefully and answer it as well as you can. You may find some of the questions in this test easy, and others difficult. Answer as many questions as you can.

Do not start working through the test questions yet. You will be told when to begin.

First we will do some practice questions together. There are six types of questions in the test. Turn to the practice questions at the back of the book.

Multiple Choice

Look at practice question 1.

In these questions you must shade the bubble next to the correct answer. There is only one correct answer in this type of question.

Read practice question 1 to the students.

Q1 Shade in the bubble next to the correct answer.

The colour of blood is

- ◯ blue.
- ◯ green.
- ◯ red.
- ◯ yellow.

Shade in the bubble next to the correct answer.

Allow time for students to answer practice question 1.

The answer is 'red' so you should have shaded the third bubble next to the word 'red'.

Check that students have shaded in the bubble for 'red'.

Deal with any questions or problems.

Circle the Word or Words

Look at practice question 2.

In these questions you must circle the word, or words, that are correct. For example:

Read practice question 2 to the students.

Q2 Circle the correct words in the sentence below.

An elephant is **a bit smaller** / **much bigger** than a human.

Allow time for students to answer practice question 2.

The answer is 'much bigger', so you should have circled those words in the sentence.

Check that students have circled 'much bigger'.

Deal with any questions or problems.

One or Two Word Answer

Look at practice question 3.

In these questions you only need to write one or two word answers.

Read practice question 3 to the students.

Q3 On a clear, sunny day the colour of the sky is _____ .

Write your answer in the space provided.

Allow time for students to answer practice question 3.

What answers would you suggest?

Respond to the student answers as they are given. Typical answers would be: 'blue' or 'azure'.

Remind students that answers which repeat information in the question would not be rewarded, e.g. 'clear'.

Deal with any questions or problems.

Long Answer

Look at practice question 4.

In these questions 'explain' means give a full explanation for your answer.

You may need to write two or three sentences to give the best answer.

Read practice question 4 to the students.

Q4 Explain what happens to a balloon when you blow it up.

_____

_____

Write your answer in the space provided.

Allow time for students to answer practice question 4.

What answers would you suggest?

Respond to the student answers as they are given. Typical answers would be 'It gets bigger' or 'It explodes'.

Encourage students to provide well-considered and complete answers like: 'The air pressure causes the rubber to expand, so the volume of the balloon increases. If the air pressure in the balloon is greater than the rubber can stand, then the balloon breaks'.

Explain that answers that provide more information may be awarded higher marks.

Explain that, for questions like practice question 4, the number of lines is a guide to how much students need to write.

Tick the Boxes

Look at practice question 5.

In these questions you must place a tick in the boxes next to the correct answers. There may be more than one correct answer in this type of question.

Read practice question 5 to the students.

Q5 Which of the following are fruit? Tick all possible answers.

☐ banana ☐ bicycle ☐ apple ☐ chair

Allow time for students to answer practice question 5.

The answers are 'banana' and 'apple', so you should have placed a tick in the boxes next to both of those words.

Check that students have placed a tick in the appropriate boxes.

Deal with any questions or problems.

Fill in the Table

Look at practice question 6.

In these questions you must complete the table by filling in the blank sections.

Read practice question 6 to the students.

Q6 Look at the features of this face.

Complete the table below.

Feature	Sense
eyes	sight
ears	
	smell

Allow time for students to answer practice question 6.

The answers are ‘hearing’ and ‘nose’ so you should have written ‘hearing’ in the empty box in the table next to ‘ears’ and ‘nose’ in the empty box next to ‘smell’.

Deal with any questions or problems.

Are there any questions about how to record your answers?

Answer any student questions.

Do **not** turn to the first page of the test booklet until I tell you to.

The objective test session

You have now finished the practice questions.

You will have one hour to complete the first section of the test booklet. Then you will have a break before you start the second section of the test booklet, the practical task.

You will work on your own to answer the questions in the test booklet.

Read carefully the text that comes before the questions. It includes information that will help you answer the questions.

If you make a mistake and want to change your answer, erase it and write your new answer.

If you don’t know the answer to a question, try the next one. If you have time, go back to the questions you didn’t finish, and attempt to complete them.

Do not start until I tell you to. Are there any questions?

Answer any student questions.

Now turn to the first page of questions inside the front cover.

Use your time carefully and do as much as you can. Please begin.

Monitor the students.

After 30 minutes, say:

You have 30 minutes to go. When you finish, go back through the test and answer any questions you may have missed.

After 55 minutes, say:

You have about 5 minutes to go.

After 60 minutes, say:

Please stop. Close your test booklet. We will now have a break.

The break does not have to be timed exactly and is at the discretion of the teacher and should align with normal school policies or breaks. It should be no less than 20 minutes.

Preparing the students for the practical task

After the break, organise students into groups of three as described on page 16. When the students are seated in the assigned groups and quiet, say:

Today you will be doing a science practical task called **Which beak works best?**. You will work in your group for the practical activity (Part A). You must work alone for the rest of the task (Part B), when you write your answers to questions by yourself.

There are the same types of questions in this practical task as there were in the first section, so we will not look at the practice questions again.

You will do Part A of the practical task in your group. You will need to read through the instructions carefully and do the task as a group. While completing the task you will write all of your results in your own test booklet.

You may discuss the task quietly as a group while you are completing Part A of the task. For Part B, you will work on your own.

If you make a mistake and want to change your answer, erase it and write your new answer.

If you don't know the answer to a question, try the next one. If you have time, go back to any question you didn't finish.

Do not start until I tell you to. Are there any questions?

Answer any student questions.

Starting the students on the practical task

Begin the assessment task when the students are ready.

Have one student from each group collect the equipment from a side table.

Before you start the task, we will check that each group has all the materials.

Read through the list of materials for the practical task shown on page 16 and in the test booklet.

Supply any missing materials to groups, if required.

You have 45 minutes to complete Part A and Part B of the task. You should spend about 25 minutes on Part A. Use your time carefully and do as much as you can.

Please begin Part A. Do not start Part B until I tell you.

Monitor the students.

The students have 45 minutes to complete the practical task, Part A and Part B. Part A should take no longer than 25 minutes, so that there is at least 20 minutes for students to complete Part B. Use your judgement as to exactly when you ask the groups to stop working and start the individual work.

After 20 minutes, warn the students that they have 5 minutes to finish the practical activity (Part A) before starting the questions.

After a further 5 minutes, ask the students to stop work, gather all the materials together in one place on the table and sit at their desks.

You must now work on your own to answer the questions in your test booklet for Part B.

You have 20 minutes to complete Part B of the assessment. Use your time carefully and do as much as you can. Please begin.

While students are completing Part B, quietly collect the practical materials.

As the end time approaches, watch for students who appear to have finished and remind them to check their work. A student who, in your opinion, has satisfactorily completed as much as possible of the test may read a book or magazine.

After a total of 45 minutes, say:

Please stop.

Monitor the students. At your discretion you may allow a minute or two extra for students to finish answering the question they are working on.

Collect the test booklets. This concludes the assessment.

Chapter 4
Science Literacy School Release Materials

The Science Literacy School Release Materials can be found on the following pages.

Two forms of the National Assessment Program - Science Literacy School Release Materials have been included. The first form includes both Objective items and a Practical task. The second form includes Objective items only for those schools that do not wish to administer a Practical task.

NATIONAL ASSESSMENT PROGRAM (NAP-SL)

SCIENCE LITERACY 2009

YEAR 6

RELEASED ITEMS

OBJECTIVE ASSESSMENT
PRACTICAL TASK

First Name: _____

Last Name: _____

School: _____

MCEECDYA
Ministerial Council for Education,
Early Childhood Development and Youth Affairs

THE UNIVERSITY OF NEW SOUTH WALES
EDUCATIONAL ASSESSMENT AUSTRALIA

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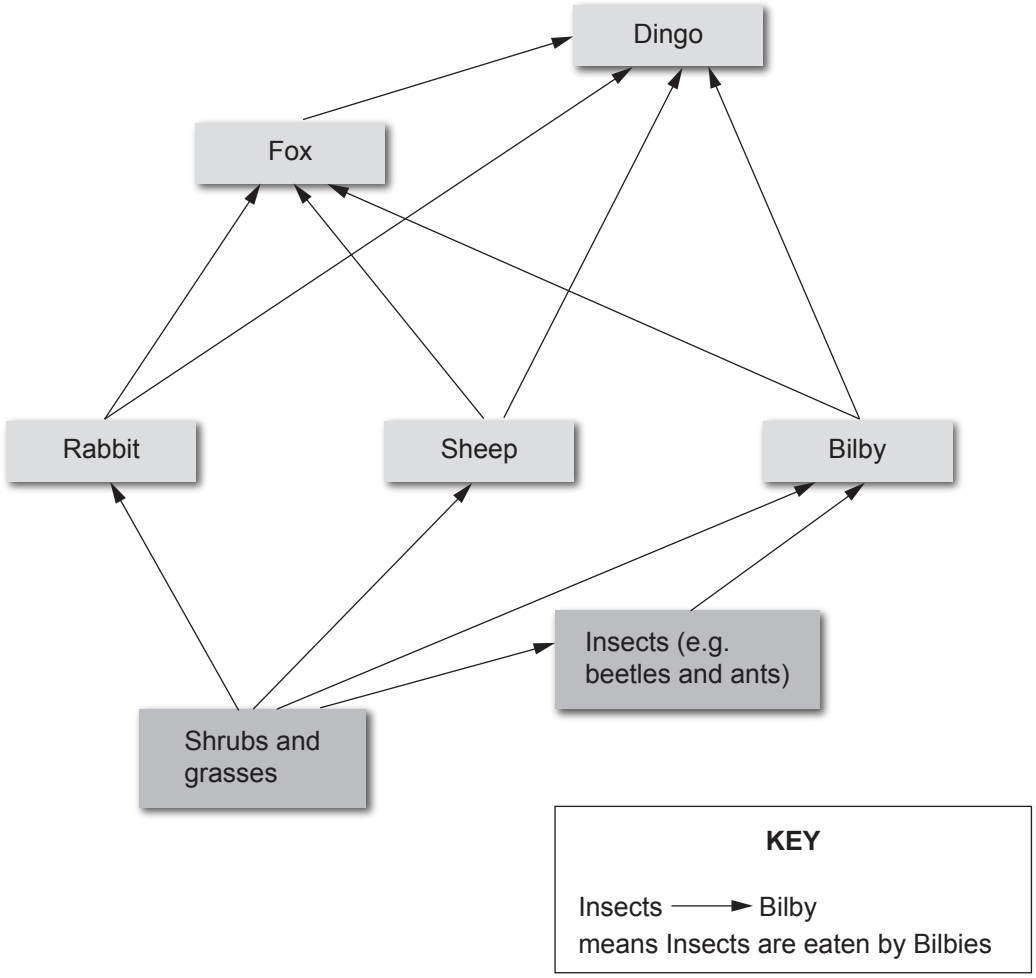
Native and introduced animals

Native animals occur naturally in Australia. Introduced animals have been brought into Australia from other countries.

The food web below contains four introduced animals: rabbits, sheep, foxes and dingoes.



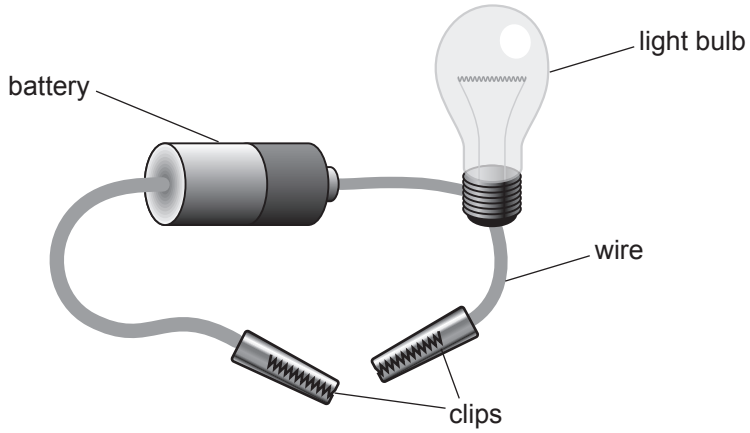
Q1 For this food web, which of the following statements is correct?

- ◯ Bilbies eat foxes.
- ◯ Dingoes eat rabbits.
- ◯ Dingoes eat insects.
- ◯ Foxes eat shrubs and grasses.

Energy efficient light bulbs

The diagram below shows an incomplete electric circuit containing a battery, wires and a light bulb.

A light bulb in an incomplete electric circuit



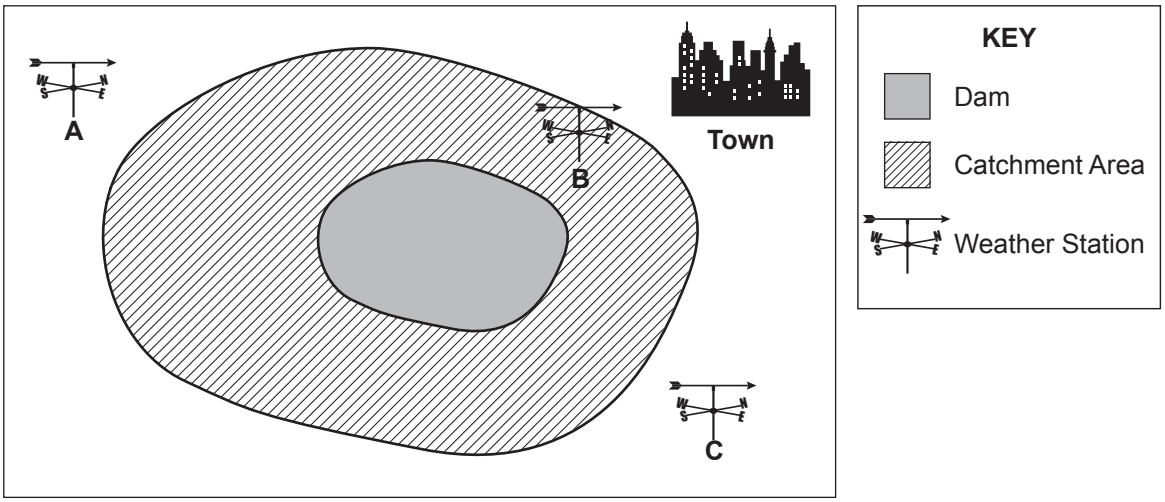
Q2 Which item could be placed between the clips to complete the circuit and cause the light bulb to glow?

- ⬭ paper clip
- ⬭ piece of paper
- ⬭ straw
- ⬭ toothpick

Water resources

The picture below shows a dam and its catchment area. When rain falls in the catchment area it flows into the dam as run-off and is stored. This dam provides much of the local town's water.

Map of a dam and its catchment area



Q3 A poisonous chemical was used within the catchment area to control the spread of weeds.

How might this affect the town's water supply?

_____

_____

_____

_____

Q4 There are times when the dam level is low and rainfall in the catchment area is also low.

Suggest one way to reduce water usage in the home during such times.

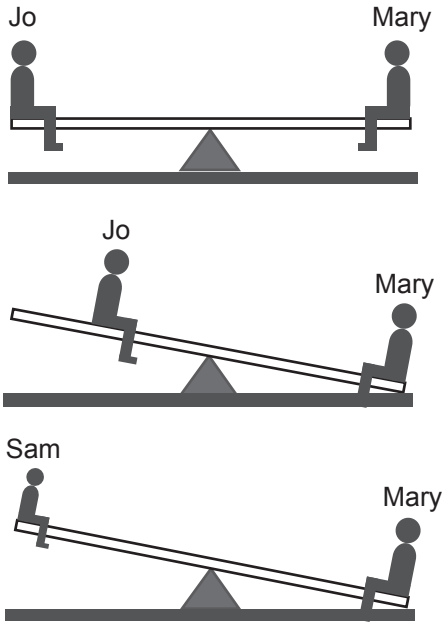
_____

_____

Lifting weights

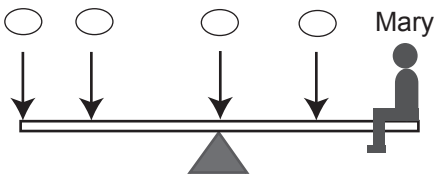
Mary, Jo and Jo's little sister Sam investigated balancing on a seesaw. Both Jo and Mary each weighed 40 kg. Sam weighed 20 kg.

The diagrams show the observations the children made during their investigation. When no one is sitting on the seesaw, it is balanced.



Q5 In the diagram below Mary is sitting at one end of the bar of the seesaw.

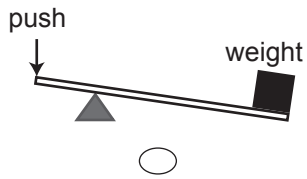
If Sam sat on Jo's lap, where should they sit to balance the seesaw?

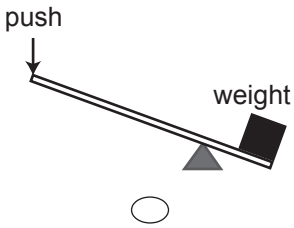


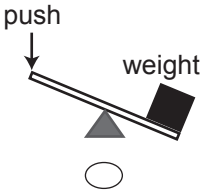
Q6 Levers are used to lift heavy weights such as rocks and crates. Seesaws are a type of lever. You push down on one end of the bar to move a heavy weight upwards at the other end.

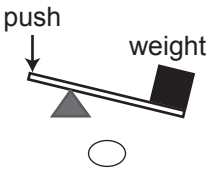
The diagram below shows four levers ready to lift a weight. They are shown at the same scale.

Which lever will lift the same weight with the least push?









Separating mixtures

Jan investigated how a mixture could be separated into its parts.

She mixed the following substances together in a glass:

100 mL water
1 teaspoon olive oil
1 teaspoon rolled oats
1 teaspoon powdered drinking chocolate.

She used the following **steps** in her investigation:

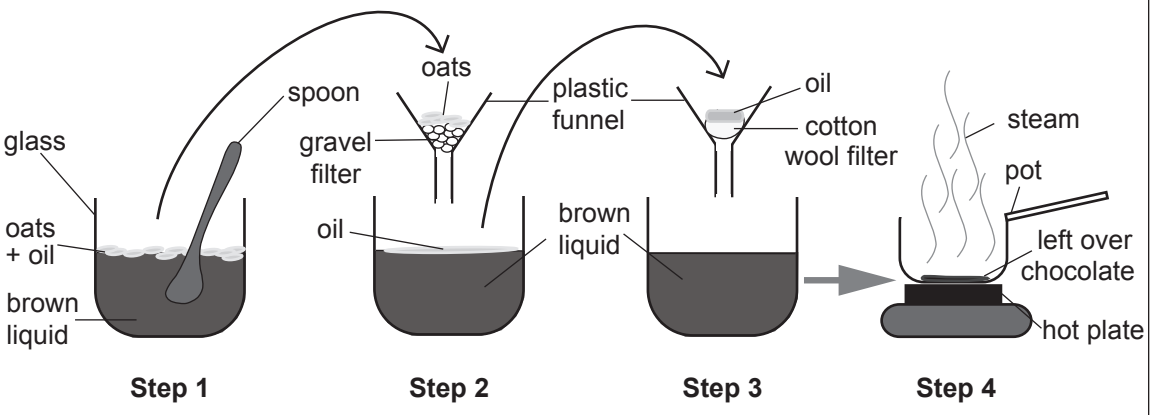
1. Stir the mixture with a spoon.

2. Pour the mixture through a gravel filter and collect what passes through in a glass.

3. Pour the contents collected in the glass in **Step 2** through a cotton wool filter and collect what passes through in another glass.

4. Place the contents of the glass collected in **Step 3** into a pot and boil it.

The diagram shows Jan's observations of the steps taken in her investigation.



Q7 Jan wanted to collect the water that had been separated from the mixture in her investigation.

How could she best achieve this?

- ◯ Collect the contents of the glass in **Step 3**, which is water only.
- ◯ Put the mixture through **Step 3** a second time.
- ◯ Allow the pot in **Step 4** to cool leaving water only.
- ◯ Collect the steam from **Step 4** and cool it to a liquid.

Three methods for separating mixtures into their parts are:		
Dissolving	Using a magnet	Filtering

Which method should Jan use to separate the mixtures listed below into their parts?

Q8 Separate sand and iron filings (tiny pieces of iron):

_____

Q9 Separate mud in water from water:

_____

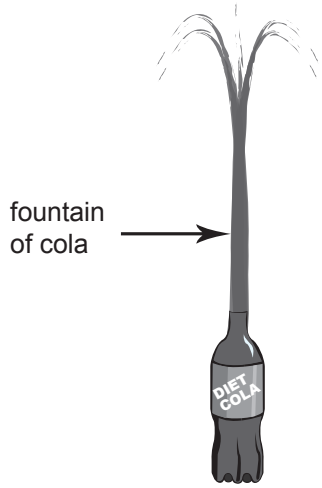
Q10 Which **two** methods should Jan use to separate the mixture listed below into its parts?

Separate sand and salt:

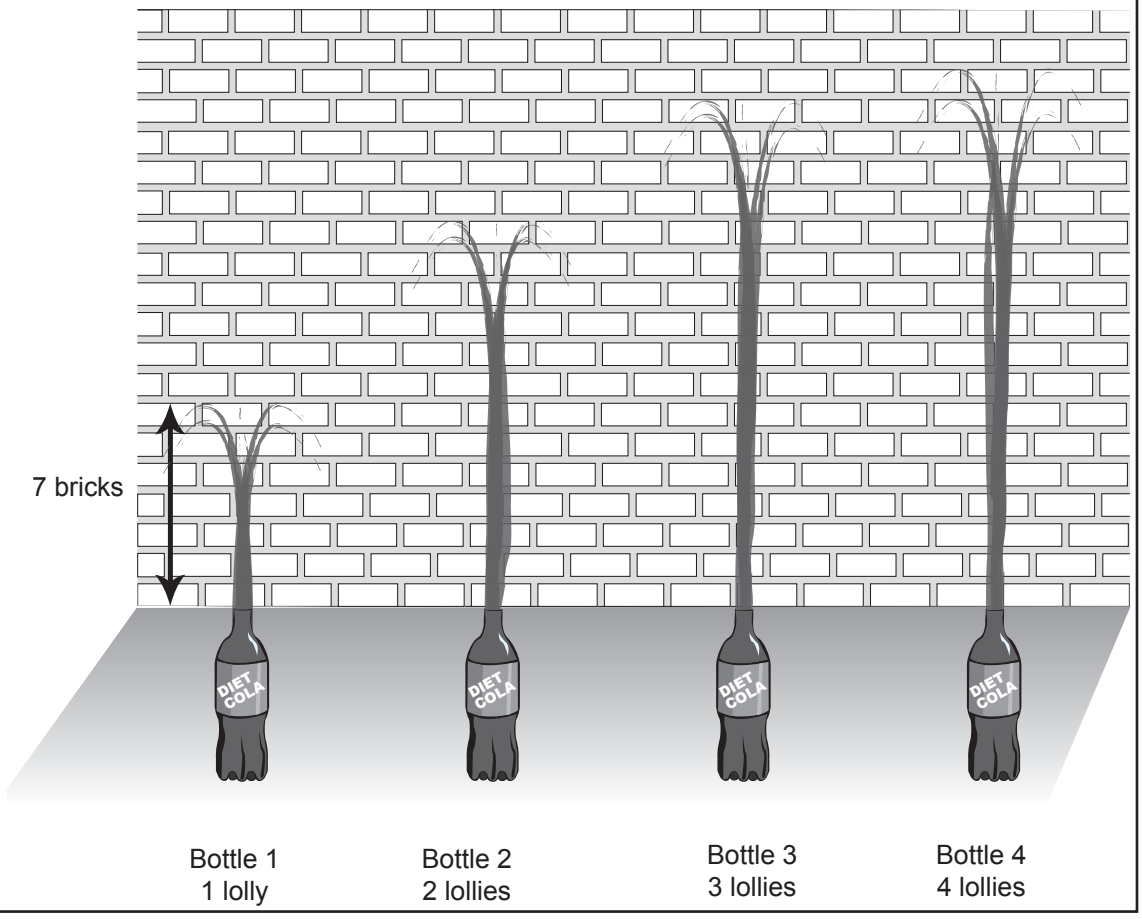
_____

Cola fountain

Dropping a mint lolly into a bottle of diet cola produces a fountain.



Sam and Michael investigated whether they could make a higher fountain by adding different numbers of lollies to bottles of diet cola. They set up four bottles against a brick wall as shown below. They measured the height of the fountains using the brick wall.



Q11 Sam measured the height of each fountain using the bricks on the wall. Complete the table below to record the results of this experiment.

Table: Height of fountain compared to number of lollies

	Number of lollies	Height of fountain (bricks)
Bottle 1	1	7
Bottle 2	2	
Bottle 3	3	
Bottle 4	4	

Q12 What should Sam and Michael keep the same in this experiment to make it a fair test?

Tick all possible answers.

- ☐ the number of lollies dropped in each bottle
- ☐ the type of diet cola used
- ☐ the amount of diet cola in each bottle
- ☐ the number of bottles used

Q13 Regular cola contains sugar. Diet cola contains an artificial sweetener.

Sam suggested that this sweetener caused the fountain when the lolly was dropped in the diet cola. Explain in detail how Sam could test his idea.

_____

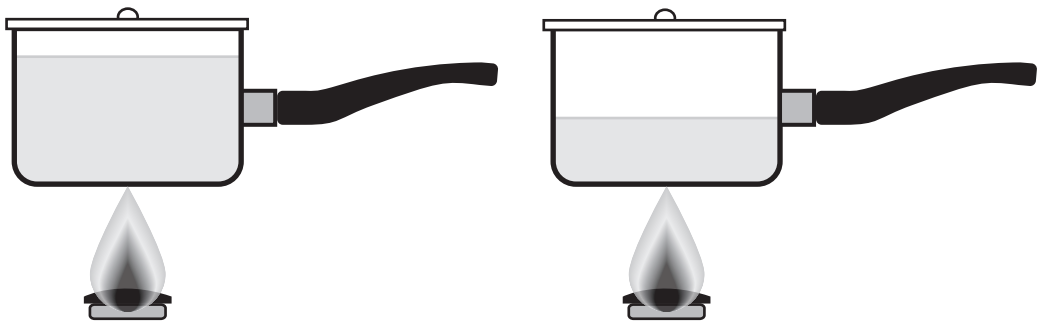
_____

_____

_____

Heating and cooling

Anna had two pots that were exactly the same - Pot A and Pot B. She placed one litre of water in Pot A and half a litre of water in Pot B. The temperature of the water in both pots was 20 °C to begin with. She placed the pots on two stoves set at the same temperature and covered them.



After two minutes, Anna turned off the stoves and measured again the temperature of the water in the two pots.

Q14 Circle the correct words in the sentence below.

After two minutes, the temperature of the water in Pot A was

lower than / the same as / higher than the temperature of the water in Pot B.

Give a reason for your answer.

_____

_____

_____

_____

Q15 Anna placed the following four objects on the same table in a room:

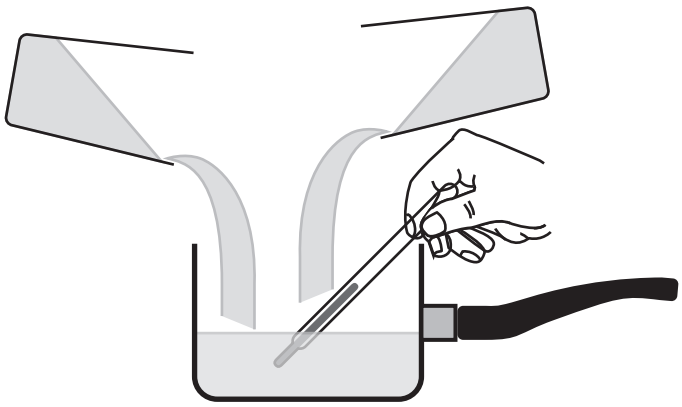
- metal spoon
- plastic spoon
- bowl of hot soup
- glass of cold lemonade

After 10 hours, how will the temperature of the objects compare with the room temperature?

For each object, place a tick in the correct box.

	Below room temperature	At room temperature	Above room temperature
Metal spoon			
Plastic spoon			
Bowl of hot soup			
Glass of cold lemonade			

Q16 John has a glass of water at a temperature of 60 °C and a glass with the same amount of water at 20 °C. He pours the water from both glasses into a pot and measures the temperature of the mixed water immediately.



What is the most likely temperature of the mixed water?

- ◯ 20 °C
- ◯ 40 °C
- ◯ 60 °C
- ◯ 80 °C

Greenhouse gas emissions

The table below shows the amount of carbon dioxide produced per year for two different households in New South Wales. Both households have four people. The carbon dioxide is created when electricity is produced to power electrical devices in these households.

Table: Amount of carbon dioxide produced per year for two households

	Amount of carbon dioxide (tonnes/year)	
Activities	**Household 1**	**Household 2**
Heating and cooling the home	2.8	0.0
Cooking	0.4	0.6
Water heating	2.4	2.2
Lighting	0.6	0.8
Using kitchen appliances	1.6	2.0
Leaving kitchen appliances in standby mode	0.5	0.3
Total	8.3	5.9

Q17 Household 1 decided to switch off the kitchen appliances instead of leaving them in standby mode. By how much would they reduce their carbon dioxide emissions?

- ◯ 0.3 tonnes/year
- ◯ 0.5 tonnes/year
- ◯ 1.6 tonnes/year
- ◯ 2.0 tonnes/year

Q18 Household 2 produces less carbon dioxide than Household 1.

Which of the following reasons **best** explains this?

- ◯ Household 2 uses more energy efficient light bulbs compared to Household 1.
- ◯ Household 2 uses fewer kitchen appliances than Household 1.
- ◯ Household 2 takes shorter showers requiring less water to be heated.
- ◯ Household 2 does not use air conditioning or heating devices.

Phases of the Moon

Sally recorded the shape of the Moon on different days in April. On some days, however, it was cloudy and she could not see the Moon. The table shows her results.

Table: Shape of the Moon on different days

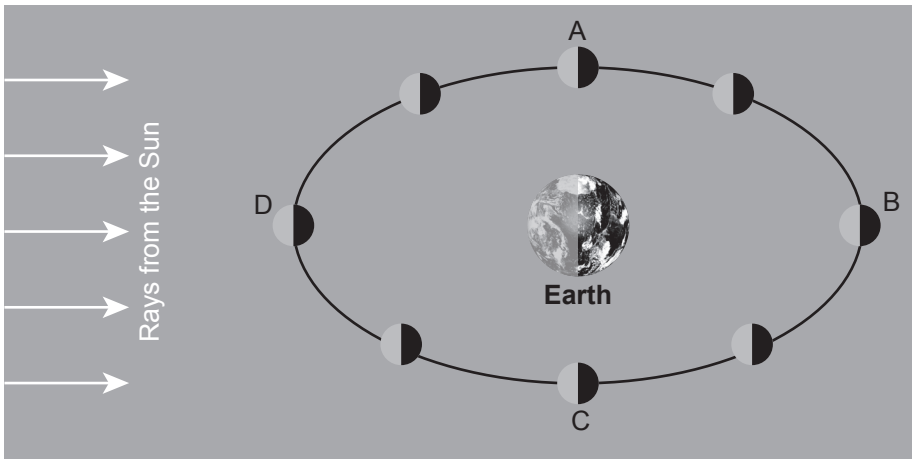
Crescent 		Quarter Moon 	Full Moon 	Quarter Moon 	
April 4	**April 6**	**April 8**	**April 15**	**April 22**	**April 25**

Q19 In the table above, draw what Sally would have seen on April 6 and April 25 if it had not been cloudy.

Q20 The Moon takes about 28 days to orbit Earth. What did the Moon look like on May 8 of the same year? Give reasons for your answer.

Q21 The Moon does not emit light. We see the Moon from Earth because it reflects light from the Sun. The Moon is always half lit by the Sun, but as the Moon orbits Earth we get to see more or less of the lit half. The shape of the Moon that we see at any time is then determined by the combination of two factors - which part of the Moon is lit by the Sun and is also visible to Earth at the same time.

The figure below shows the orbit of the Moon around Earth. The Sun is far off the paper to the left.



Where is the Moon in its orbit around Earth at the time of a full moon?

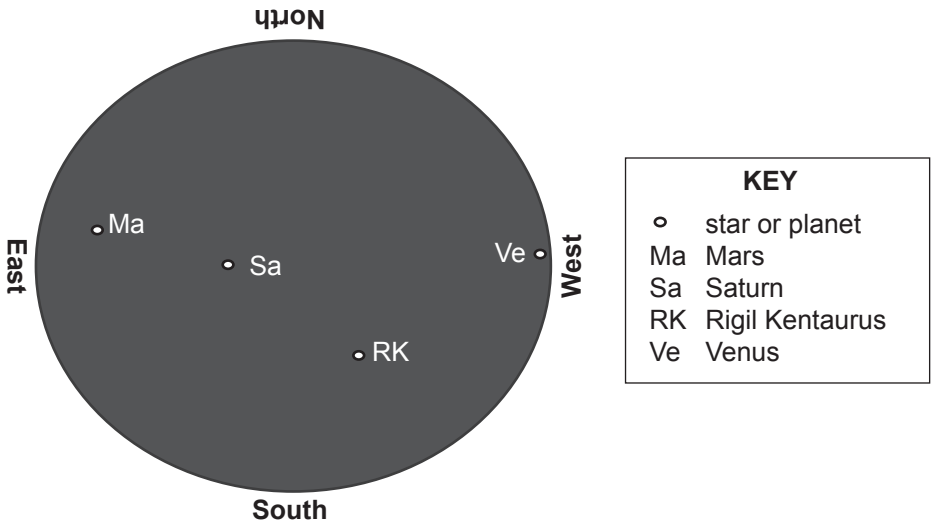
- ○ position A
- ○ position B
- ○ position C
- ○ position D

Q22 The Moon rises in the east and sets in the west.

The Sun and the Moon appear much brighter in the sky than the planets and stars, so we rarely see planets and stars in the sky during the day time.

Jamie lay down on his back and looked up at the night sky. The chart shows the positions of some bright stars and planets that he observed just before moonrise.

Chart of the night sky



A full moon was predicted for this night.

Which object would be **least** likely to be seen as the Moon was rising?

- ◯ Mars
- ◯ Saturn
- ◯ Rigil Kentaurus
- ◯ Venus

Using and saving energy

Most of Australia's energy comes from burning fossil fuels such as coal, natural gas and oil.

Burning fossil fuels produces greenhouse gases which contribute to global warming.

Q23 Hot water systems use a lot of energy in houses.

Which type of hot water system contributes **least** to global warming?

- ◯ electrical
- ◯ natural gas
- ◯ solar
- ◯ wood

Explain why.

_____

_____

_____

Q24 What are renewable sources of energy?

_____

_____

_____

Give one example of a renewable source of energy.

_____

Climate change

Earth has warmed by about 0.6 degrees over the past 100 years. It is estimated that the average temperature of Earth will increase by 2–5 degrees within the next 30 years.

Q25 Which of these events in Australia is **not** likely to be a consequence of global warming?

- ◯ There are longer and more frequent droughts.
- ◯ Tasmania experiences heat-wave conditions during winter.
- ◯ Average temperatures are higher in October than in July in Adelaide.
- ◯ There are larger and more frequent floods in southern Queensland.

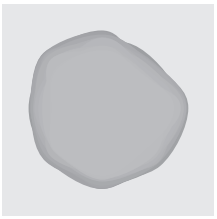
Q26 Global warming causes changes in the climate patterns in many places.

Name **another** consequence of global warming. Explain why this is a problem.

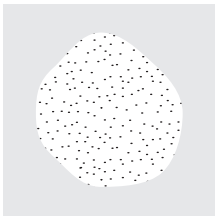
Collecting ants

Kayla wanted to find out which food would attract the most ants. She set up some traps to collect ants. The traps were pieces of cardboard with different types of food on them.

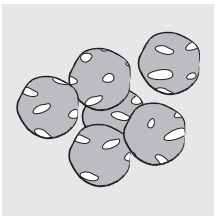
Kayla made sure all four cardboard pieces were the same size.



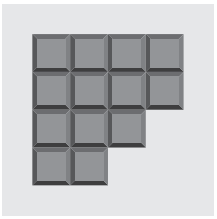
Honey



Sugar



Biscuits



Chocolate

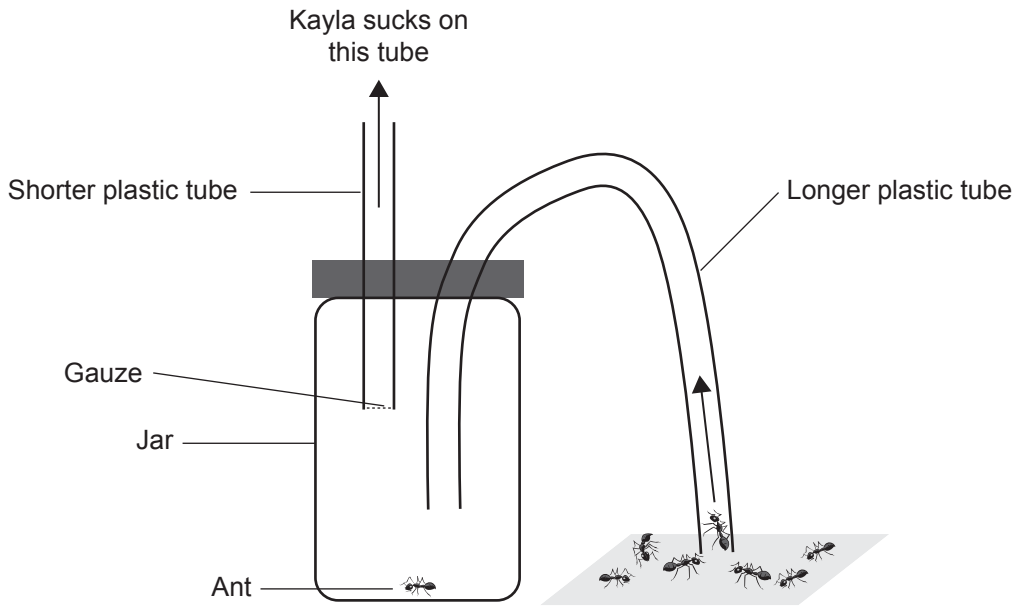
Q27 Name **two** other things that Kayla needs to keep the same to make the experiment fair.

1 _____

2 _____

Q28 Kayla made a device called an insect pooter to collect the ants. She made the pooter by making two holes in the lid of an empty jar and inserting a plastic tube tightly into each hole.

Insect pooter



Kayla placed the longer tube over an ant and sucked on the shorter plastic tube. The ant ended up in the bottom of the jar.

Explain how this happened.

_____

_____

_____

_____

Q29 Black ants can spray formic acid at people or other animals. Formic acid stings the eyes and skin. Why do ants spray formic acid?

_____

_____

Tomato plants

A farmer wants to grow taller tomato plants with more tomatoes. He decides to test two methods.

Method 1: buy seeds and add more fertiliser to the soil.

Method 2: save seeds from his tallest tomatoes and plant them the following year.

Results for Method 1

	Average height of plants (cm)	Average weight of plants with tomatoes attached (kg)	Average weight of tomatoes per plant (kg)
Group A (usual amount of fertiliser)	116	8.0	3.5
Group B (double the amount of fertiliser)	116	8.0	2.0

Q30 The average weight of a plant with the tomatoes attached is mostly made up of tomatoes and leaves.

Circle the group of plants which you would expect to have more leaves.

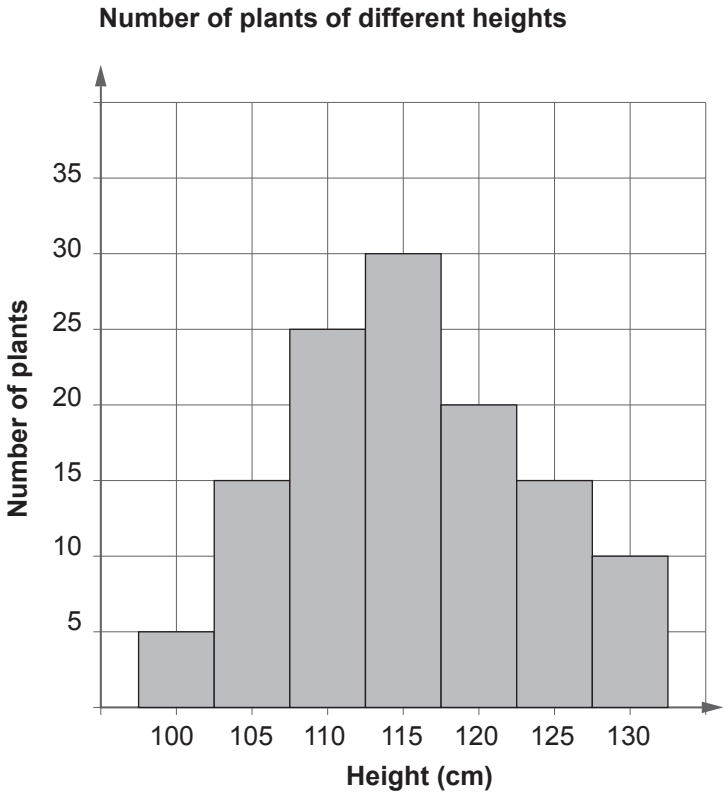
Group A Group B

Use the results for Method 1 to explain your answer.

Results for Method 2

The farmer collected seeds from his tallest tomato plants **(130 cm tall)**.

He planted the seeds and measured the heights of the plants that grew from the seeds.



Look at the column (bar) graph.

Q31 How many plants grew from the seeds?

- ◯ 30
- ◯ 115
- ◯ 120
- ◯ 130

Q32 What was the height of the tallest tomato plants?

_____ (cm)

Q33 Name one other piece of information that the farmer needs to collect to decide which of the two methods of growing plants is better.

_____

_____

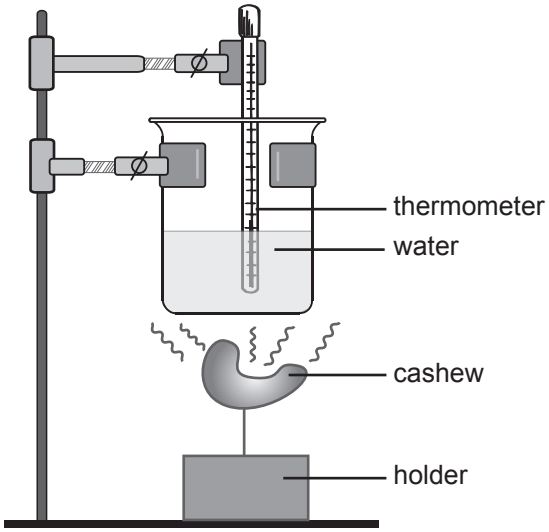
Burning foods

Mr. George compared different foods to see which one gives off the most heat energy when burnt.

He identified samples of four different foods with the same mass. He filled four containers with 200 mL of water and measured the temperature of the water in each container.

Then he

- lit each food sample with a match;
- placed each food sample under a container with water as soon as the food sample was burning;
- measured the temperature of the water in the container after the food sample had burnt completely.



His results are shown in the table below.

Table: Temperature of water before and after burning each food sample

Food sample	Starting temperature of water (°C)	Final temperature of water (°C)
marshmallow	20	35
cashew	20	45
potato chip	20	35
jelly bean	20	40

Q34 Mr. George calculated the temperature increase for the four food samples.

For which two food samples was the temperature increase the same?

- ◯ cashew and potato chip
- ◯ marshmallow and potato chip
- ◯ cashew and jelly bean
- ◯ marshmallow and jelly bean

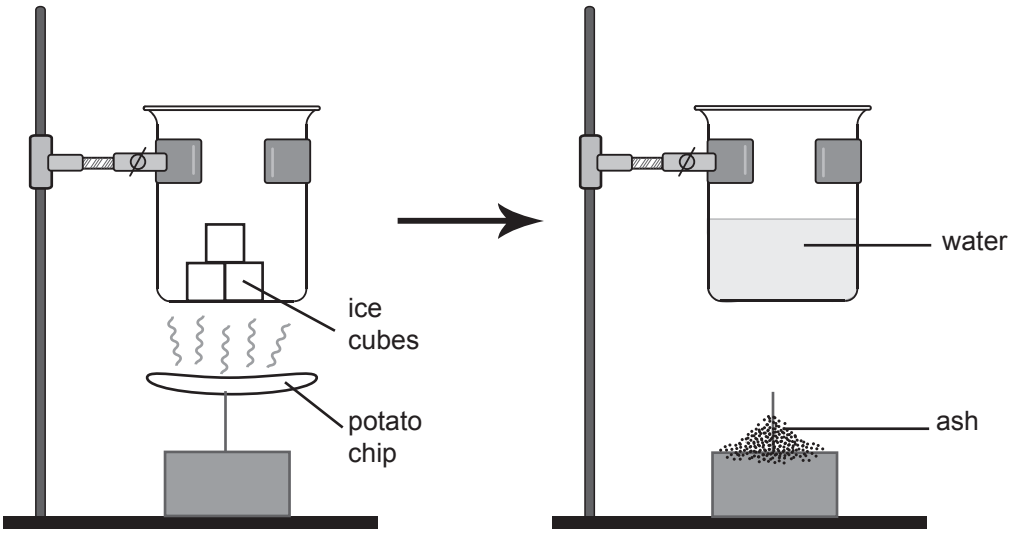
Q35 Why did Mr. George need to figure out the **temperature increase** of the water for the four food samples?

Q36 Did Mr. George's experiment measure all the energy given off by each food sample?

◯ Yes ◯ No

Give reasons for your answer.

Q37 Mr. George repeated his experiment with the potato chip but instead of using a container with water he used a container with some ice in it.



Mr. George noticed two changes that occurred during the experiment. The potato chip changed to a pile of ash and the ice melted.

Circle the correct word in the sentences below.

- The burning of the potato chip **can** / **cannot** be reversed.
- The melting of the ice **can** / **cannot** be reversed.

This is the end of the objective test.

STOP and wait for your teacher's instructions.

PRACTICAL TASK

Which beak works best?

Introduction

All living things have features that make them suited to their environment. For example, birds have beaks with different shapes that function (work) in different ways. In this practical task you will investigate which beak shape works best to gather different types of food.

What to do

Complete Part A of the activity in your group. You will collect and record your data in Part A.

Complete Part B by yourself. You will use the data you collected in Part A to answer questions.

What you will need per group of three students

- Plastic plate
- Plastic cup
- 30 beads
- One A5 sheet of paper, marked in 2 cm squares
- Two craft sticks
- Toothpick
- Plastic spoon

Part A

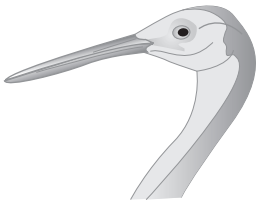
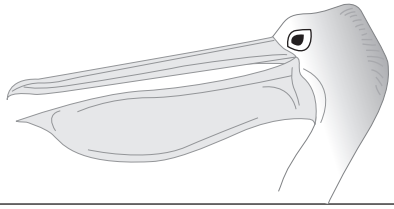
Group work (Work as a group of three students.)

Experiment: **Which beak works best?**

You will investigate which beak type works best to gather different types of food.

The pictures below show three birds, each with a different type of beak: sieve (filter), spear and net. In the experiment, you will use two craft sticks as a sieve-type beak, a toothpick as a spear-type beak and a spoon as a net-type beak.

You will use beads and pieces of paper as food.

Beak type	Example of bird with this beak type	Photo of bird
Sieve (two craft sticks)	**Duck** 	
Spear (toothpick)	**Heron** 	
Net (plastic spoon)	**Pelican** 	

Setting up the experiment

1. Place the plastic plate on a flat surface.
2. Place the two craft sticks, the toothpick and the plastic spoon next to the plate.
3. Place the plastic cup next to the plate.

Conducting the experiment

You will use the different 'beak' types (craft sticks, toothpick and spoon) to pick up objects that you have placed on the plate.

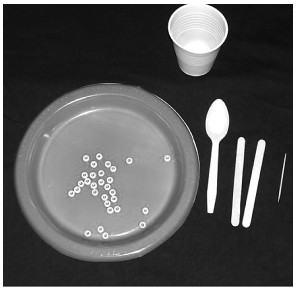
You will take turns to use the 'beaks'.

Remember:

- **You must not pick up the objects with your hands.**
- **You must keep the plate flat on the table during the experiment.**
- **You must make sure that the cup is empty before you place any objects into it.**

Gathering beads

1. Put all of the beads on the plate.



HINT When using the two craft sticks, use one stick in each hand.

NOTE Count ten seconds by saying 'one thousand and one, one thousand and two, one thousand and three' up to 'one thousand and ten'.

2. Take turns to use the **craft sticks** to pick up as many beads as you can in 10 seconds. You can pick up more than one bead at a time. As you pick them up, place the beads into the cup.

Count and record each person's results in Table 1 on the next page.

Remember to empty the cup after each person's turn.

NOTE Please make sure that you record your data accurately. You will need to use the data to answer questions in Part B.

3. Take turns to use the **toothpick** to pick up as many beads as you can in 10 seconds. You can pick up more than one bead at a time. As you pick them up, place the beads into the cup.

Count and record each person's results in Table 1 on the next page.

Remember to empty the cup after each person's turn.

4. Take turns to use the **plastic spoon** to pick up as many beads as you can in 10 seconds. You can pick up more than one bead at a time. As you pick them up, place the beads into the cup.

Count and record each person's results in Table 1 below.

Remember to empty the cup after each person's turn.

5. Now make sure **you** have a copy of all of your group's data in Table 1.

Table 1: 'Food' (number of beads) gathered

Beak type	'Food' (number of beads) gathered by			
	Person 1	Person 2	Person 3	Total
Sieve (two craft sticks)				
Spear (toothpick)				
Net (plastic spoon)				

6. When you have recorded all of your group's data, calculate and record in Table 1 the **total number** of beads gathered by all three persons in your group for the craft sticks, the toothpick and the plastic spoon.

7. Put the beads back in the bag supplied.

Gathering pieces of paper

1. Tear the sheet of paper into pieces of approximately 2 cm square.

2. Put all of the pieces of paper on the plate.

3. Take turns to use the **craft sticks** to pick up as many pieces of paper as you can in 10 seconds. You can pick up more than one piece of paper at a time. As you pick them up, place the pieces of paper into the cup.

Count and record each person's results in Table 2 on the next page.

Remember to empty the cup after each person's turn.

4. Take turns to use the **toothpick** to pick up as many pieces of paper as you can in 10 seconds. You can pick up more than one piece of paper at a time. As you pick them up, place the pieces of paper into the cup.

Count and record each person's results in Table 2 below.

Remember to empty the cup after each person's turn.

5. Take turns to use the **plastic spoon** to pick up as many pieces of paper as you can in 10 seconds. You can pick up more than one piece of paper at a time. As you pick them up, place the pieces of paper into the cup.

Count and record each person's results in Table 2 below.

Remember to empty the cup after each person's turn.

6. Now make sure **you** have a copy of all of your group's data in Table 2.

Table 2: 'Food' (number of pieces of paper) gathered

Beak type	'Food' (number of pieces of paper) gathered by			
	Person 1	Person 2	Person 3	Total
Sieve (two craft sticks)				
Spear (toothpick)				
Net (plastic spoon)				

7. When you have recorded all of your group's data, calculate and record in **Table 2** the **total number** of pieces of paper gathered by all three persons in your group for the craft sticks, the toothpick and the plastic spoon.

8. Place the pieces of paper in a pile near the plate.

Before you go on, make sure you have recorded all of your group's results. You will need to use these results when you work by yourself in Part B.

You have finished Part A.

Do not turn the page until you are told to do so.

Part B

Individual work (Answer these questions by yourself.)

Q1 Look at your group's results in **Table 1:** *'Food' (number of beads) gathered*.

When Person 1 used the **craft sticks**, how many beads did they gather?

_____

Q2 In the experiment you used a plastic spoon as a net-type beak.

Describe how a plastic spoon works in a similar way to a net-type beak.

_____

_____

Q3 Describe how a plastic spoon is different from a net-type beak.

_____

_____

Q4 Ducks move over the surface of the water with their mouths open to sieve (filter) floating weed. In this experiment small pieces of paper were used to represent floating weed.

Do your group's results show that the best type of a beak to collect floating weed is a sieve?

Circle: Yes / No

Use the data you collected in the experiment to explain your answer.

_____

_____

_____

_____

Q5–Q7

Use the **TOTAL number of beads gathered** to draw a column (bar) graph that displays your group's data from **Table 1**.

Draw your graph in the space below. Remember to label the axes of your graph.

Total number of beads gathered by each beak type

Q8

How is a bird's beak matched to what the bird eats?

Give an example to support your answer.

Q9 Counting seconds by saying 'one thousand and one, one thousand and two…' is the timing method you used.

Explain why using a clock with a second hand would be a better timing method.

_____

_____

Q10 In the experiment, each person only used each beak once. One way to improve the experiment would be to ask each person in the group to use each beak **three** times.

The purpose of this would be to

- ◯ make the experiment fair.
- ◯ reduce the effect of errors.
- ◯ pick up as much food as possible.
- ◯ show that their results would be exactly the same.

This is the end of the practical task.

STOP and wait for your teacher's instructions.

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Practice questions

Multiple Choice

Q1 Shade in the bubble next to the correct answer.

The colour of blood is

- ◯ blue.
- ◯ green.
- ◯ red.
- ◯ yellow.

Circle the Word or Words

Q2 Circle the correct words in the sentence below.

An elephant is **a bit smaller / much bigger** than a human.

One or Two Word Answer

Q3 On a clear, sunny day the colour of the sky is _____ .

Long Answer

Q4 Explain what happens to a balloon when you blow it up.

_____

_____

Tick the Boxes

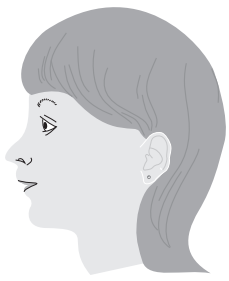
Q5 Which of the following are fruit? Tick all possible answers.

☐ banana ☐ bicycle ☐ apple ☐ chair

Fill in the Table

Q6 Look at the features of this face.

Complete the table below.



Feature	Sense
eyes	sight
ears	
	smell

NATIONAL ASSESSMENT PROGRAM (NAP-SL)

SCIENCE LITERACY 2009

YEAR 6

RELEASED ITEMS

OBJECTIVE ASSESSMENT

First Name: _____

Last Name: _____

School: _____

MCEECDYA
Ministerial Council for Education,
Early Childhood Development and Youth Affairs

THE UNIVERSITY OF NEW SOUTH WALES
EDUCATIONAL ASSESSMENT AUSTRALIA

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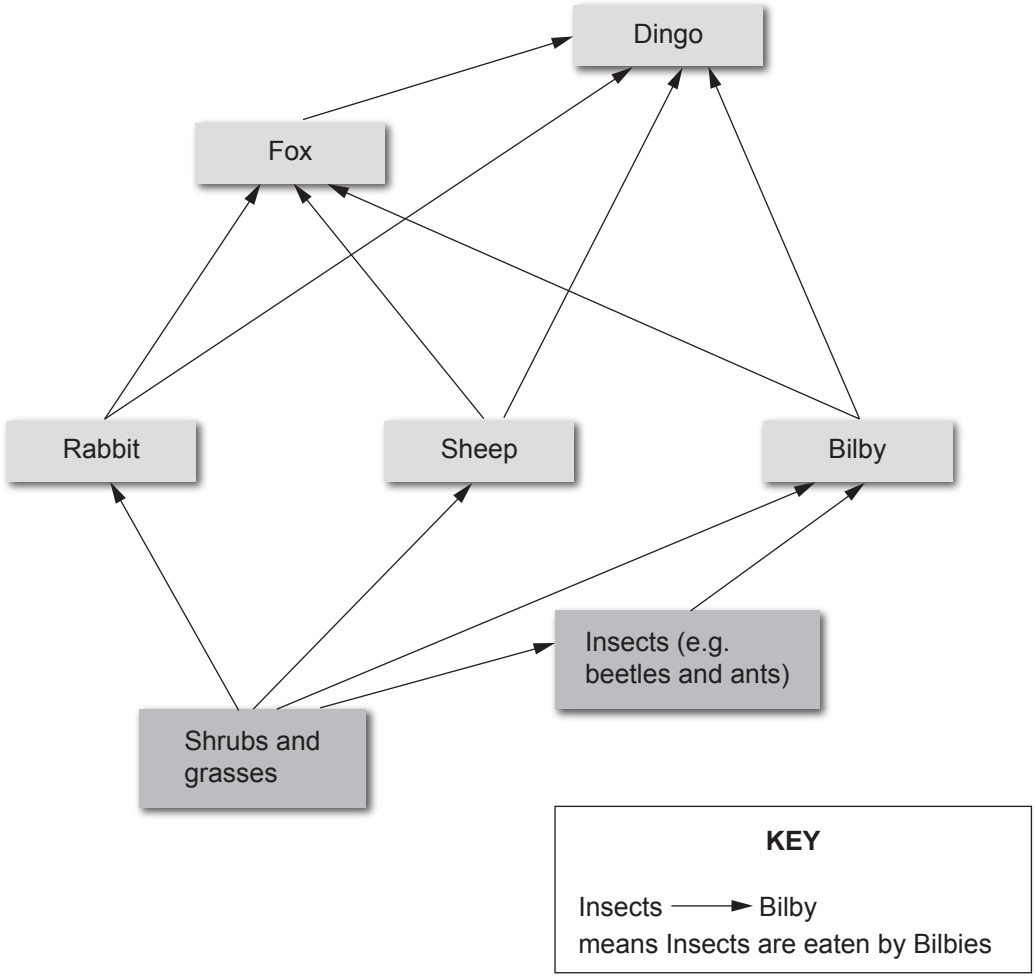
Native and introduced animals

Native animals occur naturally in Australia. Introduced animals have been brought into Australia from other countries.

The food web below contains four introduced animals: rabbits, sheep, foxes and dingoes.



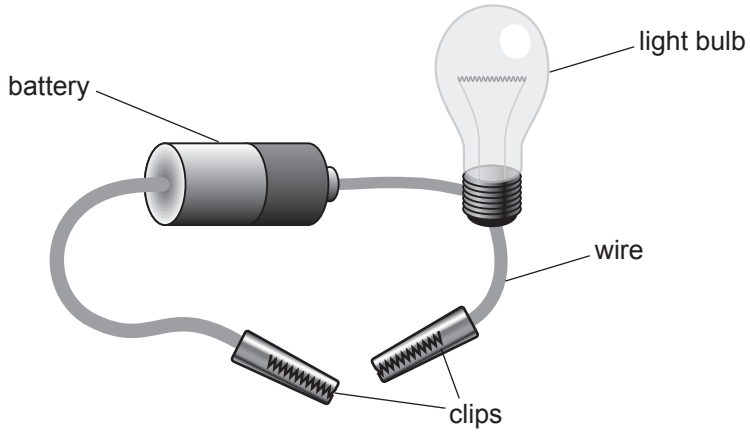
Q1 For this food web, which of the following statements is correct?

- ◯ Bilbies eat foxes.
- ◯ Dingoes eat rabbits.
- ◯ Dingoes eat insects.
- ◯ Foxes eat shrubs and grasses.

Energy efficient light bulbs

The diagram below shows an incomplete electric circuit containing a battery, wires and a light bulb.

A light bulb in an incomplete electric circuit



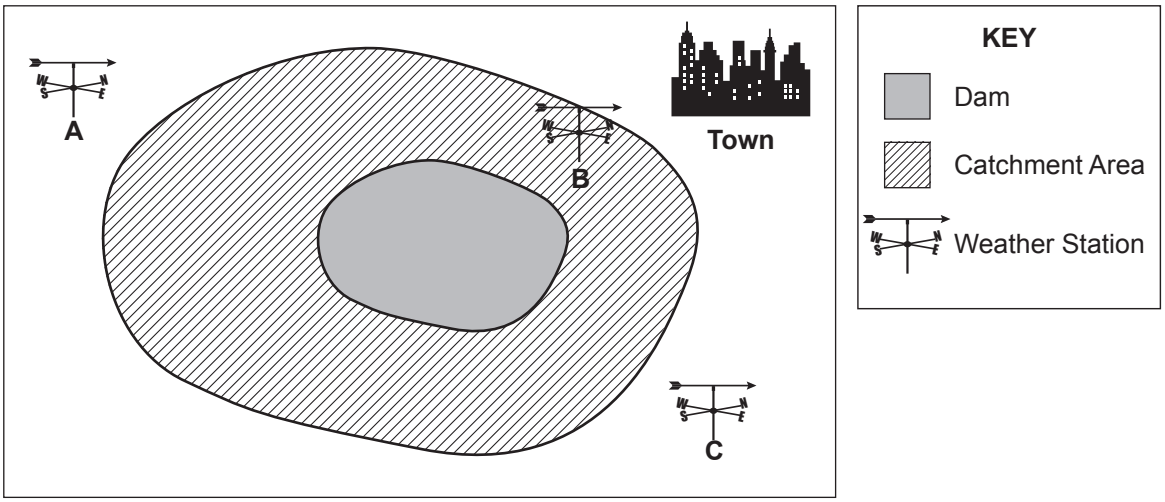
Q2 Which item could be placed between the clips to complete the circuit and cause the light bulb to glow?

- ⬭ paper clip
- ⬭ piece of paper
- ⬭ straw
- ⬭ toothpick

Water resources

The picture below shows a dam and its catchment area. When rain falls in the catchment area it flows into the dam as run-off and is stored. This dam provides much of the local town's water.

Map of a dam and its catchment area



Q3 A poisonous chemical was used within the catchment area to control the spread of weeds.

How might this affect the town's water supply?

_____

_____

_____

_____

Q4 There are times when the dam level is low and rainfall in the catchment area is also low.

Suggest one way to reduce water usage in the home during such times.

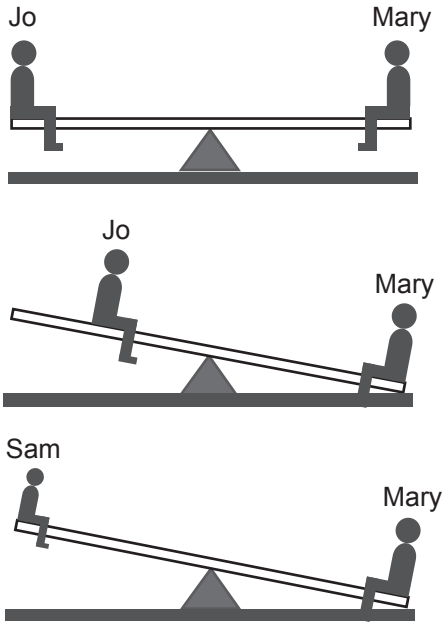
_____

_____

Lifting weights

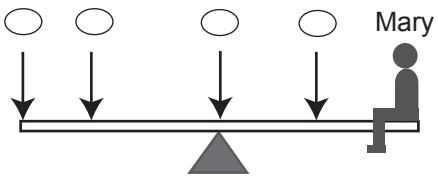
Mary, Jo and Jo's little sister Sam investigated balancing on a seesaw. Both Jo and Mary each weighed 40 kg. Sam weighed 20 kg.

The diagrams show the observations the children made during their investigation. When no one is sitting on the seesaw, it is balanced.



Q5 In the diagram below Mary is sitting at one end of the bar of the seesaw.

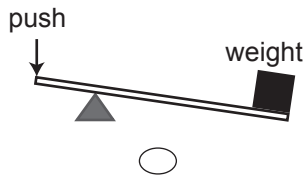
If Sam sat on Jo's lap, where should they sit to balance the seesaw?

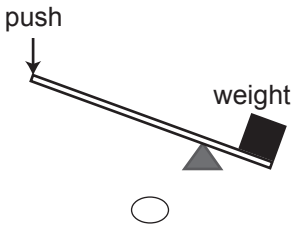


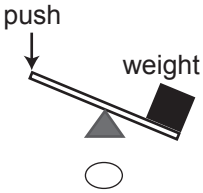
Q6 Levers are used to lift heavy weights such as rocks and crates. Seesaws are a type of lever. You push down on one end of the bar to move a heavy weight upwards at the other end.

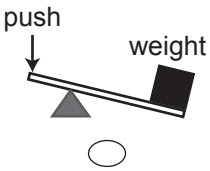
The diagram below shows four levers ready to lift a weight. They are shown at the same scale.

Which lever will lift the same weight with the least push?









Separating mixtures

Jan investigated how a mixture could be separated into its parts.

She mixed the following substances together in a glass:

100 mL water
1 teaspoon olive oil
1 teaspoon rolled oats
1 teaspoon powdered drinking chocolate.

She used the following **steps** in her investigation:

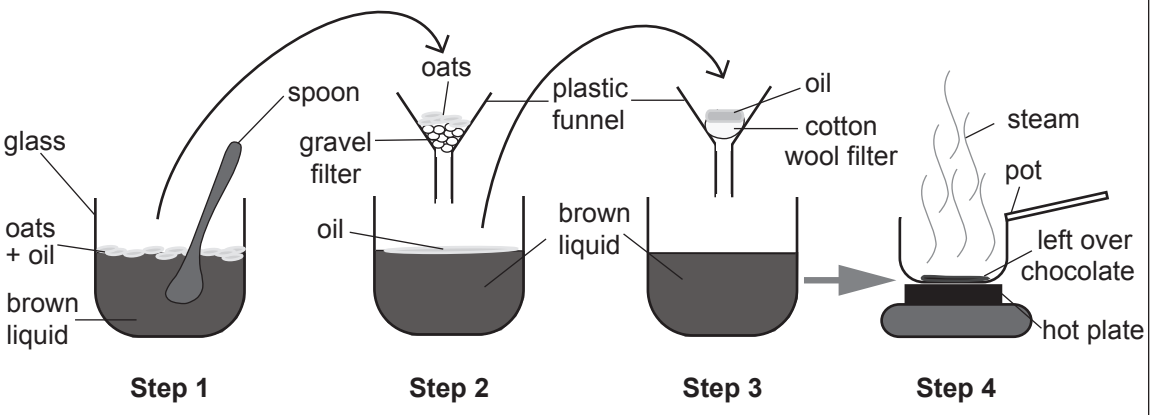
1. Stir the mixture with a spoon.

2. Pour the mixture through a gravel filter and collect what passes through in a glass.

3. Pour the contents collected in the glass in **Step 2** through a cotton wool filter and collect what passes through in another glass.

4. Place the contents of the glass collected in **Step 3** into a pot and boil it.

The diagram shows Jan's observations of the steps taken in her investigation.



Q7 Jan wanted to collect the water that had been separated from the mixture in her investigation.

How could she best achieve this?

- ◯ Collect the contents of the glass in **Step 3**, which is water only.
- ◯ Put the mixture through **Step 3** a second time.
- ◯ Allow the pot in **Step 4** to cool leaving water only.
- ◯ Collect the steam from **Step 4** and cool it to a liquid.

Three methods for separating mixtures into their parts are:		
Dissolving	Using a magnet	Filtering

Which method should Jan use to separate the mixtures listed below into their parts?

Q8 Separate sand and iron filings (tiny pieces of iron):

_____

Q9 Separate mud in water from water:

_____

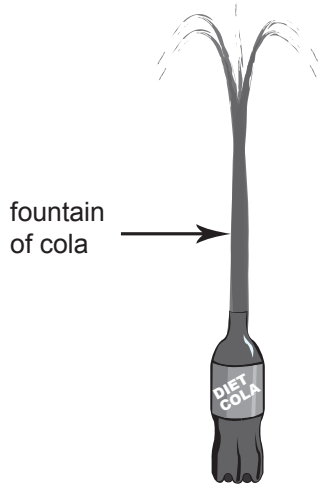
Q10 Which **two** methods should Jan use to separate the mixture listed below into its parts?

Separate sand and salt:

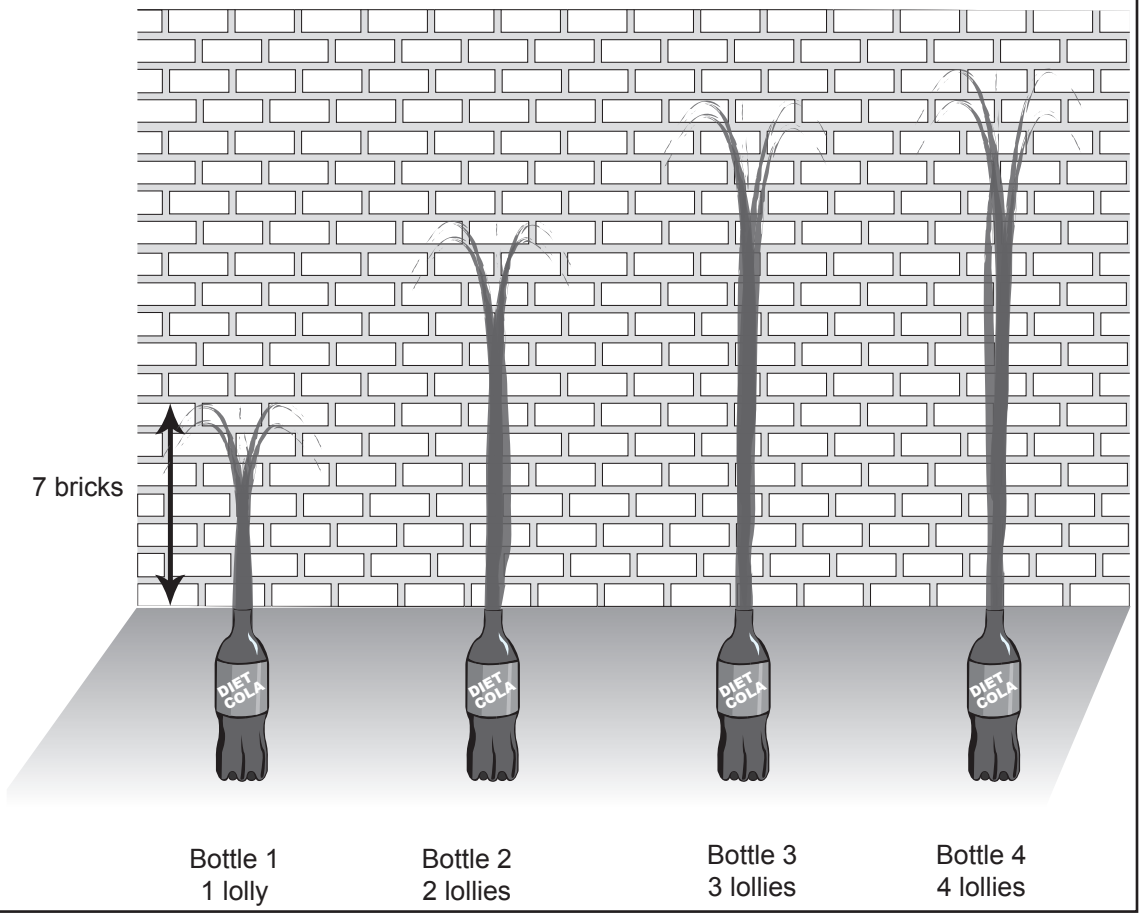
_____

Cola fountain

Dropping a mint lolly into a bottle of diet cola produces a fountain.



Sam and Michael investigated whether they could make a higher fountain by adding different numbers of lollies to bottles of diet cola. They set up four bottles against a brick wall as shown below. They measured the height of the fountains using the brick wall.



Q11 Sam measured the height of each fountain using the bricks on the wall. Complete the table below to record the results of this experiment.

Table: Height of fountain compared to number of lollies

	Number of lollies	Height of fountain (bricks)
Bottle 1	1	7
Bottle 2	2	
Bottle 3	3	
Bottle 4	4	

Q12 What should Sam and Michael keep the same in this experiment to make it a fair test?

Tick all possible answers.

- ☐ the number of lollies dropped in each bottle
- ☐ the type of diet cola used
- ☐ the amount of diet cola in each bottle
- ☐ the number of bottles used

Q13 Regular cola contains sugar. Diet cola contains an artificial sweetener.

Sam suggested that this sweetener caused the fountain when the lolly was dropped in the diet cola. Explain in detail how Sam could test his idea.

_____

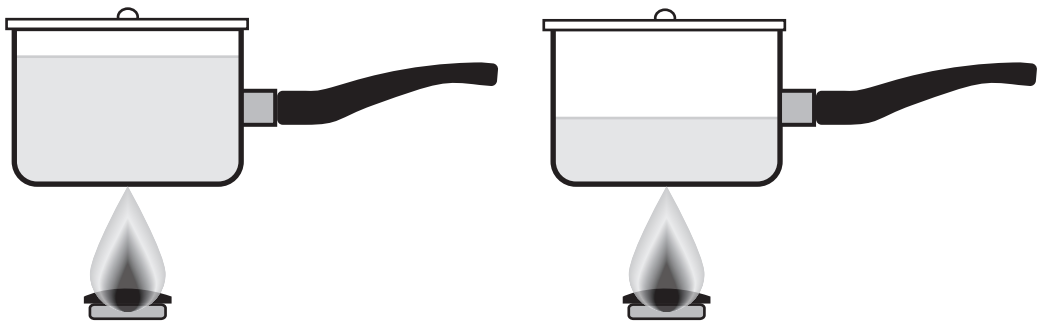
_____

_____

_____

Heating and cooling

Anna had two pots that were exactly the same - Pot A and Pot B. She placed one litre of water in Pot A and half a litre of water in Pot B. The temperature of the water in both pots was 20 °C to begin with. She placed the pots on two stoves set at the same temperature and covered them.



After two minutes, Anna turned off the stoves and measured again the temperature of the water in the two pots.

Q14 Circle the correct words in the sentence below.

After two minutes, the temperature of the water in Pot A was

lower than / the same as / higher than the temperature of the water in Pot B.

Give a reason for your answer.

_____

_____

_____

_____

Q15 Anna placed the following four objects on the same table in a room:

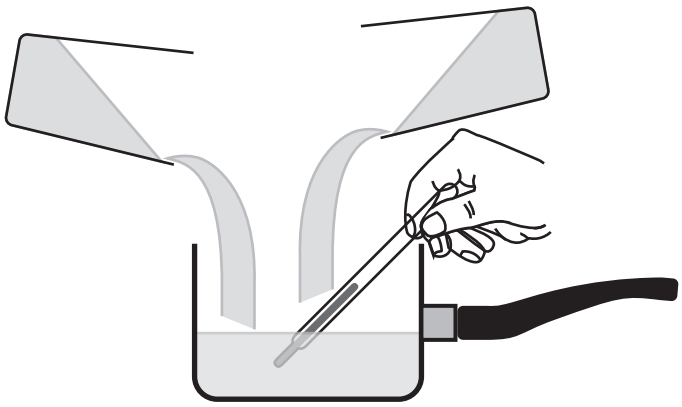
- metal spoon
- plastic spoon
- bowl of hot soup
- glass of cold lemonade

After 10 hours, how will the temperature of the objects compare with the room temperature?

For each object, place a tick in the correct box.

	Below room temperature	At room temperature	Above room temperature
Metal spoon			
Plastic spoon			
Bowl of hot soup			
Glass of cold lemonade			

Q16 John has a glass of water at a temperature of 60 °C and a glass with the same amount of water at 20 °C. He pours the water from both glasses into a pot and measures the temperature of the mixed water immediately.



What is the most likely temperature of the mixed water?

- ◯ 20 °C
- ◯ 40 °C
- ◯ 60 °C
- ◯ 80 °C

Greenhouse gas emissions

The table below shows the amount of carbon dioxide produced per year for two different households in New South Wales. Both households have four people. The carbon dioxide is created when electricity is produced to power electrical devices in these households.

Table: Amount of carbon dioxide produced per year for two households

	Amount of carbon dioxide (tonnes/year)	
Activities	**Household 1**	**Household 2**
Heating and cooling the home	2.8	0.0
Cooking	0.4	0.6
Water heating	2.4	2.2
Lighting	0.6	0.8
Using kitchen appliances	1.6	2.0
Leaving kitchen appliances in standby mode	0.5	0.3
Total	8.3	5.9

Q17 Household 1 decided to switch off the kitchen appliances instead of leaving them in standby mode. By how much would they reduce their carbon dioxide emissions?

- ◯ 0.3 tonnes/year
- ◯ 0.5 tonnes/year
- ◯ 1.6 tonnes/year
- ◯ 2.0 tonnes/year

Q18 Household 2 produces less carbon dioxide than Household 1.

Which of the following reasons **best** explains this?

- ◯ Household 2 uses more energy efficient light bulbs compared to Household 1.
- ◯ Household 2 uses fewer kitchen appliances than Household 1.
- ◯ Household 2 takes shorter showers requiring less water to be heated.
- ◯ Household 2 does not use air conditioning or heating devices.

Phases of the Moon

Sally recorded the shape of the Moon on different days in April. On some days, however, it was cloudy and she could not see the Moon. The table shows her results.

Table: Shape of the Moon on different days

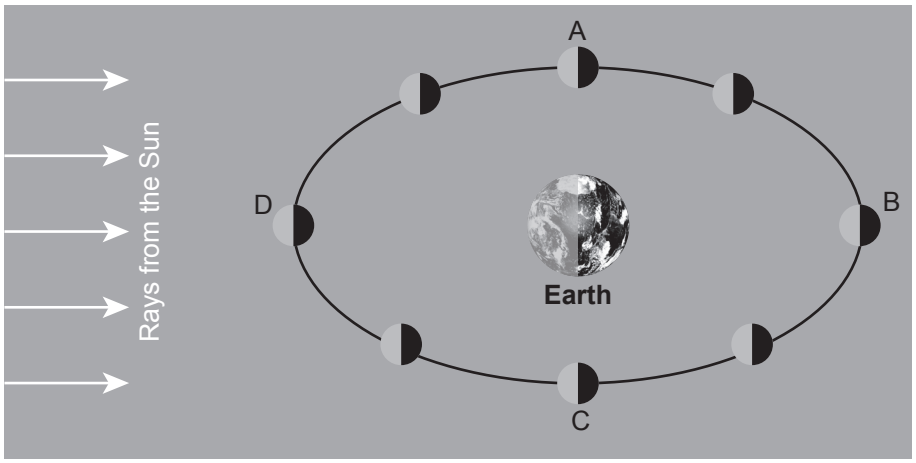
Crescent 		Quarter Moon 	Full Moon 	Quarter Moon 	
April 4	**April 6**	**April 8**	**April 15**	**April 22**	**April 25**

Q19 In the table above, draw what Sally would have seen on April 6 and April 25 if it had not been cloudy.

Q20 The Moon takes about 28 days to orbit Earth. What did the Moon look like on May 8 of the same year? Give reasons for your answer.

Q21 The Moon does not emit light. We see the Moon from Earth because it reflects light from the Sun. The Moon is always half lit by the Sun, but as the Moon orbits Earth we get to see more or less of the lit half. The shape of the Moon that we see at any time is then determined by the combination of two factors - which part of the Moon is lit by the Sun and is also visible to Earth at the same time.

The figure below shows the orbit of the Moon around Earth. The Sun is far off the paper to the left.



Where is the Moon in its orbit around Earth at the time of a full moon?

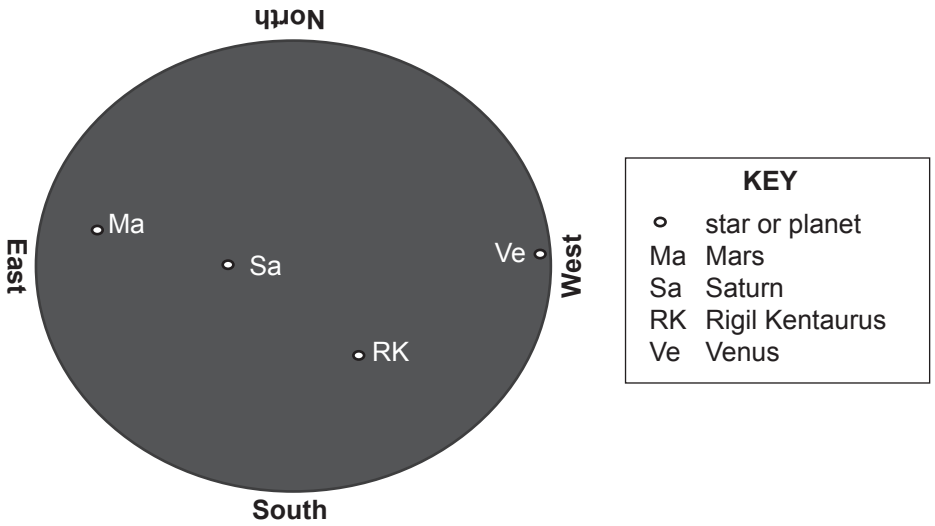
- ○ position A
- ○ position B
- ○ position C
- ○ position D

Q22 The Moon rises in the east and sets in the west.

The Sun and the Moon appear much brighter in the sky than the planets and stars, so we rarely see planets and stars in the sky during the day time.

Jamie lay down on his back and looked up at the night sky. The chart shows the positions of some bright stars and planets that he observed just before moonrise.

Chart of the night sky



A full moon was predicted for this night.

Which object would be **least** likely to be seen as the Moon was rising?

- ◯ Mars
- ◯ Saturn
- ◯ Rigil Kentaurus
- ◯ Venus

Using and saving energy

Most of Australia's energy comes from burning fossil fuels such as coal, natural gas and oil.

Burning fossil fuels produces greenhouse gases which contribute to global warming.

Q23 Hot water systems use a lot of energy in houses.

Which type of hot water system contributes **least** to global warming?

- ◯ electrical
- ◯ natural gas
- ◯ solar
- ◯ wood

Explain why.

_____

_____

_____

Q24 What are renewable sources of energy?

_____

_____

_____

Give one example of a renewable source of energy.

_____

Climate change

Earth has warmed by about 0.6 degrees over the past 100 years. It is estimated that the average temperature of Earth will increase by 2–5 degrees within the next 30 years.

Q25 Which of these events in Australia is **not** likely to be a consequence of global warming?

- ◯ There are longer and more frequent droughts.
- ◯ Tasmania experiences heat-wave conditions during winter.
- ◯ Average temperatures are higher in October than in July in Adelaide.
- ◯ There are larger and more frequent floods in southern Queensland.

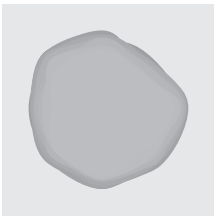
Q26 Global warming causes changes in the climate patterns in many places.

Name **another** consequence of global warming. Explain why this is a problem.

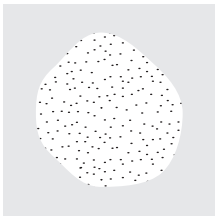
Collecting ants

Kayla wanted to find out which food would attract the most ants. She set up some traps to collect ants. The traps were pieces of cardboard with different types of food on them.

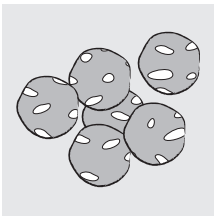
Kayla made sure all four cardboard pieces were the same size.



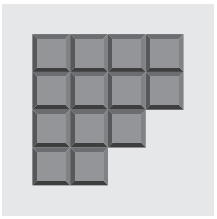
Honey



Sugar



Biscuits



Chocolate

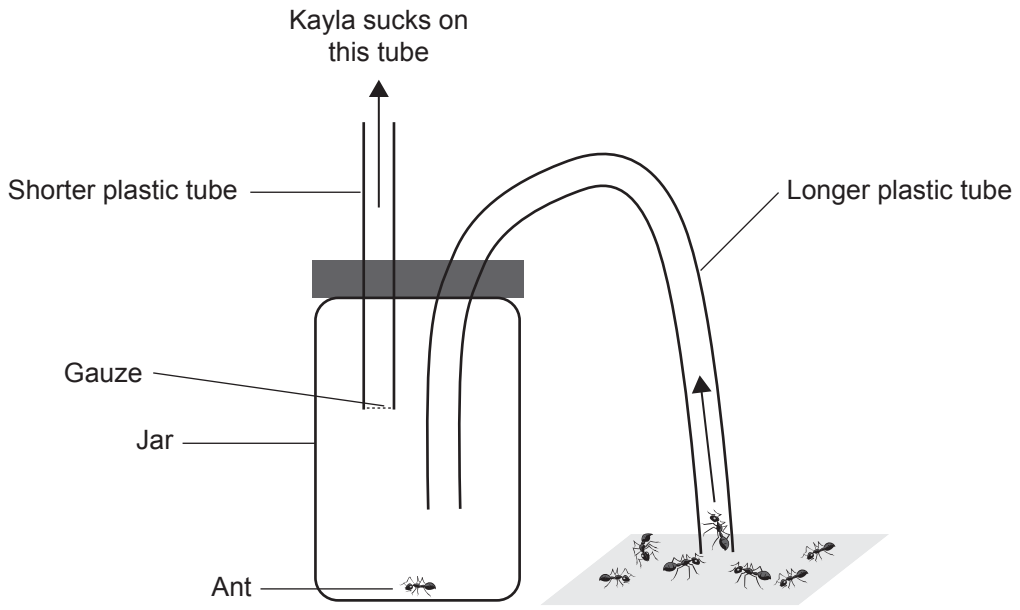
Q27 Name **two** other things that Kayla needs to keep the same to make the experiment fair.

1 _____

2 _____

Q28 Kayla made a device called an insect pooter to collect the ants. She made the pooter by making two holes in the lid of an empty jar and inserting a plastic tube tightly into each hole.

Insect pooter



Kayla placed the longer tube over an ant and sucked on the shorter plastic tube. The ant ended up in the bottom of the jar.

Explain how this happened.

_____

_____

_____

_____

Q29 Black ants can spray formic acid at people or other animals. Formic acid stings the eyes and skin. Why do ants spray formic acid?

_____

_____

Tomato plants

A farmer wants to grow taller tomato plants with more tomatoes. He decides to test two methods.

Method 1: buy seeds and add more fertiliser to the soil.

Method 2: save seeds from his tallest tomatoes and plant them the following year.

Results for Method 1

	Average height of plants (cm)	Average weight of plants with tomatoes attached (kg)	Average weight of tomatoes per plant (kg)
Group A (usual amount of fertiliser)	116	8.0	3.5
Group B (double the amount of fertiliser)	116	8.0	2.0

Q30 The average weight of a plant with the tomatoes attached is mostly made up of tomatoes and leaves.

Circle the group of plants which you would expect to have more leaves.

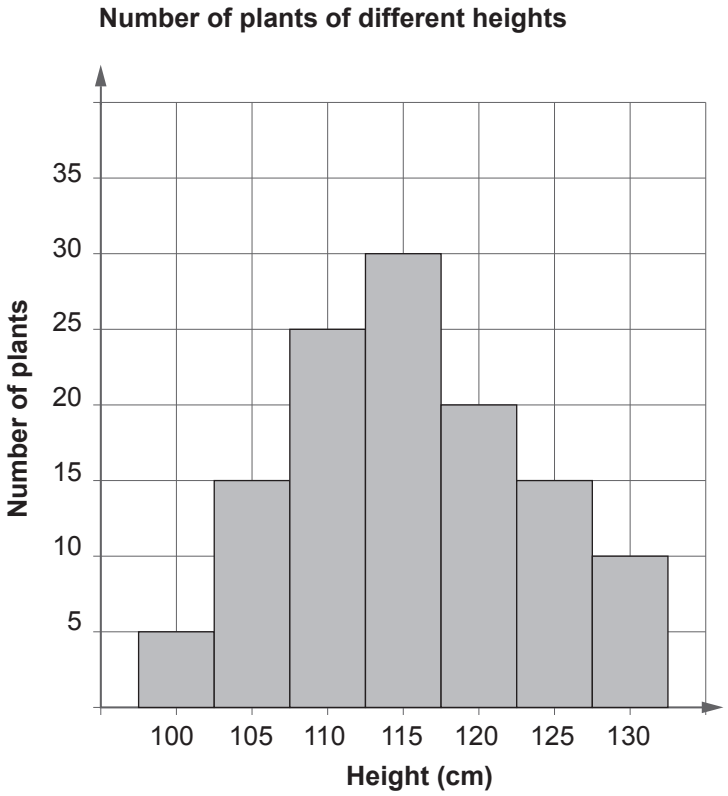
Group A Group B

Use the results for Method 1 to explain your answer.

Results for Method 2

The farmer collected seeds from his tallest tomato plants **(130 cm tall)**.

He planted the seeds and measured the heights of the plants that grew from the seeds.



Look at the column (bar) graph.

Q31 How many plants grew from the seeds?

- ◯ 30
- ◯ 115
- ◯ 120
- ◯ 130

Q32 What was the height of the tallest tomato plants?

_____ (cm)

Q33 Name one other piece of information that the farmer needs to collect to decide which of the two methods of growing plants is better.

_____

_____

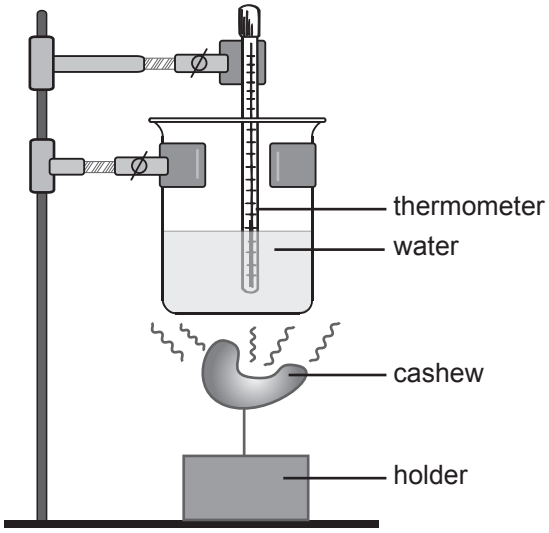
Burning foods

Mr. George compared different foods to see which one gives off the most heat energy when burnt.

He identified samples of four different foods with the same mass. He filled four containers with 200 mL of water and measured the temperature of the water in each container.

Then he

- lit each food sample with a match;
- placed each food sample under a container with water as soon as the food sample was burning;
- measured the temperature of the water in the container after the food sample had burnt completely.



His results are shown in the table below.

Table: Temperature of water before and after burning each food sample

Food sample	Starting temperature of water (°C)	Final temperature of water (°C)
marshmallow	20	35
cashew	20	45
potato chip	20	35
jelly bean	20	40

Q34 Mr. George calculated the temperature increase for the four food samples.

For which two food samples was the temperature increase the same?

- ◯ cashew and potato chip
- ◯ marshmallow and potato chip
- ◯ cashew and jelly bean
- ◯ marshmallow and jelly bean

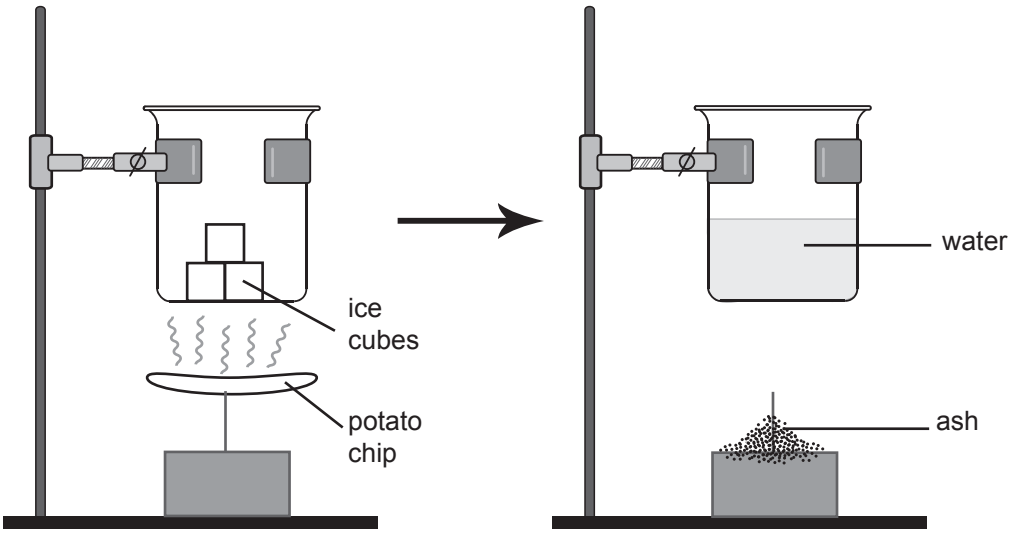
Q35 Why did Mr. George need to figure out the **temperature increase** of the water for the four food samples?

Q36 Did Mr. George's experiment measure all the energy given off by each food sample?

◯ Yes ◯ No

Give reasons for your answer.

Q37 Mr. George repeated his experiment with the potato chip but instead of using a container with water he used a container with some ice in it.



Mr. George noticed two changes that occurred during the experiment. The potato chip changed to a pile of ash and the ice melted.

Circle the correct word in the sentences below.

- The burning of the potato chip **can** / **cannot** be reversed.
- The melting of the ice **can** / **cannot** be reversed.

This is the end of the objective test.

STOP and wait for your teacher's instructions.

This page is meant to be blank.

Practice questions

Multiple Choice

Q1 Shade in the bubble next to the correct answer.

The colour of blood is

- ◯ blue.
- ◯ green.
- ◯ red.
- ◯ yellow.

Circle the Word or Words

Q2 Circle the correct words in the sentence below.

An elephant is **a bit smaller / much bigger** than a human.

One or Two Word Answer

Q3 On a clear, sunny day the colour of the sky is _____ .

Long Answer

Q4 Explain what happens to a balloon when you blow it up.

_____

_____

Tick the Boxes

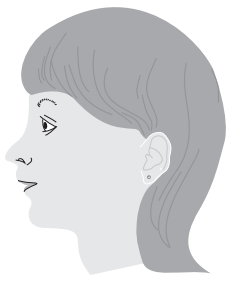
Q5 Which of the following are fruit? Tick all possible answers.

☐ banana ☐ bicycle ☐ apple ☐ chair

Fill in the Table

Q6 Look at the features of this face.

Complete the table below.



Feature	Sense
eyes	sight
ears	
	smell

Chapter 5
Marking Guide

The guide below reflects the final marking guide used for the National Assessment Program – Science Literacy and provides a standardised means of scoring student responses. Use of this rubric in scoring class responses will allow valid comparisons to be made of your students' results with the results of the National Assessment Program – Science Literacy presented in Chapters 6 and 7.

The marking guide provides examples of the types of responses that would be awarded 1 mark or 2 marks (where applicable).

While most items are marked on a 0/1 basis, items 14, 23 and 27 of the Objective Assessment and Question 8 in the Practical Task are polytomous. This means that scores of either 1 or 2 are possible, depending on the level of the response.

National Assessment Program – Science Literacy

Year 6

Science Literacy School Assessment

Marking Guide

2009 Released Items

PART A: Objective Assessment

PART B: Practical Task

MARKING GUIDE

PART A (OBJECTIVE ASSESSMENT)

Markers have been instructed to award responses that are 'other' than those indicated in the information below a mark of zero, ('0').

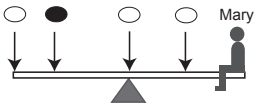
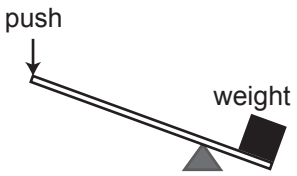
All multiple choice questions are marked as 1 mark or zero ('0') marks.

Question	Score	Response: answers/examples/information
NATIVE AND INTRODUCED ANIMALS		
Q1	1	B: Dingoes eat rabbits

Question	Score	Response: answers/examples/information
ENERGY EFFICIENT LIGHT BULBS		
Q2	1	A: paper clip

Question	Score	Response: answers/examples/information
WATER RESOURCES		
Q3	1	*Identifies the impact of pollutants on a town's water supply* **Examples of correct answers (score 1):** • The chemicals may enter the dam and poison the town's water supply. • The chemicals may run off into the dam and pollute the water. • The poisonous chemicals may dissolve in the water in the catchment area and then enter the dam. This would mean that the town water supply might contain a poisonous chemical. **Examples of incorrect answers (score 0):** • Put up a water restriction. • The chemicals might enter the dam.

Q4	1	*Identifies a strategy for reduction in water usage* **Examples of correct answers (score 1):** • take shorter showers • use half flush toilets • reduce the number of times you use the washing machine by using it only for full loads • turn the tap off when brushing teeth • reduce the amount of water used in the garden

Question	Score	Response: answers/examples/information
LIFTING WEIGHTS		
Q5	1	B: 
Q6	1	B: 

Question	Score	Response: answers/examples/information
SEPARATING MIXTURES		
Q7	1	D: Collect the steam from **Step 4** and cool it to a liquid.
Q8	1	*Identifies the correct method for separating mixture into its parts* **Example of correct answer (score 1)** Using a magnet will separate sand and iron filings.
Q9	1	*Identifies the correct method*: **Example of correct answer (score 1).** Filtering, will separate mud in water from water.
Q10	1	*Identifies the correct methods*: **Example of correct answer (score 1).** Dissolving and Filtering, will separate sand and salt.

<table>
<tr><th>Question</th><th>Score</th><th>Response: answers/examples/information</th></tr>
<tr><td colspan="3">COLA FOUNTAIN</td></tr>
<tr><td>Q11</td><td>1</td><td>Records correctly all remaining results: 13, 17, 18
<table>
<tr><th></th><th>Number of lollies</th><th>Height of fountain (bricks)</th></tr>
<tr><td>Bottle 1</td><td>1</td><td>7</td></tr>
<tr><td>Bottle 2</td><td>2</td><td>13</td></tr>
<tr><td>Bottle 3</td><td>3</td><td>17</td></tr>
<tr><td>Bottle 4</td><td>4</td><td>18</td></tr>
</table></td></tr>
<tr><td>Q12</td><td>1</td><td>Identifies both variables to be controlled: the type of diet cola used, the amount of diet cola in each bottle.

☐ the number of lollies dropped in each bottle
☑ the type of diet cola used
☑ the amount of diet cola in each bottle
☐ the number of bottles used
Examples of incorrect answers (score 0):

• Identifies only one correct variable.
• Identifies one correct and one incorrect variable.</td></tr>
<tr><td>Q13</td><td>1</td><td>Specifies that lollies should be added to a bottle of regular cola and diet cola and the heights of the fountains measured and compared.

Examples of correct answers (score 1):

• Sam knows the height for diet cola. He needs to measure the height for the normal cola and compare the height reached against the diet cola.
• Sam needs to measure the heights of the fountains for diet cola and the normal cola and check whether the diet cola fountain is higher.
Example of incorrect answers (score 0):

• He needs to drop lollies into the regular cola.</td></tr>
</table>

<table>
<tr><th>Question</th><th>Score</th><th>Response: answers/examples/information</th></tr>
<tr><td colspan="3">HEATING AND COOLING</td></tr>
<tr><td>Q14</td><td>2

1</td><td>Selects ‘lower than’ and uses concept of heat transfer (or energy transfer) in explanation.

Examples of correct answers at score 2:

• 'lower than’ and if the same amount of heat (energy) is added, then the smaller amount of water will reach a higher temperature.
• ‘lower than’ and the same amount of heat will be more spread out in Pot A.

Selects ‘lower than’ and refers to relationship between size of pot (or amount of water) and temperature rise.

Examples of correct answers at score 1:

• ‘lower than’ and states: It is lower in Pot A because small things get hotter.
• ‘lower than’ and states: The temperature in Pot A is lower because it has more water in it.</td></tr>
<tr><td>Q15</td><td>1</td><td>Indicates that all objects would be at room temperature
<table><tr><th></th><th>Below room temperature</th><th>At room temperature</th><th>Above room temperature</th></tr><tr><td>Metal spoon</td><td></td><td>✓</td><td></td></tr><tr><td>Plastic spoon</td><td></td><td>✓</td><td></td></tr><tr><td>Bowl of hot soup</td><td></td><td>✓</td><td></td></tr><tr><td>Glass of cold lemonade</td><td></td><td>✓</td><td></td></tr></table></td></tr>
<tr><td>Q16</td><td>1</td><td>B: 40 °C</td></tr>
</table>

<table>
<tr><th>Question</th><th>Score</th><th>Response: answers/examples/information</th></tr>
<tr><td colspan="3">GREENHOUSE GAS EMISSIONS</td></tr>
<tr><td>Q17</td><td>1</td><td>B: 0.5 tonnes/year</td></tr>
<tr><td>Q18</td><td>1</td><td>D: Household 2 does not use air conditioning or heating devices.</td></tr>
</table>

Question	Score	Response: answers/examples/information
PHASES OF THE MOON		
Q19	1	*April 6 drawing shows waxing crescent fuller than on April 4,*  ***AND** April 25 drawing shows waning crescent smaller than on April 22. (Both approximatley quarter Moon)*  **Examples of incorrect answers (score 0):** • April 6 drawing shows waning crescent • April 6 drawing shows crescent identical to April 4 or April 8 • April 25 shows waxing crescent
Q20	1	*Answer describes the shape of the Moon as being fuller than on April 8 (a gibbous Moon) and explains that there are more than 28 days between April 8 and May 8. Note: Response may include a drawing.* **Example of correct answer (score 1):** • I started on 8th April and jumped forward 1 month and then took away 2 days, and the answer I came up with was fuller than quarter moon (fuller than half moon). **Examples of incorrect answers (score 0):** • correct description of the shape of the Moon (or correct drawing) but incorrect explanation. • crescent
Q21	1	B: position B
Q22	1	D: Venus

Question	Score	Response: answers/examples/information
USING AND SAVING ENERGY		
Q23	2	*Selects 'solar' water system and provides appropriate explanation. Note: The appropriate response is 'solar' if one considers which water system contributes least to global warming, once the water systems are in place. Sophisticated answers may refer to greenhouse gas emissions that occur prior to that. If such responses occur and are correct, they should be given a score of 2.* **Example of correct answer at score 2:** • Selects 'solar' water system and states: Using solar water heaters does not cause emission of greenhouse gases, which leads to global warming.
	1	**Score 1:** • *Just selects 'solar' water system without appropriate explanation.*
Q24	1	*Indicates that renewable sources of energy are continually replaced (they cannot run out). Note: Both the explanation and the example are required.* **Example of correct answer (score 1):** • Renewable sources of energy are replaced all the time, e.g. wind/sun/water/geothermal/biomass **Examples of incorrect answers (score 0):** • Provides a definition of renewable sources without an example. • Provides an example of renewable sources without a definition (or without a correct definition). • Renewable energy is clean energy.

Question	Score	Response: answers/examples/information
CLIMATE CHANGE		
Q25	1	C: Average temperatures are higher in October than in July in Adelaide.
Q26	1	*Relates global warming to a potential impact and explains why it is a problem.* **Examples of correct answers (score 1):** • Melting of ice caps leads to sea level rise and coastal flooding. • Changes in ecosystems which impact on farm land and the survival of plants and animals **Examples of incorrect answers (score 0):** • changes in weather, climate (*question asks for another consequence of global warming*) • ice caps melt • changes in ecosystems (plants and animals die) (*with no explanation*)

Question	Score	Response: answers/examples/information
COLLECTING ANTS		
Q27	2	**Score 2:** *Correctly identifies two variables to be controlled. Variables to be controlled include:* • amount of food on each piece of cardboard • time each cardboard was left out for • time of day cardboards are put out • location of cardboards (area / place) • proximity to ant nest of each board • location of food on cardboard
	1	**Score 1:** *Correctly identifies one variable to be controlled* **Examples of incorrect answers (score 0):** • type of trap • number of ants

Q28	1	*Refers to the pressure difference between the air in the jar and the air outside the jar or the creation of a partial vacuum in the jar after Kayla sucks on the shorter plastic tube.* **Example of correct answer (score 1):** • When air is sucked out of the jar through the short tube, air is forced back into the jar through the long tube and this carries the ant into the jar. **Example of incorrect answer (score 0):** • Because she sucks them in.
Q29	1	*Indicates that ants spray formic acid to protect themselves.* **Examples of correct answers (score 1):** • to fight off other animals/people • to defend themselves, their homes and/or colony • under threat / threatened / when in danger / they are afraid / they are prey

Question	Score	Response: answers/examples/information
TOMATO PLANTS		
Q30	1	*Circles 'Group B' and indicates that the average weight of the plants is the same but the average weight of tomatoes per plant in group B is smaller.* **Example of correct answer (score 1):** • Circles Group B and states: Average weight of the tomatoes produced on these plants is less than Group A. **Examples of incorrect answers (score 0):** • Too much fertiliser was used • Only circles Group B
Q31	1	C: 120
Q32	1	130 (cm)

Q33	1	*Indicates that the farmer needs to measure the weight of the fruit produced on the plants in Method 2.* *OR* *Indicates that the farmer needs to know the distribution of heights of tomato plants in Method 1.* **Examples of correct answers (score 1):** • the weight of the tomatoes produced when the farmer used method 2 • the heights of the tomatoes when the farmer used method 1 • count number of tomatoes on each plant

Question	Score	Response: answers/examples/information
BURNING FOODS		
Q34	1	B: marshmallow and potato chip
Q35	1	*Response links the temperature increase to the heat (energy) transferred from the food samples to the water.* **Examples of correct answers (score 1):** • to find the amount of heat (energy) that was transferred to the water • to work out which food gave off more heat energy
Q36	1	*'No' and explains that some of the energy given off is transferred to the environment/surrounding air or is converted to light energy.* **Examples of correct answers (score 1):** • No. Some of the energy went to the air. • No. Some of the energy heated up the air. • No. Some of it changed to light energy. • No. Some of the energy heated the beaker. **Examples of incorrect answers (score 0):** • Yes. • No. (*With incorrect explanation*) • Because it only measured the heat energy not any other energy.
Q37	1	• The burning of the potato chip **can** / **cannot** be reversed. • The melting of the ice **can** / **cannot** be reversed. **Examples of incorrect answers (score 0):** • *circles one correct word* • *circles two incorrect words*

MARKING GUIDE

PART B (PRACTICAL TASK)

In the practical task, only the questions in Part B (Individual work) are marked.

Responses which are 'other' than those indicated in the information are given zero, ('0').

Question	Score	Response: answers/examples/information
WHICH BEAK WORKS BEST?		
Q1	1	*Provides the number of beads consistent with the result of Person 1 recorded in Table 1 – craft sticks.* *Note: Must use Person 1 (use heading) for data from Table 1.* **Examples of correct answers (score 1):** *Note: Answer must be consistent with Table 1 results recorded by Person 1 using two craft sticks.* • 10 • 10 beads **Examples of incorrect answers (score 0):** • our results are 10, 9 & 8 • they are all the same • 9 and 10 (one incorrect answer combined with the correct answer)

Q2	1	*Identifies one relevant functional similarity between a net-type beak and a spoon.* **Examples of correct answers (score 1):** (*Must be function)* • A spoon scoops like a net-type beak to collect food. • A spoon holds/stores food like a net-type beak. • A spoon picks up food like a net-type beak. **Examples of incorrect answers (score 0):** • picks things up • They are both wide/bowl-shaped. • They are curved. *(Anything about appearance)*
Q3	1	*Identifies one relevant difference between a net-type beak and a spoon.* **Examples of correct answers (score 1):** *(Accept function or appearance)* • They are made of different materials. • They are different in size, shape. • A net-type beak has a top beak and it can close its mouth and carry things without them falling out. **Example of incorrect answers (score 0):** • The net-type beak is the best for picking up the paper because it can scoop up the paper easier than grabbing it with the sieve.

Q4	1	*Identifies evidence to support whether the best type of model beak to collect floating weed is a sieve. Evidence is consistent with the group's results.* • Yes, because ... OR • No, because ... *Note: If results are the same for each beak type then students are expected to state this in their response.* **Example of correct answers (score 1):** • Yes, we gathered the most food with the sieve. • Yes, the sieve was the most successful ("successful" can relate to gathered most). • No, (*if substantiated by data*). **Example of incorrect answers (score 0):** • Yes/No *alone* • *evidence is not consistent with the group's data, refers to properties of a sieve without referring to data collected* • Yes, because the net-type spoon has a bigger beak so that's the better of the two. (*does not refer to the results of the experiment*) • Yes, because it can glide its beak across the top of the water. • No, because the net is easier to pick things up.

Q5 - axes	1	*Axis labels name the variables for which data are recorded. In this case, for the Y axis, the amount of food or total number of beads. Labels for the X axis include names for the columns, e.g. craft sticks, toothpicks, plastic spoon. In additon there must be the more general label for the axis, e.g. beak type.* **Examples of correct answers (score 1):** Y axis: • 'Amount of food' OR • 'Total number of beads' AND X axis: • Craftsticks, toothpicks, plastic spoon **AND** • Beak type **Example of incorrect answer (score 0):** Y axis: • 'Amount of food' • 'Total number of beads' AND X axis: • craft sticks, toothpicks, plastic spoon NB: *No general label for the axis is provided.*

Q6 - scale	1	*The scale for the total amount of food (total number of beads) should be of an appropriate range to encompass the lowest and highest number of beads (referenced from the student's Table 1 results) and the scale for the total amount of food (total number of beads) should be constructed in intervals of equal measure.* *Note 1: Must begin with 0 on baseline.* *Note 2: If students have not graphed totals, but have graphed individual data, then check that scale matches data used.* *Note 3: Students should get a mark if they draw a horizontal bar graph instead of a column graph.*
Q7 - data	1	*Values for total amount of food (total number of beads) from Table 1 are plotted accurately for all three beak types.* *Note 1: This aspect should be marked independently of whether or not the student has used regular or irregular intervals on the vertical axis: the focus here is on data point plotting being consistent with the student's values in Table 1. All three data points must be plotted accurately.* *Note 2: Students should get mark if they draw a horizontal bar graph.* **Examples of correct answers (score 1):** • Plots data correctly for all beak types. • Plots straight lines **Examples of incorrect answers (score 0):** • Students plot the data correctly for one or two beak types only. • Students plot the data for each person rather than the totals. • Columns are drawn over several grid boxes and have different widths.

Q8	2	*The shape/structure of the beak helps the bird pick up certain types of food easier/helps pick up more of a certain type of food. For example, a bird with a net-type beak will pick up the bead type of food easier than the paper type of food.* *Note: Accept examples that students might know from their everyday experience or examples that are given in the stimulus for the task.* **Examples of correct answers at score 2** • How the beak is shaped affects what the bird eats. For example, the pelican eats fish so the pelican's beak is net-shaped so it can trap the fish inside. • A bird's beak shape determines what it eats. For example, sparrows have short thick beaks for cracking seeds. (*Generalisation and example*)
	1	**Examples of correct answers at score 1** • If it is a small beak the bird has to eat small food. If it is a large beak the bird can eat larger food. (*Only generalisation*) • Hawks and owls have sharp and curved beaks for tearing meat (*Only example*) **Examples of incorrect answers (score 0):** • The beak is right for the bird to what it eats. • The duck eats the weed by grabbing as much weed as it can. • The heron eats by stabbing its food.

Q9	1	*A clock would give more consistent/accurate results; counting is less accurate; a clock wouldn't go faster/ get interrupted etc.* **Examples of correct answers (score 1):** • When we count seconds, we might go too fast or too slow, so the results are not accurate. • A clock with a second hand would be better because it is more accurate and never forgets which number it was up to. **Examples of incorrect answers (score 0):** • A clock is better for timing things. • so that we don't tell people the wrong time • because you would know when your time is up
Q10	1	B: reduce the effect of errors

Chapter 6
Performance Profile and Proficiency Standard

Standard for Year 6 scientific literacy

A standard for scientific literacy was established after the 2003 testing to provide parents, educators and the community with a clear picture of the proficiency that students are expected to demonstrate by the end of Year 6.

To identify what students should know and be able to do by the end of Year 6, university science educators, curriculum officers and experienced primary teachers in all states and territories, from government, Catholic and independent schools, were brought together. The members of this expert group used their classroom experience and knowledge of the science curricula in the various jurisdictions to examine the test items from the national assessment.

The crucial science – literacy skills and understandings needed by students for the next phase of science learning at school were discussed and debated before consensus was reached on a 'proficient standard' for Year 6. This standard informed the development of the tests for the 2006 and 2009 assessments.

The proficient standard is a challenging level of performance, with students needing to demonstrate more than minimal or elementary skills to be regarded as reaching it.

The Proficency Levels can be found in Appendix C, Table C.1. The proficient standard was found to be equivalent to Level 3.2; that is, students achieving at Level 3.2 are considered to have a sound understanding of Year 6 science. Students

at this level demonstrate considerably more skill and understanding than those performing at Levels 3.1 and below.

Year 6 students who exceed the proficient standard (those who perform at Level 3.3 and above) demonstrate exemplary performance.

Student performance and the Year 6 standard

One of the main objectives of the National Assessment Program – Science Literacy is to monitor trends in scientific literacy performance over time. One convenient and informative way of doing so is to reference the results to Proficiency Levels.

Table 6.1 and Table 6.2 enable teachers to determine whether their students have demonstrated proficiency in science by reaching Level 3.2 or better on the scientific literacy scale.

The tables can be used to convert students' raw scores on the Science Literacy School Release Materials to corresponding scaled scores on the National Assessment Program – Science Literacy. The 2009 National Assessment Program – Science Literacy mean score is 392 and the standard deviation of the scale is 100.

The following tables can be used to determine the Proficiency Level of a student by matching his or her raw score with the scaled score and corresponding Proficiency Level.

If your students have used Form Two and have attempted **only** the **objective assessment**, Table 6.1 provides the information needed to convert their scores to the national scale.

If your students have used Form One and have attempted **both** the **objective assessment** and the **practical task**, Table 6.2 provides the information needed to convert their scores to the national scale.

Table 6.1 Conversion of raw scores to scaled scores and level attained: **Objective Assessment only**

Student raw score	Equivalent sample scaled score	Level attained	Level descriptors
0/1	n/a	Level 2	Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge. Identifies simple patterns in the data and/or interprets a data set containing some interrelated elements. Makes measurements or comparisons involving information or stimulus in a familiar context.
2	57		
3	104		
4	141		
5	172		
6	199		
7	224		
8	246		
9	266	Level 3.1	Selects appropriate reason to explain reported observation related to personal experience. Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.
10	285		
11	303		
12	320		
13	337		
14	353		
15	368		
16	383		
17	398	Level 3.2	Interprets information in a contextualised report by application of relevant science knowledge. Interprets data and identifies patterns in – and/or relationships between – elements of the data. Collates and compares data set of collected information. Gives reason for controlling a single variable.
18	413		
19	427		
20	441		
21	456		
22	470		
23	485		
24	500		
25	515		
26	531	Level 3.3	Applies knowledge of relationship to explain a reported phenomenon. Extrapolates from an observed pattern to describe an expected outcome or event. Demonstrates an awareness of the principles of conducting an experiment and controlling variables.
27	547		
28	564		
29	582		
30	600		
31	620		
32	642		
33	665	Level 4	Explains interactions that have been observed in terms of an abstract science concept. Conclusions summarise and explain the patterns in the data in the form of a rule and are consistent with the data. When provided with an experimental design involving multiple variables, can identify the questions being investigated.
34	690		
35	719		
36	751		
37	789		
38	837		
39	904		
40	1033		

Proficient Standard

Table 6.2 Conversion of raw scores to scaled scores and level attained: **Objective Assessment and Practical Task**

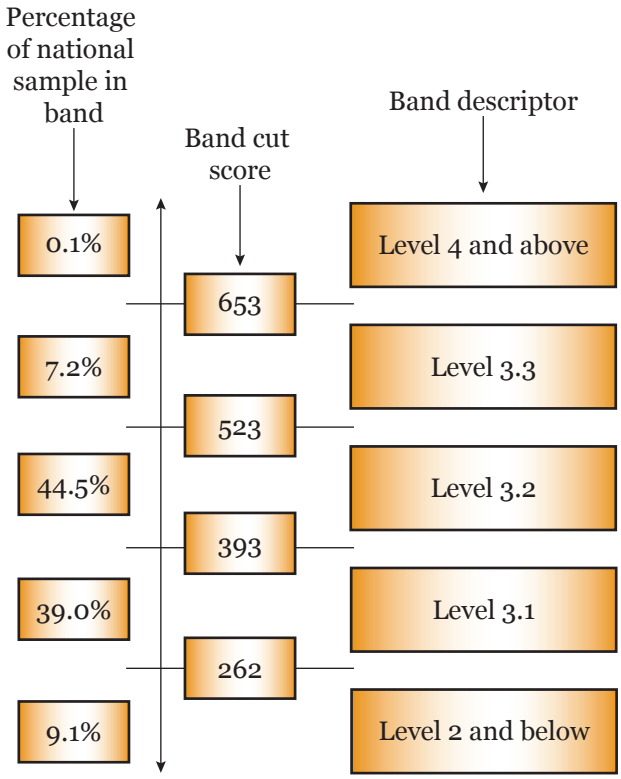
Student raw score	Equivalent sample scaled score	Level attained	Level descriptors	
0/1	n.a	Level 2	Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge. Identifies simple patterns in the data and/ or interprets a data set containing some interrelated elements. Makes measurements or comparisons involving information or stimulus in a familiar context.	
2	18			
3	64			
4	100			
5	130			
6	156			
7	179			
8	200			
9	219			
10	236			
11	253			
12	268	Level 3.1	Selects appropriate reason to explain reported observation related to personal experience. Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.	
13	283			
14	297			
15	311			
16	324			
17	337			
18	349			
19	361			
20	373			
21	385			
22	396	Level 3.2	Interprets information in a contextualised report by application of relevant science knowledge. Interprets data and identifies patterns in – and/or relationships between – elements of the data. Collates and compares data set of collected information. Gives reason for controlling a single variable.	Proficient Standard
23	408			
24	419			
25	430			
26	442			
27	453			
28	464			
29	476			
30	487			
31	499			
32	511			
33	524	Level 3.3	Applies knowledge of relationship to explain a reported phenomenon. Extrapolates from an observed pattern to describe an expected outcome or event. Demonstrates an awareness of the principles of conducting an experiment and controlling variables.	
34	536			
35	550			
36	563			
37	577			
38	592			
39	608			
40	624			
41	642			

42	661	Level 4	Explains interactions that have been observed in terms of an abstract science concept. Conclusions summarise and explain the patterns in the data in the form of a rule and are consistent with the data. When provided with an experimental design involving multiple variables, can identify the questions being investigated.
43	681		
44	704		
45	729		
46	757		
47	789		
48	827		
49	876		
50	943		
51	1072		

Distribution of Year 6 student performance

Figure 6.1 below shows the national distribution of students who achieved each Proficiency Level in the 2009 National Assessment Program – Science Literacy. The information draws on the distribution of students' performances across Proficiency Levels as presented in Chapter 5 of the 2009 Public Report.

Figure 6.1 Percentages of students from the 2009 National Assessment Program – Science Literacy at each Proficiency Level and the corresponding scaled score



Chapter 7
Class and Item Analysis Sheet

Class record sheet

The class record sheet provided here is to be used in conjunction with the Marking Guide (see Chapter 5). It provides a template for recording student marks and a format for recording information for later analysis.

The record sheet can be used to:

- record the scores for each student for each item
- calculate the total score for each student for comparison with the information provided in Table 6.1 and Table 6.2
- record the number of students who score each category of the item for use in the analysis in Table 7.2 and Table 7.3.

Year 6 Class record sheet

	Question	Total score	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23
	Possible score		1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2
No	Name																								
1																									
2																									
3																									
4																									
5																									
6																									
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26																									
27																									
No. scoring zero																									
No. scoring 1 mark																									
No. scoring 2 marks																									

Table 7.1 Year 6 Class record sheet

Year 6 Class record sheet

	Question	Total score	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
	Possible score		1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1
No	Name																									
1																										
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26																										
27																										
No. scoring zero																										
No. scoring 1 mark																										
No. scoring 2 marks																										

Item analysis sheet

The item analysis sheets (Table 7.2 and Table 7.3) provide a tool for comparing class performance against the results reported in the National Assessment Program – Science Literacy.

The details for the column headed 'Number of students' can be obtained from the summary recorded at the bottom of the class record sheet in Table 7.1.

Percentages

The percentage of students who have achieved the correct answer on an item can be calculated using the formula:

$$\frac{\text{number of students at score point}}{\text{number of students assessed}} \times 100$$

This formula can also be used to calculate the percentage of students who achieved 2 marks by using the number of students who scored 2 marks instead of 1. The percentage can be compared with the results reported in the 2009 National Assessment Program – Science Literacy Public Report, which are shown in the column headed 'National % Correct'. For those questions worth 2 marks, the percentage of students scoring both 1 mark and 2 marks are shown.

In making comparisons, teachers are advised to consider the items in relation to their school's science program and educational context.

Table 7.2 Item analysis sheet for **Objective items**

		Number of students assessed		
Item Number	**Proficiency Level**	**Number of students**	**Percentage of students**	**National % Correct**
1	3.1			77.9
2	≤ 2			91.4
3	3.3			34.9
4	3.2			60.8
5	3.1			63.3
6	3.2			41.3
7	3.3			34.0
8	3.1			66.8
9	3.1			60.2
10	3.3			33.0
11	3.1			73.6
12	3.3			20.5
13	3.3			22.0
14 (1 or 2 marks)	3.2 ≥ 4			43.0 2.1
15	≥ 4			4.0
16	3.2			48.6
17	3.2			40.0
18	3.1			58.3
19	3.2			53.5
20	≥ 4			2.7
21	3.2			47.5
22	3.2			35.6
23 (1 or 2 marks)	3.1 3.3			55.8 20.3
24	≥ 4			15.4
25	3.3			24.3
26	≥ 4			15.6
27 (1 or 2 marks)	3.1 3.3			32.3 25.2
28	3.3			23.6
29	≤ 2			83.8
30	≥ 4			12.8
31	3.3			33.9
32	3.2			44.9
33	≥ 4			11.3
34	≤ 2			83.9
35	3.3			33.2
36	≥ 4			8.2
37	3.2			55.8

Table 7.3 Item analysis sheet for **Practical Task items**

			Number of students assessed		
Item Number	**Proficiency Level**		**Number of students**	**(%) of students**	**National % Correct**
Prac 1	≤ 2				92.8
Prac 2	3.2				54.8
Prac 3	3.1				74.3
Prac 4	3.3				37.2
Prac 5	3.3				22.2
Prac 6	3.2				63.2
Prac 7	3.2				51.2
Prac 8 (1 or 2 marks)	3.3	≥ 4			28.3 1.0
Prac 9	3.2				54.3
Prac 10	3.3				34.7

Class analysis sheet

The class analysis sheet (Table 7.4 or Table 7.5) is designed to assist in drawing a graph of class or school performance that enables comparisons to be made between a student group and the National Assessment Program – Science Literacy.

The graph is a simple pictorial presentation of the data that enables visual comparisons to be made of the performance of a student group with the sample study findings. It also includes the national mean and distribution estimates.

However, teachers should use these as indicators only. The National Assessment Program – Science Literacy was constructed and implemented scientifically to provide a representative estimate of the national Year 6 population. Small groups such as schools or classes may have quite abnormal distributions that are unique to them at the time they use this material.

Using the class analysis sheet

The graph can be constructed as a simple histogram by shading the cells vertically to represent the number of students who have achieved a particular score.

National test mean and distribution

The shaded vertical column at the scaled score of 392 represents the best estimate of the mean for the national test in 2009.

The shaded bars titled ‘National distribution’ indicate the proportions of students falling within the lower 25th percentile, the middle 50th percentile and top 25th percentile in the October 2009 sample study.

Student proficiency

With respect to Proficiency Levels, the shaded bars entitled 'Level distribution' indicate the proportions of students falling within each of the standards levels defined in the scientific literacy assessment domain. Level 3 has been divided into three sub-levels (Level 3.1, Level 3.2 and Level 3.3) for the purpose of providing more precise descriptors of the level of performance than those provided by the global Level 3 descriptor.

The overlaps in the proficiency bars represent a degree of uncertainty (measurement error) of the estimates around the cut scores that have been used to define achievement at each Proficiency Level.

Table 7.4 Class analysis sheet for students who attempted the **Objective Assessment only**

Number of students achieving score

																		sample mean																							
24																																									
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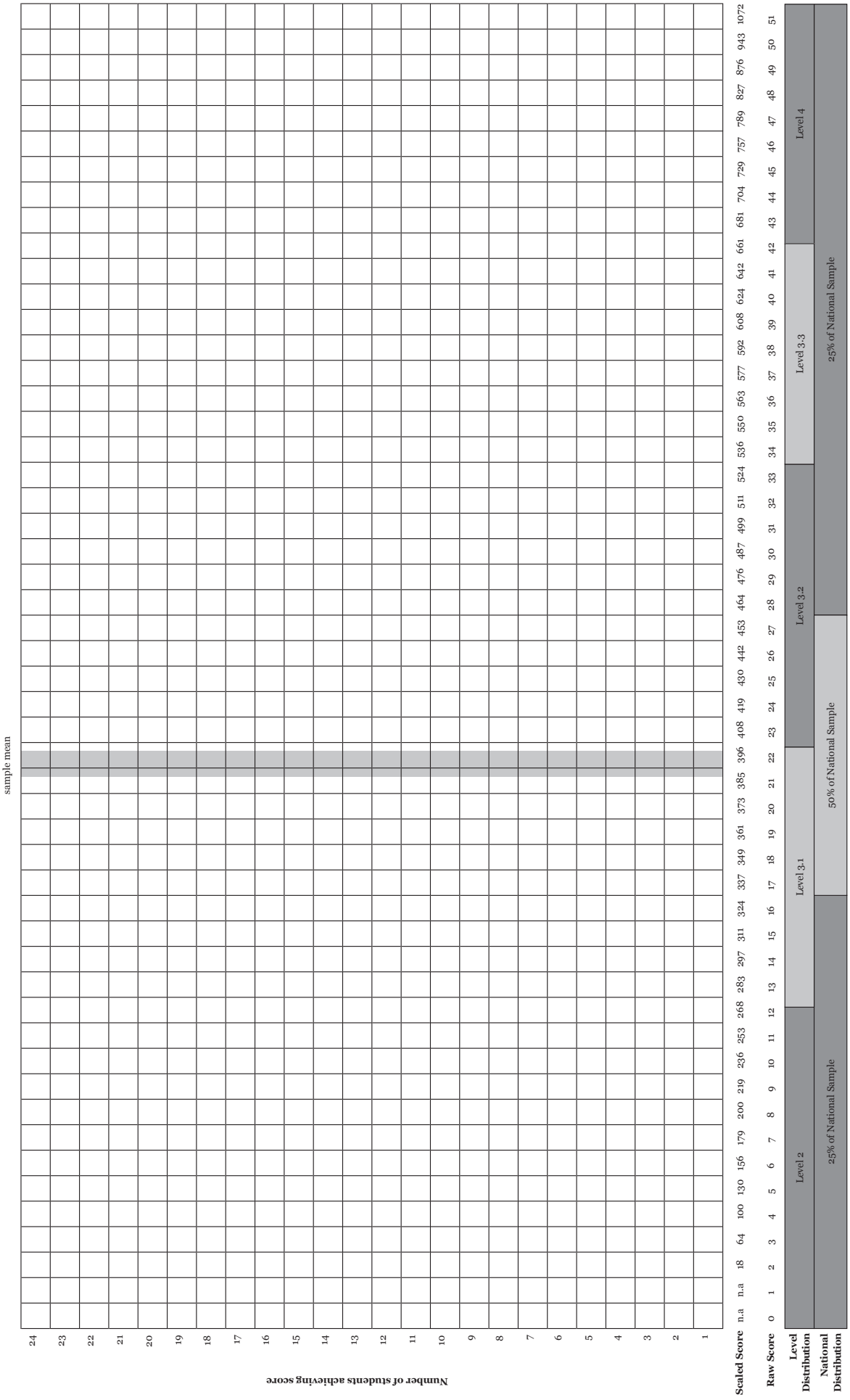
2																																									
1																																									
Scaled Score	n.a	n.a	57	104	141	172	199	224	246	266	285	303	320	337	353	368	383	398	413	427	441	456	470	485	500	515	531	547	564	582	600	620	642	665	690	719	751	789	837	904	1033
Raw Score	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40 Maximum score 40
Level Distribution	Level 2										Level 3.1							Level 3.2									Level 3.3							Level 4							
National Distribution	25% of National Sample													50% of National Sample								25% of National Sample																			

Table 7.5 Class analysis sheet for students who attempted both the **Objective Assessment and the Practical Task**



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Item	Page	Acknowledgement
Chestnut Teal	54	© Wendy Opie/Viridans Images

Page references refer to the Science Literacy School Release Materials.

Appendix A
2009 National Assessment Program – Science Literacy, Year 6: Assessment Domain

Assessment strands: Scientific literacy

The national review of the status and quality of teaching and learning of science in Australian schools (Goodrum, Hackling & Rennie 2001) argued that the broad purpose of science in the compulsory years of schooling is to develop scientific literacy for all students.

Scientific literacy is a high priority for all citizens, helping them to:

- be interested in and understand the world around them
- engage in the discourses of and about science
- be sceptical and questioning of claims made by others about scientific matters
- be able to identify questions, investigate and draw evidence-based conclusions
- make informed decisions about the environment and their own health and wellbeing.

Scientific literacy is important because it contributes to the economic and social wellbeing of the nation and improved decision making at public and personal levels (Laugksch 2000).

PISA focuses on aspects of preparedness for adult life in terms of functional knowledge and skills that allow citizens to participate actively in society. It is argued that scientifically-literate people are 'able to use scientific knowledge and processes not just to understand the natural world but also to participate in decisions that affect it' (OECD 1999, p. 13).

The OECD-PISA defined scientific literacy as:

> *... the capacity to use scientific knowledge, to identify questions (investigate)*[1] *and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.*
>
> (OECD 1999, p. 60)

This definition has been adopted for the National Assessment Program – Science Literacy in accord with the Ball et al. 2000 report recommendation.

Scientific literacy: Progress Map

A scientific literacy progress map was developed based on the construct of scientific literacy and an analysis of state and territory curriculum and assessment frameworks. The progress map describes the development of scientific literacy across three strands of knowledge which are inclusive of Ball et al.'s concepts and processes and the elements of the OECD–PISA definition.

The five elements of scientific literacy, including concepts and processes used in PISA 2000 (OECD 1999), include:

1. demonstrating understanding of scientific concepts
2. recognising scientifically investigable questions
3. identifying evidence needed in a scientific investigation
4. drawing or evaluating conclusions
5. communicating valid conclusions.

These elements have been clustered into three more holistic strands which have been described below. The second and third elements and conducting investigations to collect data are encompassed in Strand A; the fourth and fifth elements and conducting investigations to collect and interpret data are included in Strand B; and the first element is included in Strand C.

Strand A: Formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence.

This process strand includes posing questions or hypotheses for investigation or recognising scientifically investigable questions; planning investigations by identifying variables and devising procedures where variables are controlled;

1 Because of the constraints of large-scale testing, PISA was not able to include performance tasks such as conducting investigations. Consequently, its definition of scientific literacy omitted reference to investigating. The word 'investigate' was inserted into the definition for the purposes of the National Assessment Program - Science Literacy, as the sample testing methodology to be used allowed for assessments of students' ability to conduct investigations.

gathering evidence through measurement and observation; and making records of data in the form of descriptions, drawings, tables and graphs using a range of information and communications technologies.

Strand B: Interpreting evidence and drawing conclusions from their own or others' data, critiquing the trustworthiness of evidence and claims made by others, and communicating findings.

This process strand includes identifying, describing and explaining the patterns and relationships between variables in scientific data; drawing conclusions that are evidence-based and related to the questions or hypotheses posed; critiquing the trustworthiness of evidence and claims made by others; and communicating findings using a range of scientific genres and information and communications technologies.

Strand C: Using science understandings for describing and explaining natural phenomena, and for interpreting reports about phenomena.

This conceptual strand includes demonstrating conceptual understandings by being able to describe, explain and make sense of natural phenomena; understand and interpret reports (e.g. TV documentaries, newspaper or magazine articles or conversations) related to scientific matters; and make decisions about scientific matters in students' own lives which may involve some consideration of social, environmental and economic costs and benefits.

Scientific literacy has been described here in three strands to facilitate the interpretation of student responses to assessment tasks. However, authentic tasks should require students to apply concepts and processes together to address problems set in real-world contexts. These tasks may involve ethical decision-making about scientific matters in students' own lives and some consideration of social, environmental and economic costs and benefits.

The scientific literacy progress map describes progression in six levels from 1 to 6 in terms of three aspects:

- increasing complexity, from explanations that involve one aspect to several aspects, through to relationships between aspects of a phenomenon
- progression from explanations that refer to and are limited to directly experienced phenomena (concrete) to explanations that go beyond what can be observed directly and involve abstract scientific concepts (abstract)
- progression from descriptions of 'what' happened in terms of objects and events, to explanations of 'how' it happened in terms of processes, to explanations of 'why' it happened in terms of science concepts.

Strands A and B are process strands and relate most closely to the science processes described by the Statements of Learning.

The conceptual strand (Strand C) has been abstracted across conceptual strands and makes no reference to particular science concepts or contexts. As

the progression in the conceptual strand is based on increasing complexity and abstraction, links have been made to the Structure of Observed Learning Outcomes (SOLO) taxonomy (Biggs & Collis 1982).

The taxonomy was written to describe levels of student responses to assessment tasks. The basic SOLO categories include:

prestructural	no logical response
unistructural	refers to only one aspect
multistructural	refers to several independent aspects
relational	can generalise (describe relationships between aspects) within the given or experienced context
extended abstract	can generalise to situations not experienced.

The three main categories of unistructural, multistructural and relational can also be applied, as cycles of learning, to the four modes of representation:

sensorimotor	the world is understood and represented through motor activity
iconic	the world is represented as internal images
concrete	writing and other symbols are used to represent and describe the experienced world
formal	the world is represented and explained using abstract conceptual systems.

The conceptual strand, Strand C, of the progress map therefore makes links to the SOLO categories of concrete unistructural (level 1), concrete multistructural (level 2), concrete relational (level 3), abstract unistructural (level 4), abstract multistructural (level 5) and abstract relational (level 6).

The SOLO levels of performance should not be confused with Piagetian stages of cognitive development. Biggs and Collis (1982, p. 22) explain that the relationship between Piagetian stages and SOLO levels 'is exactly analogous to that between ability and attainment' and that level of performance depends on quality of instruction, motivation to perform, prior knowledge and familiarity with the context. Consequently, performance for a given individual is highly variable and often sub-optimal.

The agreed proficiency levels serve to further elaborate the Progress Map. Level 3 is described as 3.1, 3.2, and 3.3. A 'proficient' standard is a challenging level of performance, with students needing to demonstrate more than minimal or elementary skills.

Table A.1 Scientific Literacy Progress Map – July 2004 version from DEST Science Education Assessment Resource (SEAR) project

Level	Strands of scientific literacy		
	Strand A Formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence. Process strand: experimental design and data gathering.	**Strand B** Interpreting evidence and drawing conclusions from their own or others' data, critiquing the trustworthiness of evidence and claims made by others, and communicating findings. Process strand: interpreting experimental data.	**Strand C** Using understandings for describing and explaining natural phenomena, and for interpreting reports about phenomena. Conceptual strand: applies conceptual understanding.
6	Uses scientific knowledge to formulate questions, hypotheses and predictions and to identify the variables to be changed, measured and controlled. Trials and modifies techniques to enhance reliability of data collection.	Selects graph type and scales that display the data effectively. Conclusions are consistent with the data, explain the patterns and relationships in terms of scientific concepts and principles, and relate to the question, hypothesis or prediction. Critiques the trustworthiness of reported data (e.g. adequate control of variables, sample or consistency of measurements, assumptions made in formulating the methodology), and consistency between data and claims.	Explains complex interactions, systems or relationships using several abstract scientific concepts or principles and the relationships between them. SOLO taxonomy: Abstract relational
5	Formulates scientific questions or hypotheses for testing and plans experiments in which most variables are controlled. Selects equipment that is appropriate and trials measurement procedure to improve techniques and ensure safety. When provided with an experimental design involving multiple independent variables, can identify the questions being investigated.	Conclusions explain the patterns in the data using science concepts, and are consistent with the data. Makes specific suggestions for improving/extending the existing methodology (e.g. controlling an additional variable, changing an aspect of measurement technique). Interprets/compares data from two or more sources. Critiques reports of investigations noting any major flaw in design or inconsistencies in data.	Explains phenomena, or interprets reports about phenomena, using several abstract scientific concepts. SOLO taxonomy: Abstract multistructural
4	Formulates scientific questions, identifies the variable to be changed, the variable to be measured and in addition identifies at least one variable to be controlled. Uses repeated trials or replicates. Collects and records data involving two or more variables.	Calculates averages from repeat trials or replicates, plots line graphs where appropriate. Interprets data from line graph or bar graph. Conclusions summarise and explain the patterns in the science data. Able to make general suggestions for improving an investigation (e.g. make more measurements).	Explains interactions, processes or effects that have been experienced or reported, in terms of a non-observable property or abstract science concept. SOLO taxonomy: Abstract unistructural

3	Formulates simple scientific questions for testing and makes predictions. Demonstrates awareness of the need for fair testing and appreciates scientific meaning of 'fair testing'. Identifies variable to be changed and/or measured but does not indicate variables to be controlled. Makes simple standard measurements. Records data as tables, diagrams or descriptions.	Displays data as tables or constructs bar graphs when given the variables for each axis. Identifies and summarises patterns in science data in the form of a rule. Recognises the need for improvement to the method. Applies the rule by extrapolating and predicting.	Describes the relationships between individual events (including cause and effect relationships) that have been experienced or reported. Can generalise and apply the rule by predicting future events. SOLO taxonomy: Concrete relational
2	Given a question in a familiar context, identifies that one variable/factor is to be changed (but does not necessarily use the term 'variable' to describe the changed variable). Demonstrates intuitive level of awareness of fair testing. Observes and describes or makes non-standard measurements and limited records of data.	Makes comparisons between objects or events observed. Compares aspects of data in a simple supplied table of results. Can complete simple tables and bar graphs given table column headings or prepared graph axes.	Describes changes to, differences between or properties of objects or events that have been experienced or reported. SOLO taxonomy: Concrete multistructural
1	Responds to the teacher's questions and suggestions, manipulates materials and observes what happens.	Shares observations; tells, acts out or draws what happened. Focuses on one aspect of the data.	Describes (or recognises) one aspect or property of an individual object or event that has been experienced or reported. SOLO taxonomy: Concrete unistructural

Appendix B
2009 National Assessment Program – Science Literacy, Year 6: Major Scientific Concepts

Major scientific concepts in the National Assessment Program – Science Literacy

A table of the major scientific concepts found most widely in the various state and territory curriculum documents has been developed to accompany the scientific literacy Progress Map (see Table B.1).

These major concepts are broad statements of scientific understandings that Year 6 students would be expected to demonstrate. They provided item writers with a specific context in which to assess scientific literacy. An illustrative list of examples for each of the major concepts provides elaboration of these broad conceptual statements and, in conjunction with the scientific literacy Progress Map, which describes the typical developmental stages for scientific literacy, was used as a guide for the development of assessment items.

It should be noted that, because the National Assessment Program – Science Literacy test instruments are constructed within the constraints of test length, it is not be feasible to include all the listed concepts in instruments constructed for a specific testing cycle.

Table B.1 Major scientific concepts in the 2009 National Assessment Program – Science Literacy

Major scientific concepts	Examples
Earth and Space (ES)	
Earth, sky and people: Our lives depend on air, water and materials from the ground; the ways we live depend on landscape, weather and climate.	Features of weather, soil and sky and effects on me.
	People use resources from the Earth; need to use them wisely.
	Sustainability.
The changing Earth: The Earth is composed of materials that are altered by forces within and upon its surface.	Changes in weather, weather data, seasons, soil landscape and sky (e.g. Moon phases), weathering and erosion, movement of the Sun and shadows, bush fires, land clearing.
	Climate change.
Our place in space: The Earth and life on Earth are part of an immense system called the universe.	Rotation of the Earth and night/day, spatial relationships between Sun, Earth and Moon.
	Planets of our solar system and their characteristics.
	Space exploration and new developments.
Energy and Force (EF)	
Energy and us: Energy is vital to our existence and our quality of life as individuals and as a society.	Uses of energy, patterns of energy use and variations with time of day and season.
	Energy sources, renewable and non-renewable.
Transferring energy: Interaction and change involve energy transfers; control of energy transfer enables particular changes to be achieved.	Sources, transfers, carriers and receivers of energy, energy and change.
	Types of energy, energy of motion – toys and other simple machines – light, sound.
Energy sources and receivers: Observed change in an object or system is indicated by the form and amount of energy transferred to or from it.	Forces as pushes and pulls, magnetic attraction and repulsion.
Living Things (LT)	
Living together: Organisms in a particular environment are interdependent.	Living vs non-living.
	Plant vs animal and major groups.
	Dependence on the environment: Survival needs – food, space and shelter.
	Interactions between organisms and interdependence, e.g. simple food chains.
Structure and function: Living things can be understood in terms of functional units and systems.	Major structures and systems and their functions.
	Healthy lifestyle, diet and exercise.
Biodiversity, change and continuity: Life on Earth has a history of change and disruption, yet continues generation to generation.	Change over lifetime, reproductions and lifecycles.
	Adaptation to physical environment.
Matter (M)	
Materials and their uses: The properties of materials determine their uses; properties can be modified.	Materials have different properties and uses.
	Processing materials to make useful things produces waste, use of alternative materials to better care for the environment.
	Waste reduction – recycling.
	Nanotechnology.
Structure and properties: The substructure of materials determines their behaviour and properties.	The properties of materials can be explained in terms of their visible substructure, such as fibres.
	Materials can change their state and properties.
Reactions and change: Patterns of interaction of materials enable us to understand and control those interactions.	Solids, liquids and gases.

Appendix C
2009 National Assessment Program – Science Literacy, Year 6: Level Descriptors

Proficiency Levels and Proficient Standard

As shown in Table 7.2 and Table 7.3, items comprising the scientific literacy assessment have been partitioned into Proficiency Levels.

To establish Proficiency Levels, a combination of expert knowledge of the skills required to answer each of the science items and results from the analysis of students' responses was used.

Items located within one of the five Proficiency Levels were judged by subject experts to share similar features and requirements and to differ in recognisable ways from items at other levels.

Table C.1 provides a description of the level of knowledge and skills assessed by items operating at each Proficiency Level. Items at the higher Proficiency Levels require more demanding skills and understandings to answer than do items at lower Proficiency Levels.

In relation to the item analysis sheets (Table 7.2 and Table 7.3) it may be expected that the percentage correct for the items increases as the Proficiency Level decreases.

Table C.1 Description of skills assessed at each Proficiency Level

Proficiency Level	Level descriptors
Level 2 or below	Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge. Identifies simple patterns in the data and/or interprets a data set containing some interrelated elements. Makes measurements or comparisons involving information or stimulus in a familiar context.
Level 3.1	Selects appropriate reason to explain reported observation related to personal experience. Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.
Level 3.2	Interprets information in a contextualised report by application of relevant science knowledge. Interprets data and identifies patterns in – and/or relationships between – elements of the data. Collates and compares data set of collected information. Gives reason for controlling a single variable.
Level 3.3	Applies knowledge of relationship to explain a reported phenomenon. Extrapolates from an observed pattern to describe an expected outcome or event. Demonstrates an awareness of the principles of conducting an experiment and controlling variables.
Level 4 and above	Explains interactions that have been observed in terms of an abstract science concept. Conclusions summarise and explain the patterns in the data in the form of a rule and are consistent with the data. When provided with an experimental design involving multiple variables, can identify the questions being investigated.

In terms of the Proficiency Levels described in Table C.1, the standard for proficiency in scientific literacy was found to be equivalent to Level 3.2. Therefore, students achieving at Level 3.2 are considered to have a sound understanding of Year 6 science.