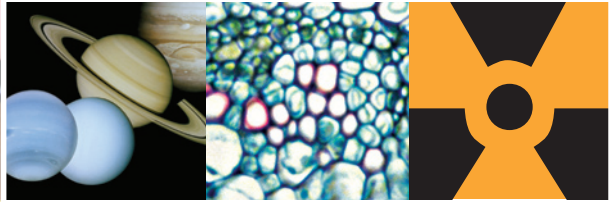




MCEETYA



National
Assessment
Program –
Science
Literacy
Year 6
School Release
Materials

2006



MINISTERIAL COUNCIL ON EDUCATION,
EMPLOYMENT, TRAINING AND YOUTH AFFAIRS

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Preface

In July 2001, the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) 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. PSAP results were reported in 2005.

In October 2006, a consortium of Educational Assessment Australia and Curriculum Corporation conducted the second national science assessment. The National Assessment Program – Science Literacy tested a sample of Year 6 students. The findings describe the scientific literacy of Year 6 Australian 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 (Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA] 1999) (www.mceetya.edu.au).

The National Goals provide the framework for reporting on student achievement through the annual MCEETYA 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 States and Territories' curricula.

The National Science Assessment was the first assessment program designed specifically to provide information about performance against the National

Goals. MCEETYA has also endorsed similar assessment programs for Civics and Citizenship, and Information and Communications Technology (ICT). The intention is that each assessment program will be repeated every three years so that performance in these areas of study can be monitored over time.

Apart from being the first subject area, science is the only program that focuses entirely on primary school performance. This is because MCEETYA has agreed to use PISA as the measure of performance for secondary science.

In 2005, PMRT awarded the contract for the second cycle of science testing, due in 2006, to a consortium of Educational Assessment Australia (EAA) and Curriculum Corporation (CC). The Benchmarking and Educational Measurement Unit (BEMU) was nominated by PMRT to liaise between the contractors and PMRT in the delivery of the project.

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.

What does the National Assessment Program – Science Literacy measure?

The National Assessment Program – Science Literacy measures scientific literacy.

The OECD–PISA (1999) has defined scientific literacy 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 National Assessment Program – Science Literacy 2006 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 B) 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 B. In addition the items drew on four concept areas: Earth and Beyond (EB); Energy and Change (EC); Life and Living (LL); and Natural and Processed Materials (NP). The major scientific concepts found most widely in States and Territories were used by item developers to guide test development. The list of endorsed examples for each of these major concepts is in Appendix C.

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 2006 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 reporting of literacy and numeracy performance in the Annual

National Report (ANR). The 2006 Public 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 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	57	57 (100%)	1345	1271 (94.4%)
NSW	92	90 (97.8%)	2104	2039 (94.0%)
NT	49	43 (87.8%)	932	740 (88.3%)
QLD	94	94 (100%)	2116	2016 (91.8%)
SA	94	93 (98.9%)	2087	1809 (90.9%)
TAS	64	64 (100%)	1397	1225 (92.1%)
VIC	91	88 (96.7%)	2098	1810 (90.7%)
WA	95	92 (96.8%)	2093	2001 (91.9%)
AUST	636	621 (97.6%)	14 172	12 911 (92%)

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. 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 scales, including results in relation to the scales by State and Territory, are contained in Chapter 6.

Results for groups such as Indigenous students and students from different geographic locations are presented in the 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, several different test forms were used. In order to produce comparable results among students who had completed different tests, 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 2006 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 2006 assessment items have been secured for the purpose of equating the next National Assessment Program – Science Literacy (which is to be undertaken in 2009) and, together with the 2003 assessment, will allow longitudinal data on student performance to be obtained.

Assessment tasks

The Science Literacy School Release materials comprise two tasks:

- an objective assessment, with 37 multiple-choice and short-answer type questions; these items assess Levels 2, 3 and 4 of the national scientific literacy assessment domain (Appendix B)
- a practical task from the Earth and Beyond concept area requiring students to conduct an experiment in groups of three and then respond individually to a set of questions about the experiment.

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.

Table 2.1 Objective assessment assessing individual student work

Q no	Unit topics	Concept area	Item descriptor
1	Classification of living things	LL	identifies and interprets pattern in a classification key
2	Classification of living things	LL	conclusion summarises and explains data in a classification key
3	Classification of living things	LL	conclusion summarises and explains data in a classification key
4	Water quality monitoring	LL	identifies patterns in science data in the form of a rule
5	Water quality monitoring	LL	explains the usefulness of having baseline data
6	Properties of plastics	NP	compares aspects of data in simple supplied table of results
7	Properties of plastics	NP	summarises patterns in the data to find common properties of plastic
8	Properties of plastics	NP	explains interactions between properties of materials and their suitability for a particular purpose
9	Properties of plastics	NP	explains cause and effect of waste plastics in marine environment
10	Effects of temperature	LL	makes comparisons between objects or events
11	Effects of temperature	LL	applies the rule by extrapolating or predicting
12	Effects of temperature	NP	describes cause and effect relationships that have been reported on
13	Effects of temperature	LL	applies the rule by extrapolating or predicting
14	Fibre forensics	NP	describes difference between objects (natural and synthetic fibres)
15	Fibre forensics	NP	describes relationships between individual events (presence of fibre as evidence for match)
16	Natural events and disasters	EB	identifies and summarises patterns in data in the form of a rule
17	Natural events and disasters	EB	describes relationships between individual events (including cause and effect relationships) that have been experienced or reported
18	Natural events and disasters	EB	identifies and summarises patterns in data in the form of a rule
19	Native grasslands and the striped legless lizard	LL	describes relationships between individual events (including cause and effect relationships) that have been experienced or reported
20	Native grasslands and the striped legless lizard	LL	identifies pattern in science data
21	Native grasslands and the striped legless lizard	LL	when provided with an experimental design involving multiple variables, can identify the questions being investigated
22	Energy transfer	EC	explains changes to objects in terms of abstract science concept (energy source)
23	Energy transfer	EC	explains changes to objects in terms of abstract science concept (energy transfer)

24	Energy transfer	EC	describes changes to objects that have been experienced (effect of sound energy)
25	Food web of native animals	LL	explains interactions, processes or effects that have been experienced or reported in terms of non-observable property or abstract science concept
26	Food web of native animals	LL	experimental design set up
27	Food web of native animals	LL	identifies pattern in science data
28	Food web of native animals	LL	experimental design: collecting evidence
29	Mission to Mars	EB	compares aspects of data in a simple supplied table of results
30	Mission to Mars	EB	explains interactions, processes or effects that have been experienced or reported
31	Mission to Mars	EB	conclusion summarises and explains the patterns in the science data
32	Mission to Mars	EB	explains interactions, processes or effects that have been experienced or reported in terms of abstract science
33	Musical instruments	EC	describes cause and effect relationships
34	Musical instruments	EC	conclusion explains the patterns in the data using scientific concepts and is consistent with the data
35	Musical instruments	EC	explains cause and effect relationships
36	States of matter	NP	describes a common property of two objects
37	States of matter	NP	describes the relationship between individual objects

Practical task

Prac Q1	Gravity effects	EB	summarises the pattern in the data
Prac Q2	Gravity effects	EB	makes a prediction from data
Prac Q3	Gravity effects	EB	focuses on one aspect of the data
Prac Q4	Gravity effects	EB	records data as descriptions
Prac Q5	Gravity effects	EB	recognises purpose of calculating average from trials
Prac Q6	Gravity effects	EB	records data as descriptions
Prac Q7	Gravity effects	EB	identifies factors that contribute to a fair test
Prac Q8	Gravity effects	EB	identifies hypothesis being tested
Prac Q9	Gravity effects	EB	plots line graph

Resource materials

The released items required to conduct the Science Literacy School Assessment, which analyse the performance of students and gauge their proficiency against the national science literacy standards, are all provided in this document and 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 7.3 and 7.4 on pages 51 and 52
- 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.
- the materials cannot be used to compare teachers and schools.

The Assessment Administration Guidelines (see Chapter 3) must be followed carefully.

Using the results from the Science Literacy School Assessment

Although the major scientific concepts tested – Earth and Beyond, Energy and Change, Life and Living, and Natural and Processed Materials – 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 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 pen-and-paper test), with 37 multiple-choice and short-answer type questions.

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

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 pages 2 and 3 facing one another.

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 (pen-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 almost three hours in total to complete, including time to read the instructions, distribute the materials and allow for a short 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 test and practical task

Objective (pen-and-paper) test		Time allowed	
Reading the instructions and distributing the test booklets, completing 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 handing out the packaged materials to each group of students		15 minutes	
Students undertake the test	Part A Part B	25 minutes 20 minutes	Total: 45 minutes
Collecting the materials and ending the session		10–15 minutes	
		Total: approximately 1 hour 15 minutes	

Materials required

Students

- pen/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 14 for practical task materials)
- reading materials for students who finish the Assessment early

Assistance

You may read questions to individual students 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 (Gravity effects) 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 **groups of three students**
- check that all practical task materials have been organised as per the table below
- set up the practical task materials in groups beforehand on a table at the side of the room; one student from each group can then collect the materials when told to do so.

Practical task materials (per group of three students)

- two pieces of string (40 cm and 20 cm)
- spare 40 cm piece of string
- sticky tape
- pencil (with flat sides)
- 2 x 17-mm fold-back clips
- stop watch, wall clock or watch with a second hand

Arranging groups for the practical task

For the practical task, groups of three students should be constructed by random assignment. Students could be assigned to groups according to alphabetical order by family name. Leftover students can 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 consists of 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 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 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 five 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.

Read practice question 1 to the students.

Q1 The colour of blood is

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

Colour 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 the bubble for 'red'.

Deal with any questions or problems.

One or two word answer

Look at practice question 2.

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

Read practice question 2 to the students.

Q2 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 2.

What answers would you suggest?

Respond to the student answers as they are given. A typical answer would be: 'blue'.

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 3.

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 3 to the students.

Q3 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 3.

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 such as: '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 bursts'.

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

Explain that, for questions like practice question 3, the number of lines is a guide to how much students need to write.

Cross the boxes

Look at practice question 4.

In these questions you must place a cross in the boxes next to the correct answers.

Read practice question 4 to the students.

Q4 Which of the following are fruit? Cross each box.

banana bicycle apple chair

Allow time for students to answer practice question 4.

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

Check that students have placed crosses in the appropriate boxes.

Deal with any questions or problems.

Fill in the table


Look at practice question 5.

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

Read practice question 5 to the students.

Q5 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 5.

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 1 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.

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 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. It 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 14. When the students are seated in the assigned groups and quiet, say:

Today you will be doing a science practical task called **Gravity effects**. 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 the 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 14 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 these 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.

Dismiss the students according to the policy of the school.

Chapter 4

Science Literacy School Release Materials

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

Two forms of the NAP 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.

YEAR 6

SCIENCE LITERACY

2006

RELEASED ITEMS

Objective Assessment Practical Task

First Name: _____

Last Name: _____

School: _____

THE UNIVERSITY OF
NEW SOUTH WALES



EDUCATIONAL ASSESSMENT
AUSTRALIA

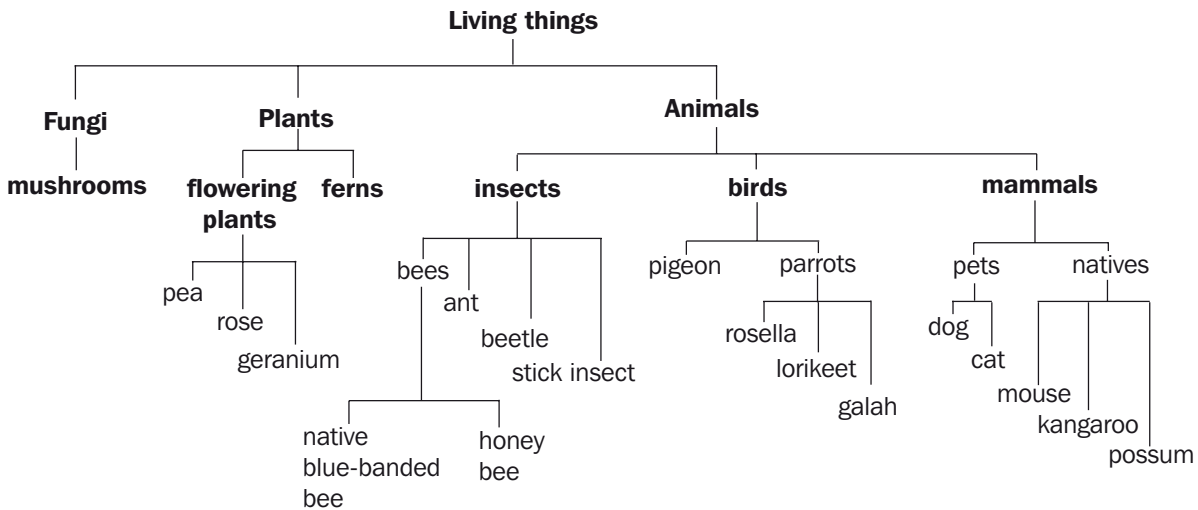


MINISTERIAL COUNCIL ON EDUCATION,
EMPLOYMENT, TRAINING AND YOUTH AFFAIRS

CC
curriculum
corporation
CC

Classification of living things

Steve observed different types of living things in a garden near his house. He constructed a diagram to show how these types of living things could be classified.



Q1 How many types of pigeon did Steve identify?

- 1
 2
 3
 4

Q2 What does the diagram show about the native blue-banded bee and the lorikeet?

- They both have wings.
 They are both insects.
 They are both native mammals.
 They are both animals.

Q3 Which statement gives the most information drawn from the diagram?

- A kangaroo is an animal.
 A honey bee is a living thing.
 A rosella is a parrot.
 A galah is a bird.

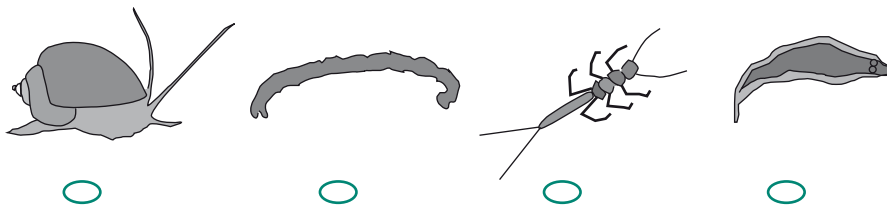
Water quality monitoring

Jack monitored the water quality in a local stream by looking for water bugs. Some water bugs are sensitive to pollution and cannot live in polluted water, while others can live in quite polluted water.

The table lists the types of water bugs that are big enough to be seen without a magnifying glass, and their sensitivities to pollution.

Water bug sensitivity to pollution	
Not sensitive to polluted water	Sensitive to polluted water
worm-like animals water snails	crayfish-like animals (such as rock lobsters) insects with a distinct head, body and legs

Q4 Jack made a drawing of each type of water bug that he found. Which drawing shows a water bug that is sensitive to pollution?



Q5 Jack continued to monitor the water quality in the stream. How would the data he collected the first time be useful to his future investigations?

Properties of plastics

Some plastics can be recycled. They can be formed into many different products.

The table lists:

- properties of some plastics
- products that are made from these plastics when they are first formed
- products that are made when these plastics are recycled.

Type of plastic	Properties			Products made from these plastics	
	Clarity	Resistance to		when first formed	when recycled
		solvents	heat		
PET	clear	good	poor	soft drink bottles, food containers	soft drink bottles, detergent bottles
HDPE	not clear	poor	good	milk containers, shopping bags	flower pots, recycle bins
PVC	clear	good	fair	clear food wrappings	floor mats, drain pipes
PP	not clear	good	good	sauce bottles, yogurt tubs	DVD cases, paint buckets

Note: A solvent is a substance, usually a liquid, capable of dissolving another substance.

Q6 According to the table, DVD cases are made from recycled

- PET.
- HDPE.
- PVC.
- PP.

- Q7** Each type of plastic listed can be
- recycled to make containers which clearly show their contents.
 - used to safely store solvents.
 - used to contain food when heating it in a microwave oven.
 - recycled to make other useful products.

Q8 PET is used to make packaging for sandwiches sold at fast food outlets.
Give one reason why the clarity of PET makes it suitable for this purpose.

Q9 Give one reason why plastic shopping bags cause problems for marine life.

The effect of temperature on animal survival

Some animals keep their body temperature constant. The body temperature of other animals changes as the temperature in their environment changes.

A scientist measured the body temperature of some animals in a hot and a cold environment. The results are summarised in this table.

Table 1

Name of animal	Type of animal	Animal body temperature (°C)	
		When placed in a hot environment (temperature = 35°C)	When placed in a cold environment (temperature = 8°C)
platypus	mammal	32	32
shark	fish	27	12
bat	mammal	33	33
snake	reptile	30	9
pigeon	bird	40	40
lizard	reptile	32	12

Q10 Look at Table 1.

The temperatures of which two types of animals stay the same in hot and cold environments?

- mammals and fish
- fish and reptiles
- mammals and birds
- birds and reptiles

Q11 The scientist then placed the lizard and the pigeon in an environment at 20 °C.

Which body temperatures are they most likely to have after a few days?

- lizard 12 °C and pigeon 22 °C
- lizard 22 °C and pigeon 22 °C
- lizard 32 °C and pigeon 40 °C
- lizard 22 °C and pigeon 40 °C

Table 2 was also in the scientist’s report.

The table shows the oxygen levels in water at different temperatures.

Table 2

Water temperature (°C)	5	10	15	20	25	30
Oxygen levels in water (mg/L)	13	11	10	9	8	7

Q12 According to Table 2, as the temperatures increase, oxygen levels

- increase.
- decrease.
- stay the same.

Q13 Look at Table 2.

A type of fish lives in water with a temperature that varies between 12 °C and 18 °C.

What would you expect the oxygen levels in the water to be for this fish?

- between 7 and 9 mg/L
- between 8 and 10 mg/L
- between 9 and 11 mg/L
- between 10 and 13 mg/L

Fibre forensics

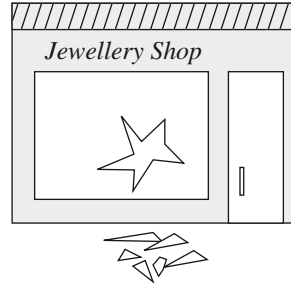
Forensics is the use of science to solve crimes.

An unsolved crime

Where: Jewellery Shop

What: • Glass window smashed
• Diamond necklace stolen

Who: Suspect A

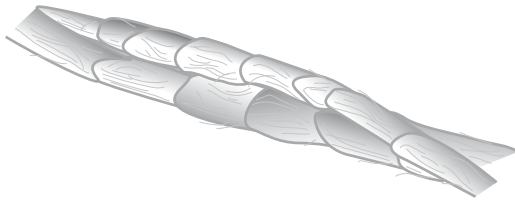


Evidence collected at scene

Fibre evidence: White threads caught on the broken glass

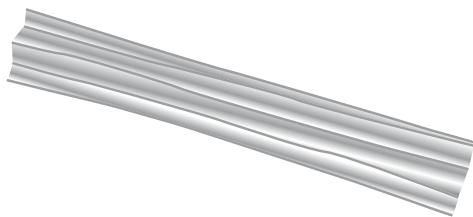
Crime lab information

Fibres from crime scene



These are natural fibres.

Fibres from Suspect A's jacket



These are synthetic (man-made) fibres.

Fibres from Suspect A's jacket were compared with the fibres found at the crime scene.

Q14 How do the fibres differ in appearance?

Q15 From the fibres that were found at the crime scene it seems

- likely that the fibres came from Suspect A's jacket.
- unlikely that the fibres came from Suspect A's jacket.
- there is a 50:50 chance that the fibres came from Suspect A's jacket.

Natural events

Earthquakes

Figure 1 shows the locations of earthquakes around parts of the world. Each dot shows where an earthquake has occurred.

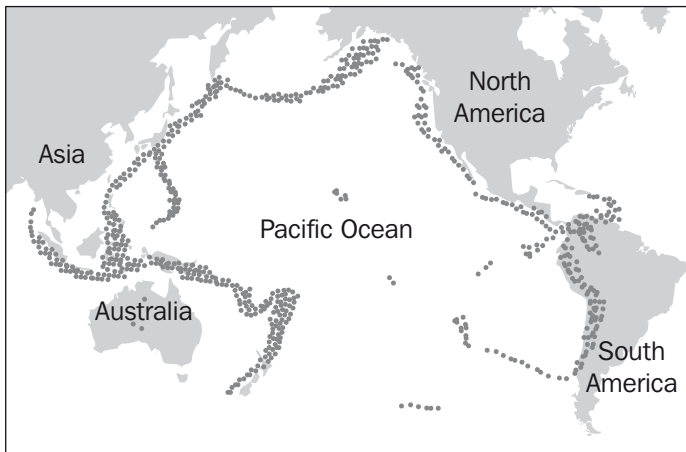


Figure 1

The Earth's crust is made up of jigsaw-like pieces called tectonic plates. The plates slide past each other, move apart or collide with (hit) each other.

Figure 2 shows some tectonic plates and their boundaries.

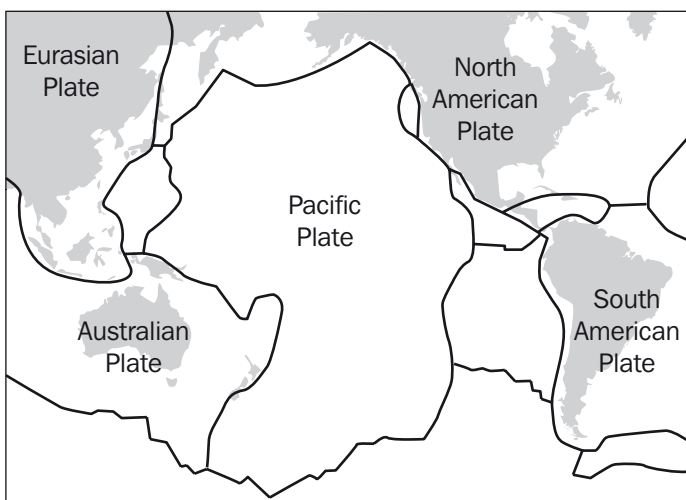


Figure 2

Q16 Compare Figures 1 and 2.

The data suggests that

- there is no pattern to where earthquakes occur.
- earthquakes do not occur in the ocean.
- most of the earthquakes occur on some of the edges of the tectonic plates.
- most of the earthquakes occur towards the middle of the tectonic plates.

Q17 Some tectonic plates collide with and slide underneath other plates.

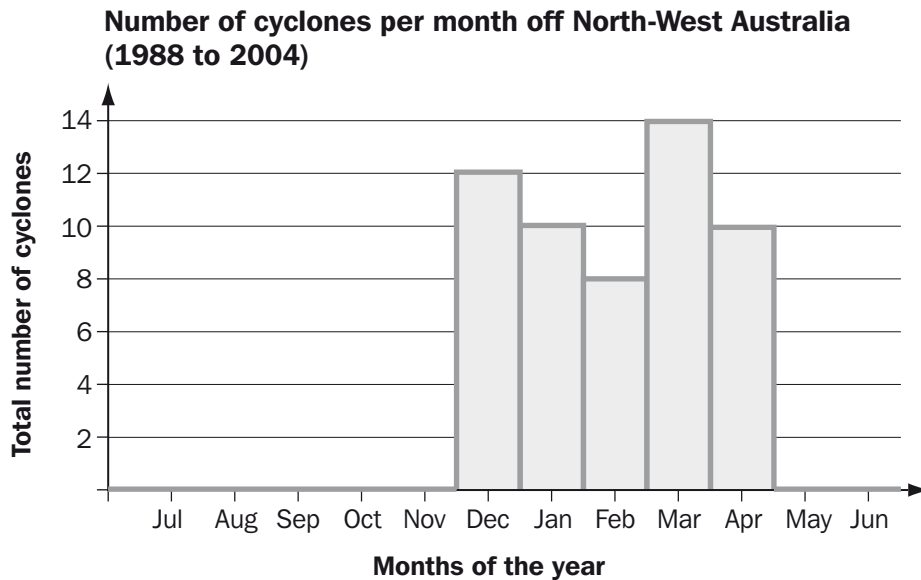
This forces one tectonic plate deep into the Earth's interior where it experiences

- low temperatures and low pressures.
- high temperatures and high pressures.
- low temperatures and high pressures.
- high temperatures and low pressures.

Cyclones

This graph shows the number of cyclones per month that formed off the North-West Australian coast from 1988 to 2004.

Q18 Look at this graph.



From the graph, you can conclude that

- conditions suitable for cyclones to form are present throughout the year.
- conditions suitable for cyclones to form are present from December to April.
- cyclones occur only during December and March.
- a cyclone occurs only in February every year.

Native grasslands and the striped legless lizard

Native grasslands

Native grasslands are one of the most threatened natural ecosystems in Australia. Some native grasslands are located on the edges of growing cities.

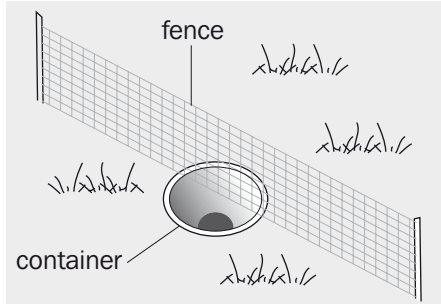
The striped legless lizard is a rare and threatened species that inhabits native grasslands. It spends most of its time out of sight in grass clumps, in cracks in the ground, or under rocks.



Q19 Explain what humans have done that has destroyed native grasslands.

Studying the striped legless lizard

A scientist studied an area of native grassland to investigate threatened striped legless lizards.



Pitfall trap

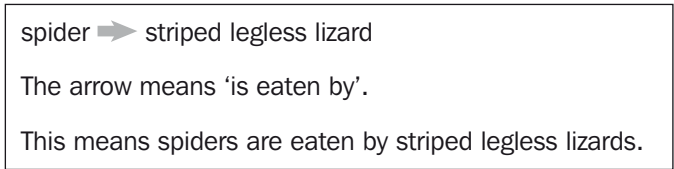
The scientist used a pitfall trap which is a smooth-sided container. It is buried so that its top is level with the ground. A small mesh fence directs animals into the trap. Invertebrates such as spiders, crickets, slaters, moth larvae and centipedes are trapped when they fall into the pit.

The scientist also collected samples of the droppings of two legless lizards.

The droppings showed that the striped legless lizard ate kangaroo grass, black crickets, spiders and moth larvae.

Q20 Scientists use diagrams called food chains to show what food is eaten by animals.

A food chain can be shown like this:



Which one of the following shows another food chain for the striped legless lizard?

- kangaroo grass → black-winged hawk → striped legless lizard → black cricket
- kangaroo grass → black cricket → striped legless lizard → black-winged hawk
- kangaroo grass → black cricket → black-winged hawk → striped legless lizard
- kangaroo grass → striped legless lizard → black cricket → black-winged hawk

Q21 What was the purpose of collecting information from both the pitfall trap and the lizard's droppings?

a Pitfall traps

b Lizard's droppings

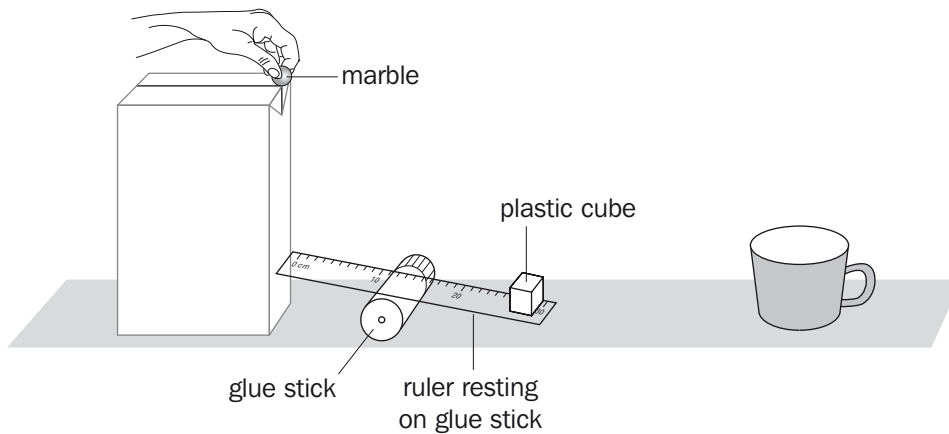
Energy transfer

'Our Invention' by Jack and Amanda

The name of our invention: *Plastic cube flyer*

The purpose of our invention: *to make a plastic cube 'fly' into a cup.*

A diagram of our invention:



How it works:

- 1 Marble is tipped over the edge of the box.
- 2 Marble hits the ruler.
- 3 Plastic cube goes flying.

What will happen in our invention: *We think the plastic cube will land in the cup.*

Q22 What energy source are Jack and Amanda using to make their machine work?

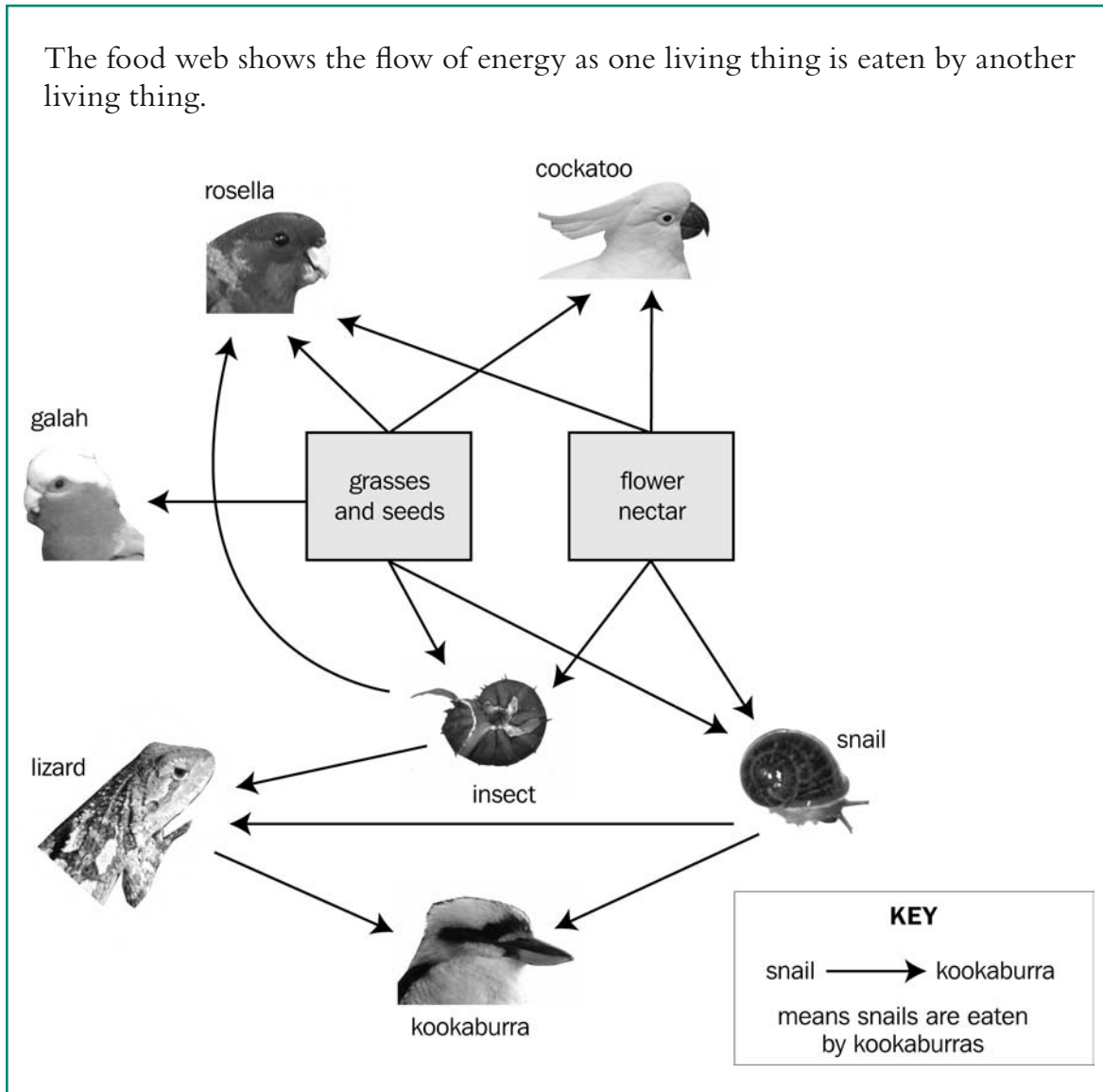
Q23 In their invention, how is energy transferred to the plastic cube to make it go ‘flying’?

Q24 When energy is transferred to the plastic cube, some energy is also changed into sound and heat.

Give one example of where energy would be ‘lost’ as sound in this invention.

Food web of native animals

The food web shows the flow of energy as one living thing is eaten by another living thing.



Q25 People attract birds to their houses by feeding them seed. Scientists warn that a deadly disease can be spread when many different birds feed from the same feeder.

Cross the boxes for all the birds in the food web that could be harmed by this.

- cockatoo galah kookaburra rosella

Q26 Competition with other animals for food can threaten the survival of an animal.

Cross the boxes for all the animals in the food web that might threaten the survival of the rosella.

cockatoo galah kookaburra lizard

Q27 A farmer uses poisonous substances to control the insects and snails that eat her crops.

How might kookaburras be affected by these poisons?

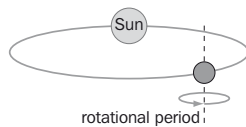
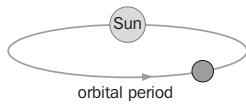
Q28 In some parts of Australia, Aboriginal people used different methods, such as fire stick farming (deliberately burning areas), to promote the spread of native grasses and other food plants.

Why would they have done this?

Mission to Mars

Humans are planning a journey to Mars.
The table gives information about the planet Mars.

Information about Mars	
Distance from Earth	55,700,000 km (minimum); 401,300,000 km (maximum)
Atmosphere	95% carbon dioxide, 3% nitrogen, 1.6% argon, 0.4% other gases
Mean radius	3,393 km
Mass (Earth = 1)	0.108
Gravity (Earth = 1)	0.38
Orbital period	686.98 Earth days
Rotational period	1.026 Earth days
Average surface temperature	-63 °C



Q29 The atmosphere of Mars is mainly made up of

- argon.
- carbon dioxide.
- nitrogen.
- gases other than argon, carbon dioxide and nitrogen.

Q30 Using the same amount of effort as it would take to jump one metre on Earth, you would _____ on Mars.

- jump the same height
- jump higher
- jump lower
- not be able to jump

Q31 Approximately how long are the orbital period and rotational period of Mars compared to Earth?

	Orbital period of Mars	Rotational period of Mars
<input type="radio"/>	twice as long	similar
<input type="radio"/>	similar	twice as long
<input type="radio"/>	twice as long	half as long
<input type="radio"/>	half as long	similar

Q32 There is a large difference in the minimum and maximum distance between Earth and Mars.

How would the difference in distance affect a journey to Mars?

Musical instruments

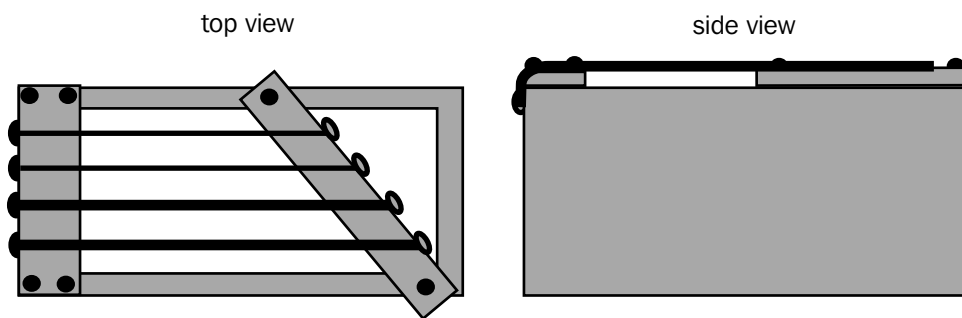
Objects produce sound when they vibrate, for example, when a guitar string is plucked, it makes a sound.

The frequency of the sound produced is the number of times something vibrates to and fro in one second.

Pitch is the highness or lowness of a note. The pitch of a sound rises as its frequency increases.

A high pitched sound is caused by something vibrating at a high frequency.
A low pitched sound is caused by something vibrating at a low frequency.

Q33 Mario made the instrument shown below using wood, string and nails.

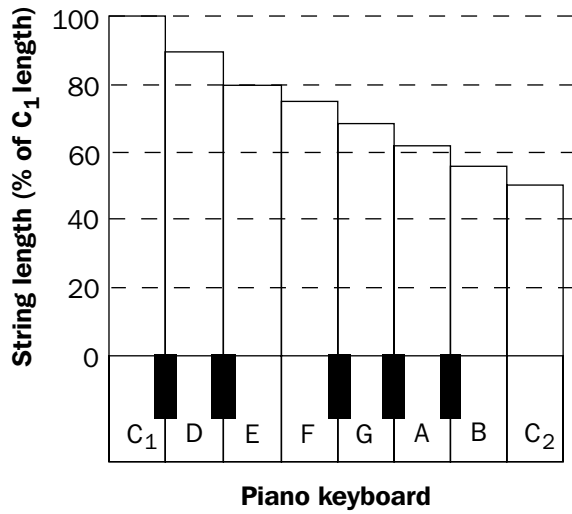


Each string of his instrument sounds at a different pitch when struck.
What two features of the strings would change the pitch of the sound?

1 _____

2 _____

Q34 The graph shows the length of some piano strings and the sound they can produce. Frequency is measured in hertz (Hz).



Piano key	Frequency (Hz)
C ₁	260
D	295
E	330
F	360
G	390
A	440
B	495
C ₂	520

Look at the information above.

Which statement is true?

- The piano key C₁ has the shortest string and produces the highest pitched sound.
- The piano key C₂ has the longest string and produces the lowest pitched sound.
- The shorter the string, the higher the pitch of the sound.
- The longer the string, the higher the pitch of the sound.

Q35 The photograph shows a small drum.



It is possible to change the pitch of the sound from the drum by tightening or loosening the skin.

Explain how this would change the pitch.

States of matter

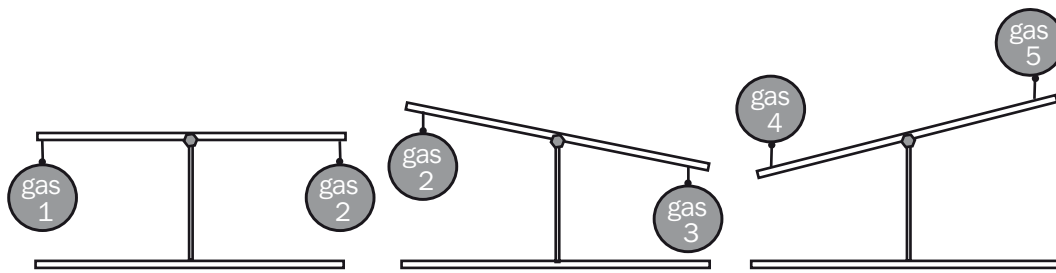
Gas has volume and mass. Gas that is heavier than air sinks. Gas that is lighter than air floats.

The mass of two objects can be compared using balance scales.

Ingrid filled six identical balloons with gases.

She tied the balloons to the ends of balance scales with light string.

Gas 1 was oxygen.



Q36 Ingrid compared the mass of equal volumes of gas 1 and gas 2.

She found that

- gas 1 had more mass than gas 2.
- gas 1 had less mass than gas 2.
- gas 1 had equal mass to gas 2.

Q37 Carbon dioxide is heavier than air. When released from a fire extinguisher, it falls down over the fire and keeps oxygen in the air away from the fuel.

Which gas was carbon dioxide?

Gas _____

This is the end of the objective test.

STOP and wait for your teacher's instructions.

PRACTICAL TASK

Gravity effects

Introduction

Gravity is an invisible force that operates between all objects in the universe.

Gravity pulls everything on Earth towards the centre of the Earth.

Gravity holds us on Earth and keeps the Earth and the planets orbiting the Sun.

A pendulum can be made by attaching a mass (called a bob) to a length of string.

Gravity pulls the bob down. A pendulum can be used to investigate gravity. It is used in some clocks to measure time.

In this practical task you will investigate gravity using a pendulum.

What to do

Complete all sections in Part A of the activity in your group. Answer the questions as you go.

Complete the Part B questions by yourself.

What you will need per group of 3 students

- 2 pieces of string (40 cm and 20 cm)
- Spare 40 cm piece of string
- Sticky tape
- 1 pencil (with flat sides)
- 2 (17 mm) fold-back clips
- Stop watch, wall clock or a watch with a second hand.

PART A

Group work (Work as part of a group of 3 students.)

Investigating a pendulum

You will complete two experiments to investigate the swing of a pendulum. In Experiment 1 you will investigate how changing the **mass of the bob** affects the swing of the pendulum. In Experiment 2 you will investigate how changing the **length of the string** affects the swing of the pendulum.

Setting up the experiments

Making the pendulum

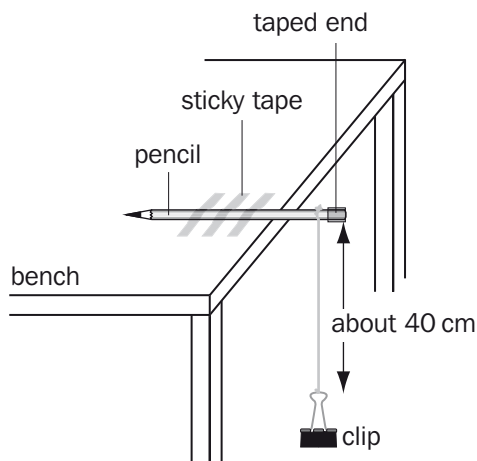


Figure 1: Making the pendulum

- 1** Wrap a piece of sticky tape around one end of the pencil (cover about 1 cm of the end). This is so the string won't fall off the end of the pencil when you tie it on.
- 2** Use three pieces of sticky tape to stick the other end of the pencil onto the desk. Make sure the taped end sticks out from the bench about one third the length of the pencil.
- 3** Put one end of the longer (40 cm) length of string through both metal loops of **one** of the clips. Tie a knot as close as possible to the end of the string to attach the clip.
- 4** Tie the other end of the string to the pencil (just behind the sticky tape).

Testing the pendulum

- 1 Hold the clip up, with its string stretched out, so it is level (horizontal) with the pencil as shown in Figure 2. The clip is the bob of the pendulum.
- 2 Release the bob.
- 3 Make sure the pendulum can swing freely (doesn't hit anything when it swings and that it swings smoothly back and forth – not in a circle).
- 4 Make sure the pencil is firmly attached to the bench.

Conducting the experiments

Experiment 1:

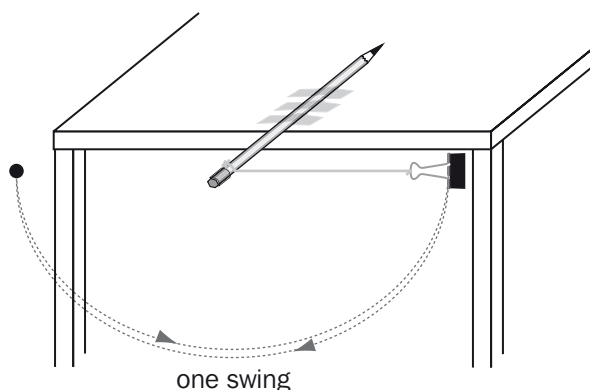
Checking the effect of changing the mass of the bob

You will collect data to test this idea (hypothesis):

'The mass of the bob of a pendulum does not change the number of swings in a given time.'

Use one clip for the bob for the first part of this experiment, then add a second clip to add extra mass. Use the longer (40 cm) piece of string each time.

- 1 Hold the bob (one-clip) up, with the string stretched out, so it is level with the pencil.
- 2 Release the bob and record how many times the pendulum swings in 10 seconds. One student says 'go' at the start of 10 seconds and 'stop' at the end.
Back and forward is one swing.



TIP Use a clock or a watch with a second hand, or count ten seconds by saying 'one thousand and one, one thousand and two, one thousand and three' up to 'one thousand and ten'.

Figure 2: Releasing the pendulum

- 3 Repeat this two more times, so that you have three results using this bob.
- 4 Record all of these results in Table 1.
- 5 Tie the second clip onto the string so there are two clips on the end (untie the string attached to the first clip and then retie the knot) as in Figure 3. Spare string is provided if needed.



Figure 3: Two-clip bob

- 6 Repeat the experiment using 2 clips as the bob.
- 7 Record your results in Table 1.

Table 1: Changing the **mass** of the bob

Number of swings in 10 seconds		
Trial	One-clip bob	Two-clip bob
1		
2		
3		

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

Experiment 2:
Checking the effect of changing the length of the string

You will collect data to test this idea (hypothesis):

‘The length of the string of a pendulum does not change the number of swings in a given time.’

You will release the two-clip bob using two different string lengths.

- 1 Using the longer (40 cm) length of string**, hold the bob up, with the string stretched out, so it is level with the pencil.
- 2** Release the bob and record how many times the pendulum swings in 10 seconds. One student says ‘go’ at the start of 10 seconds and ‘stop’ at the end.
- 3** Repeat this two more times, so that you have three results for the long piece of string.
- 4** Record all of these results in Table 2.
- 5 Now change to the shorter (20 cm) length of string** and repeat the experiment releasing the two-clip bob.
- 6** Record your results in Table 2.

Table 2: Changing the **length** of the string

Number of swings in 10 seconds (two-clip bob)		
Trial	40 cm piece of string	20 cm piece of string
1		
2		
3		

Before you go on make sure you have recorded all of your results.
 You will need to use your 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.)

Experiment 1:

Checking the effect of changing the mass of the bob

Q1 Look at your results in Table 1: *Changing the mass of the bob*.

When you used the two-clip bob, what were your results for Trial 3?

Q2 Look at your results for the one-clip and the two-clip bob in Table 1:
Changing the mass of the bob.

Write a sentence to describe what you observed.

Q3 When comparing the one-clip bob to the two-clip bob, explain why it would be better to use the average of the three trials rather than just Trial 3.

Experiment 2:

Checking the effect of changing the length of the string

Q4 Look at your results for the long and the short lengths of string in Table 2: *Changing the **length** of the string*.

Write a sentence to describe what you observed.

Q5 In this experiment you used two different lengths of string.
Why were you instructed to use the two-clip bob each time?

test continues on the next page

Joe's experiment

In the experiments you did in your group, the release position was always level with the pencil.

Joe conducted an experiment where he compared two different release positions (release position A and release position B).

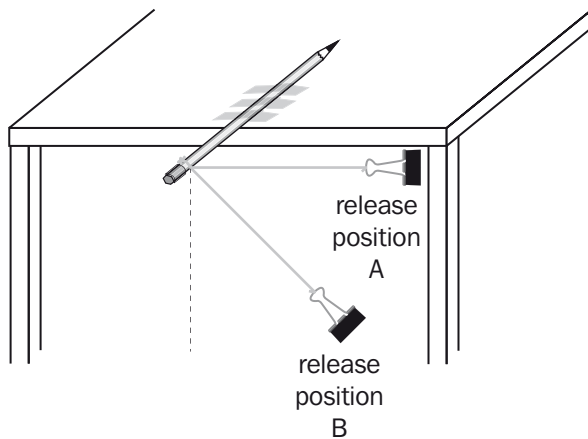


Figure 4: Joe's experiment

Q6 What idea (hypothesis) is Joe most likely testing?

The release position of the pendulum bob affects

- the number of swings.
- the length of string used.
- the mass of the bob.
- how you count the number of swings.

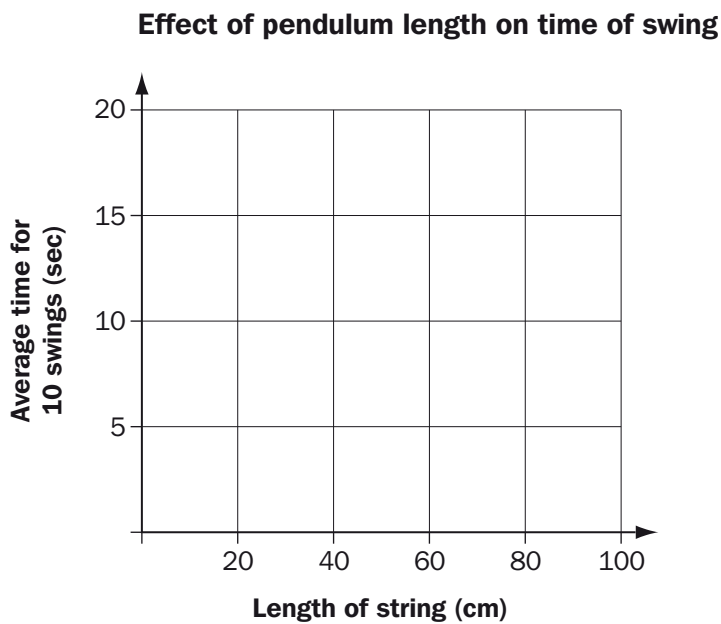
Georgia’s experiment

Georgia conducted an experiment using 5 different lengths of string. The mass of the bob and the release position stayed the same.

Here are her results.

Length of string (cm)	Average time for 10 swings (seconds)
20	9
40	13
60	16
80	18
100	20

Q7 Construct a **line graph** to show Georgia’s results.



Q8 What do Georgia’s results show?

More questions about gravity

Gravity pulls the pendulum bob down towards the ground.

Q9 This table lists the force due to gravity of some planets, compared to Earth's gravity. Gravity on Earth is equal to one (Earth = 1).

Planet	Gravity (Earth = 1)
Mercury	0.4
Venus	0.9
Earth	1.0
Mars	0.4
Jupiter	2.4

Imagine you could complete pendulum experiments on Earth and on these other planets. You would use the same bob, string length and release position.

Use the information in the table to predict on which planet the pendulum would swing most like on Earth.

- Mercury
- Venus
- Mars
- Jupiter

This is the end of the practical task.

STOP and wait for your teacher's instructions.

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meant to be blank.**

Practice questions

Multiple Choice

Q1 The colour of blood is

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

One or Two Word Answer

Q2 On a clear, sunny day the colour of the sky is _____.

Long Answer

Q3 Explain what happens to a balloon when you blow it up.

Cross the Boxes

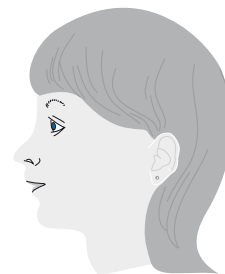
Q4 Which of the following are fruit? Cross each box.

- banana bicycle apple chair

Fill in the Table

Q5 Look at the features of this face.
Complete the table below.

Feature	Sense
eyes	sight
ears	
	smell



YEAR 6

SCIENCE LITERACY

2006

RELEASED ITEMS

Objective Assessment

First Name: _____

Last Name: _____

School: _____

THE UNIVERSITY OF
NEW SOUTH WALES



EDUCATIONAL ASSESSMENT
AUSTRALIA

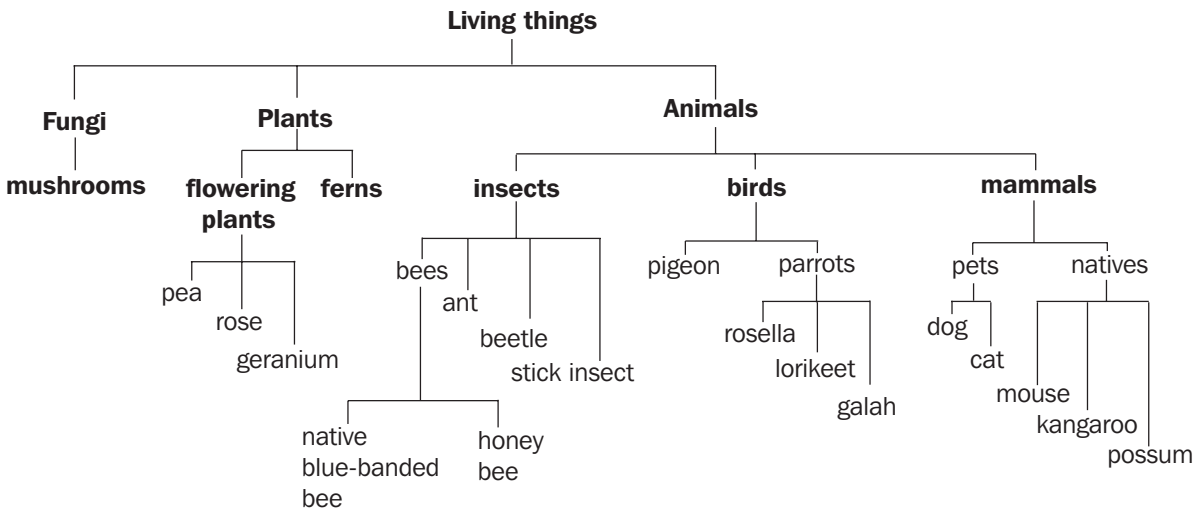


MINISTERIAL COUNCIL ON EDUCATION,
EMPLOYMENT, TRAINING AND YOUTH AFFAIRS

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Classification of living things

Steve observed different types of living things in a garden near his house. He constructed a diagram to show how these types of living things could be classified.



Q1 How many types of pigeon did Steve identify?

- 1
- 2
- 3
- 4

Q2 What does the diagram show about the native blue-banded bee and the lorikeet?

- They both have wings.
- They are both insects.
- They are both native mammals.
- They are both animals.

Q3 Which statement gives the most information drawn from the diagram?

- A kangaroo is an animal.
- A honey bee is a living thing.
- A rosella is a parrot.
- A galah is a bird.

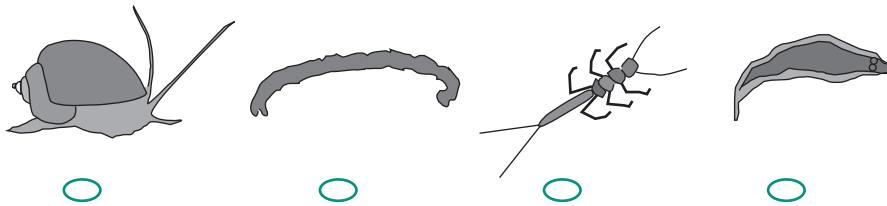
Water quality monitoring

Jack monitored the water quality in a local stream by looking for water bugs. Some water bugs are sensitive to pollution and cannot live in polluted water, while others can live in quite polluted water.

The table lists the types of water bugs that are big enough to be seen without a magnifying glass, and their sensitivities to pollution.

Water bug sensitivity to pollution	
Not sensitive to polluted water	Sensitive to polluted water
worm-like animals water snails	crayfish-like animals (such as rock lobsters) insects with a distinct head, body and legs

Q4 Jack made a drawing of each type of water bug that he found. Which drawing shows a water bug that is sensitive to pollution?



Q5 Jack continued to monitor the water quality in the stream. How would the data he collected the first time be useful to his future investigations?

Properties of plastics

Some plastics can be recycled. They can be formed into many different products.

The table lists:

- properties of some plastics
- products that are made from these plastics when they are first formed
- products that are made when these plastics are recycled.

Type of plastic	Properties			Products made from these plastics	
	Clarity	Resistance to		when first formed	when recycled
		solvents	heat		
PET	clear	good	poor	soft drink bottles, food containers	soft drink bottles, detergent bottles
HDPE	not clear	poor	good	milk containers, shopping bags	flower pots, recycle bins
PVC	clear	good	fair	clear food wrappings	floor mats, drain pipes
PP	not clear	good	good	sauce bottles, yogurt tubs	DVD cases, paint buckets

Note: A solvent is a substance, usually a liquid, capable of dissolving another substance.

Q6 According to the table, DVD cases are made from recycled

- PET.
- HDPE.
- PVC.
- PP.

Q7 Each type of plastic listed can be

- recycled to make containers which clearly show their contents.
- used to safely store solvents.
- used to contain food when heating it in a microwave oven.
- recycled to make other useful products.

Q8 PET is used to make packaging for sandwiches sold at fast food outlets.
Give one reason why the clarity of PET makes it suitable for this purpose.

Q9 Give one reason why plastic shopping bags cause problems for marine life.

The effect of temperature on animal survival

Some animals keep their body temperature constant. The body temperature of other animals changes as the temperature in their environment changes.

A scientist measured the body temperature of some animals in a hot and a cold environment. The results are summarised in this table.

Table 1

Name of animal	Type of animal	Animal body temperature (°C)	
		When placed in a hot environment (temperature = 35°C)	When placed in a cold environment (temperature = 8°C)
platypus	mammal	32	32
shark	fish	27	12
bat	mammal	33	33
snake	reptile	30	9
pigeon	bird	40	40
lizard	reptile	32	12

Q10 Look at Table 1.

The temperatures of which two types of animals stay the same in hot and cold environments?

- mammals and fish
- fish and reptiles
- mammals and birds
- birds and reptiles

Q11 The scientist then placed the lizard and the pigeon in an environment at 20 °C.

Which body temperatures are they most likely to have after a few days?

- lizard 12 °C and pigeon 22 °C
- lizard 22 °C and pigeon 22 °C
- lizard 32 °C and pigeon 40 °C
- lizard 22 °C and pigeon 40 °C

Table 2 was also in the scientist’s report.

The table shows the oxygen levels in water at different temperatures.

Table 2

Water temperature (°C)	5	10	15	20	25	30
Oxygen levels in water (mg/L)	13	11	10	9	8	7

Q12 According to Table 2, as the temperatures increase, oxygen levels

- increase.
- decrease.
- stay the same.

Q13 Look at Table 2.

A type of fish lives in water with a temperature that varies between 12 °C and 18 °C.

What would you expect the oxygen levels in the water to be for this fish?

- between 7 and 9 mg/L
- between 8 and 10 mg/L
- between 9 and 11 mg/L
- between 10 and 13 mg/L

OBJECTIVE ASSESSMENT

Fibre forensics

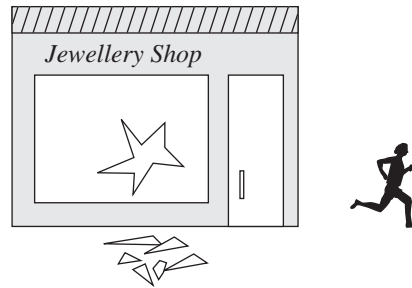
Forensics is the use of science to solve crimes.

An unsolved crime

Where: Jewellery Shop

What: • Glass window smashed
• Diamond necklace stolen

Who: Suspect A

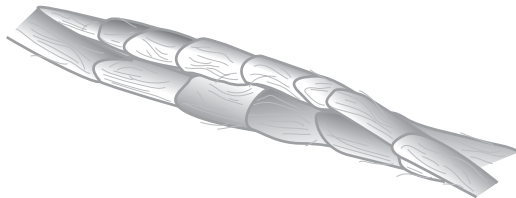


Evidence collected at scene

Fibre evidence: White threads caught on the broken glass

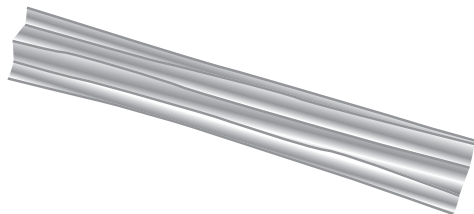
Crime lab information

Fibres from crime scene



These are natural fibres.

Fibres from Suspect A's jacket



These are synthetic (man-made) fibres.

Fibres from Suspect A's jacket were compared with the fibres found at the crime scene.

Q14 How do the fibres differ in appearance?

Q15 From the fibres that were found at the crime scene it seems

- likely that the fibres came from Suspect A's jacket.
- unlikely that the fibres came from Suspect A's jacket.
- there is a 50:50 chance that the fibres came from Suspect A's jacket.

Natural events

Earthquakes

Figure 1 shows the locations of earthquakes around parts of the world. Each dot shows where an earthquake has occurred.

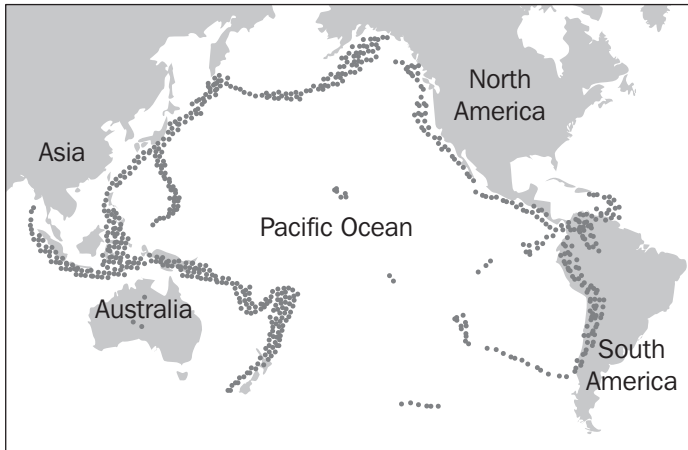


Figure 1

The Earth’s crust is made up of jigsaw-like pieces called tectonic plates. The plates slide past each other, move apart or collide with (hit) each other.

Figure 2 shows some tectonic plates and their boundaries.

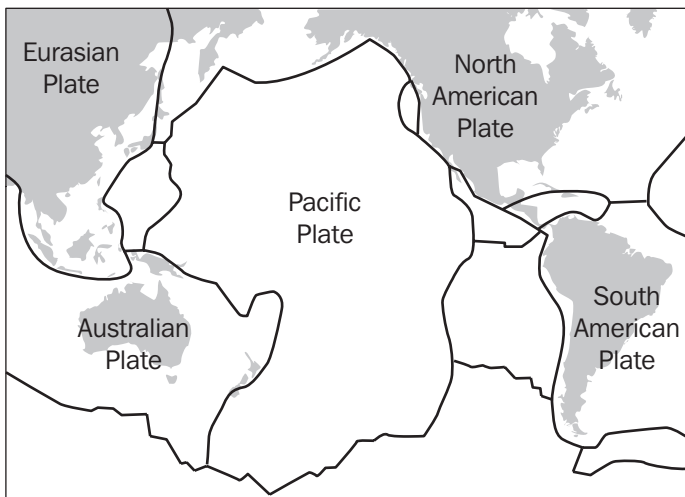


Figure 2

Q16 Compare Figures 1 and 2.

The data suggests that

- there is no pattern to where earthquakes occur.
- earthquakes do not occur in the ocean.
- most of the earthquakes occur on some of the edges of the tectonic plates.
- most of the earthquakes occur towards the middle of the tectonic plates.

Q17 Some tectonic plates collide with and slide underneath other plates.

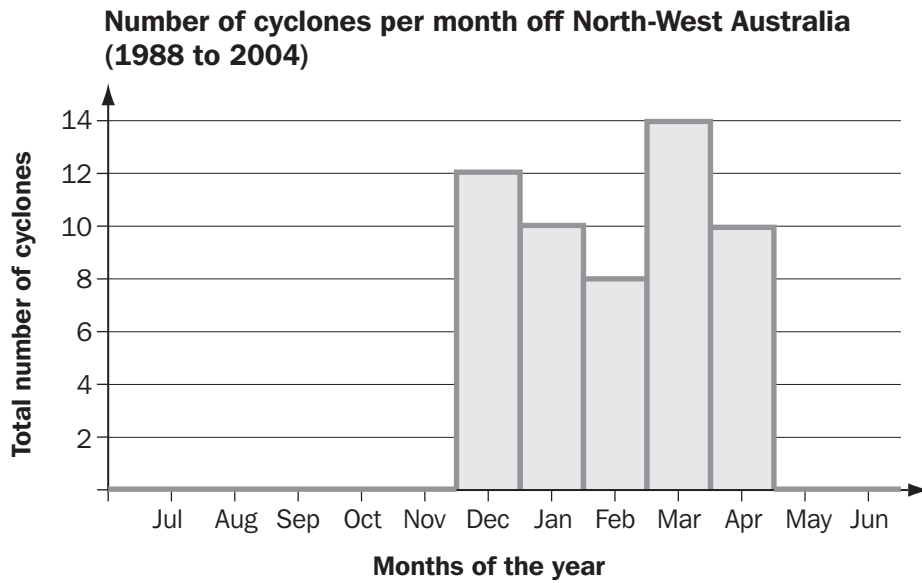
This forces one tectonic plate deep into the Earth's interior where it experiences

- low temperatures and low pressures.
- high temperatures and high pressures.
- low temperatures and high pressures.
- high temperatures and low pressures.

Cyclones

This graph shows the number of cyclones per month that formed off the North-West Australian coast from 1988 to 2004.

Q18 Look at this graph.



From the graph, you can conclude that

- conditions suitable for cyclones to form are present throughout the year.
- conditions suitable for cyclones to form are present from December to April.
- cyclones occur only during December and March.
- a cyclone occurs only in February every year.

Native grasslands and the striped legless lizard

Native grasslands

Native grasslands are one of the most threatened natural ecosystems in Australia. Some native grasslands are located on the edges of growing cities.

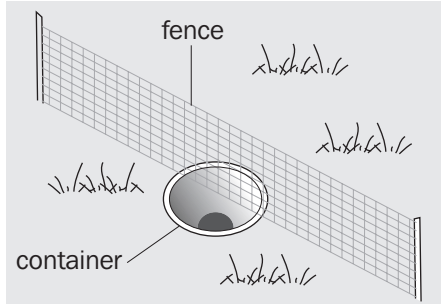
The striped legless lizard is a rare and threatened species that inhabits native grasslands. It spends most of its time out of sight in grass clumps, in cracks in the ground, or under rocks.



Q19 Explain what humans have done that has destroyed native grasslands.

Studying the striped legless lizard

A scientist studied an area of native grassland to investigate threatened striped legless lizards.



Pitfall trap

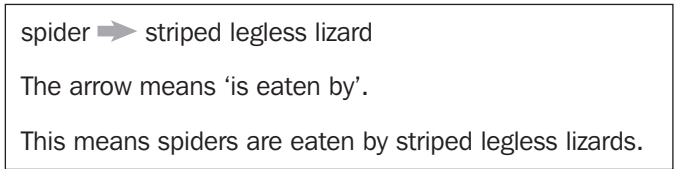
The scientist used a pitfall trap which is a smooth-sided container. It is buried so that its top is level with the ground. A small mesh fence directs animals into the trap. Invertebrates such as spiders, crickets, slaters, moth larvae and centipedes are trapped when they fall into the pit.

The scientist also collected samples of the droppings of two legless lizards.

The droppings showed that the striped legless lizard ate kangaroo grass, black crickets, spiders and moth larvae.

Q20 Scientists use diagrams called food chains to show what food is eaten by animals.

A food chain can be shown like this:



Which one of the following shows another food chain for the striped legless lizard?

- kangaroo grass → black-winged hawk → striped legless lizard → black cricket
- kangaroo grass → black cricket → striped legless lizard → black-winged hawk
- kangaroo grass → black cricket → black-winged hawk → striped legless lizard
- kangaroo grass → striped legless lizard → black cricket → black-winged hawk

Q21 What was the purpose of collecting information from both the pitfall trap and the lizard's droppings?

a Pitfall traps

b Lizard's droppings

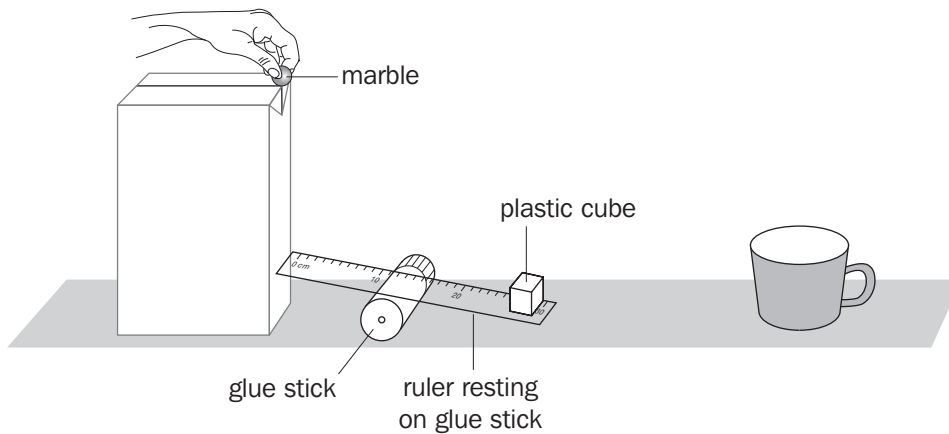
Energy transfer

'Our Invention' by Jack and Amanda

The name of our invention: *Plastic cube flyer*

The purpose of our invention: *to make a plastic cube 'fly' into a cup.*

A diagram of our invention:



How it works:

- 1 Marble is tipped over the edge of the box.
- 2 Marble hits the ruler.
- 3 Plastic cube goes flying.

What will happen in our invention: *We think the plastic cube will land in the cup.*

Q22 What energy source are Jack and Amanda using to make their machine work?

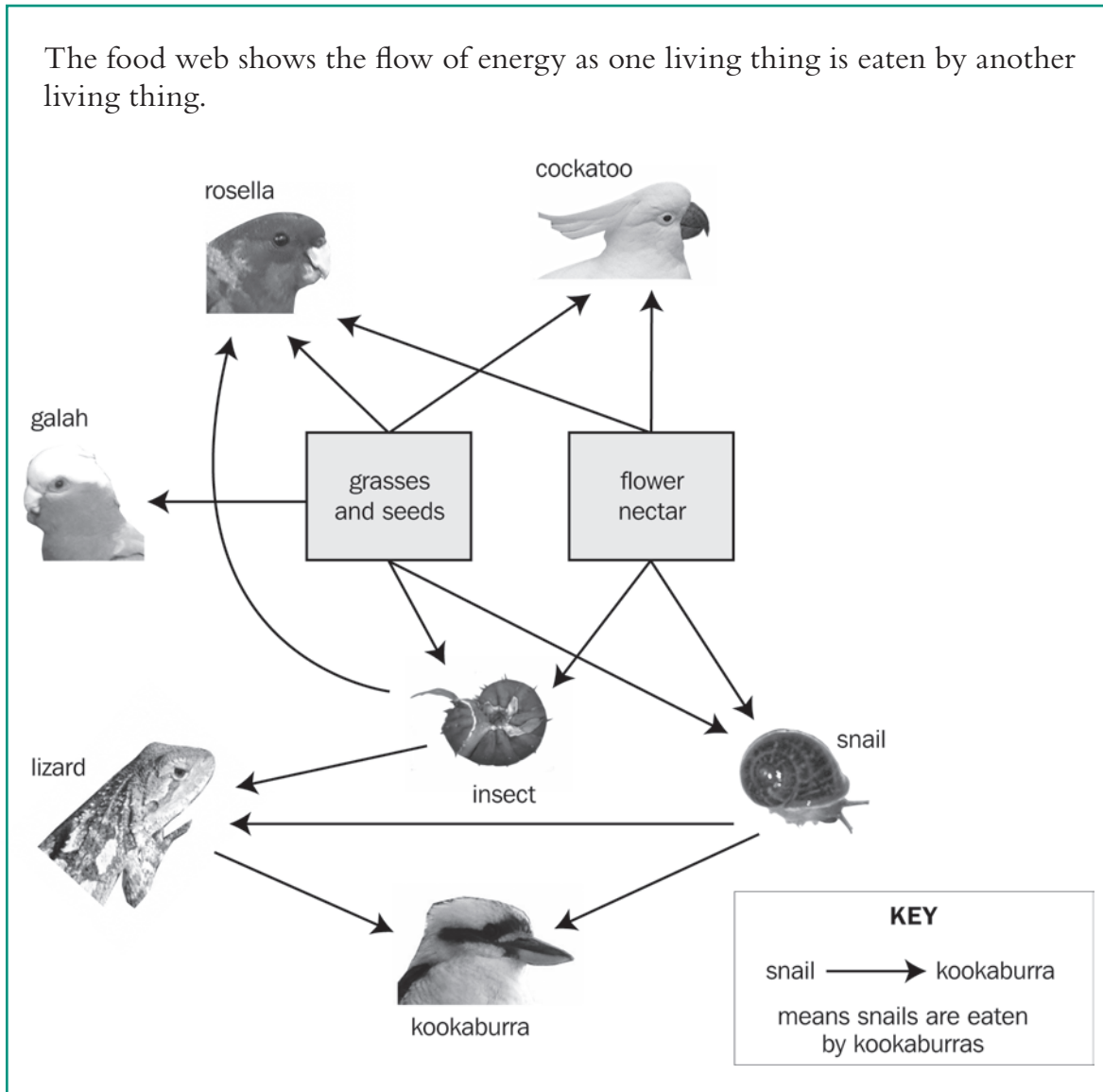
Q23 In their invention, how is energy transferred to the plastic cube to make it go ‘flying’?

Q24 When energy is transferred to the plastic cube, some energy is also changed into sound and heat.

Give one example of where energy would be ‘lost’ as sound in this invention.

Food web of native animals

The food web shows the flow of energy as one living thing is eaten by another living thing.



Q25 People attract birds to their houses by feeding them seed. Scientists warn that a deadly disease can be spread when many different birds feed from the same feeder.

Cross the boxes for all the birds in the food web that could be harmed by this.

- cockatoo galah kookaburra rosella

Q26 Competition with other animals for food can threaten the survival of an animal.

Cross the boxes for all the animals in the food web that might threaten the survival of the rosella.

cockatoo galah kookaburra lizard

Q27 A farmer uses poisonous substances to control the insects and snails that eat her crops.

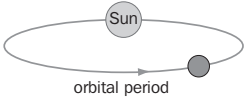
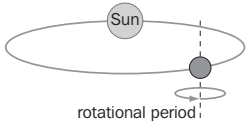
How might kookaburras be affected by these poisons?

Q28 In some parts of Australia, Aboriginal people used different methods, such as fire stick farming (deliberately burning areas), to promote the spread of native grasses and other food plants.

Why would they have done this?

Mission to Mars

Humans are planning a journey to Mars.
The table gives information about the planet Mars.

Information about Mars	
Distance from Earth	55,700,000 km (minimum); 401,300,000 km (maximum)
Atmosphere	95% carbon dioxide, 3% nitrogen, 1.6% argon, 0.4% other gases
Mean radius	3,393 km
Mass (Earth = 1)	0.108
Gravity (Earth = 1)	0.38
Orbital period 	686.98 Earth days
Rotational period 	1.026 Earth days
Average surface temperature	-63 °C

Q29 The atmosphere of Mars is mainly made up of

- argon.
- carbon dioxide.
- nitrogen.
- gases other than argon, carbon dioxide and nitrogen.

Q30 Using the same amount of effort as it would take to jump one metre on Earth, you would _____ on Mars.

- jump the same height
- jump higher
- jump lower
- not be able to jump

Q31 Approximately how long are the orbital period and rotational period of Mars compared to Earth?

	Orbital period of Mars	Rotational period of Mars
<input type="radio"/>	twice as long	similar
<input type="radio"/>	similar	twice as long
<input type="radio"/>	twice as long	half as long
<input type="radio"/>	half as long	similar

Q32 There is a large difference in the minimum and maximum distance between Earth and Mars.

How would the difference in distance affect a journey to Mars?

Musical instruments

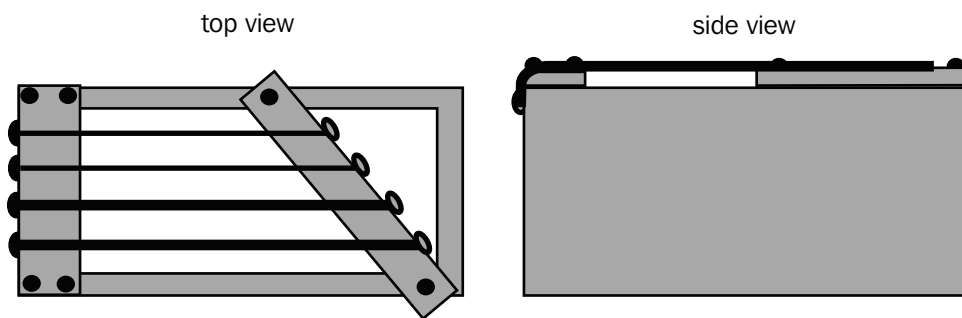
Objects produce sound when they vibrate, for example, when a guitar string is plucked, it makes a sound.

The frequency of the sound produced is the number of times something vibrates to and fro in one second.

Pitch is the highness or lowness of a note. The pitch of a sound rises as its frequency increases.

A high pitched sound is caused by something vibrating at a high frequency.
 A low pitched sound is caused by something vibrating at a low frequency.

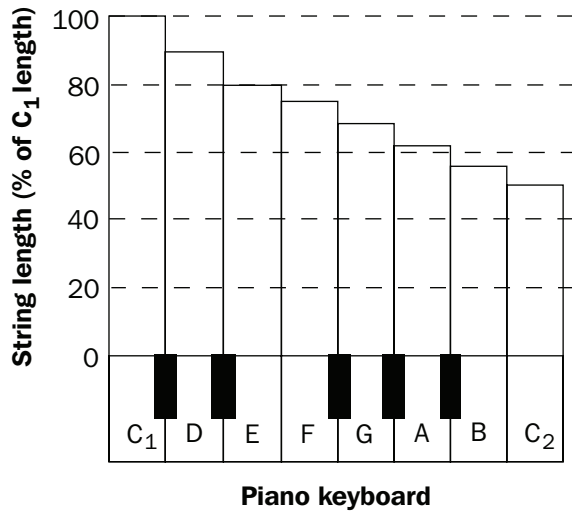
Q33 Mario made the instrument shown below using wood, string and nails.



Each string of his instrument sounds at a different pitch when struck.
 What two features of the strings would change the pitch of the sound?

- 1 _____
- 2 _____

Q34 The graph shows the length of some piano strings and the sound they can produce. Frequency is measured in hertz (Hz).



Piano key	Frequency (Hz)
C ₁	260
D	295
E	330
F	360
G	390
A	440
B	495
C ₂	520

Look at the information above.

Which statement is true?

- The piano key C₁ has the shortest string and produces the highest pitched sound.
- The piano key C₂ has the longest string and produces the lowest pitched sound.
- The shorter the string, the higher the pitch of the sound.
- The longer the string, the higher the pitch of the sound.

Q35 The photograph shows a small drum.



It is possible to change the pitch of the sound from the drum by tightening or loosening the skin.

Explain how this would change the pitch.

States of matter

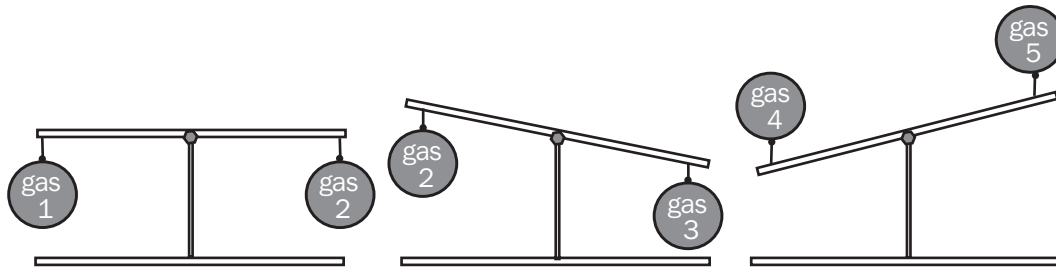
Gas has volume and mass. Gas that is heavier than air sinks. Gas that is lighter than air floats.

The mass of two objects can be compared using balance scales.

Ingrid filled six identical balloons with gases.

She tied the balloons to the ends of balance scales with light string.

Gas 1 was oxygen.



Q36 Ingrid compared the mass of equal volumes of gas 1 and gas 2.

She found that

- gas 1 had more mass than gas 2.
- gas 1 had less mass than gas 2.
- gas 1 had equal mass to gas 2.

Q37 Carbon dioxide is heavier than air. When released from a fire extinguisher, it falls down over the fire and keeps oxygen in the air away from the fuel.

Which gas was carbon dioxide?

Gas _____

This is the end of the objective test.

STOP and wait for your teacher's instructions.

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meant to be blank.**

Practice questions

Multiple Choice

Q1 The colour of blood is

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

One or Two Word Answer

Q2 On a clear, sunny day the colour of the sky is _____.

Long Answer

Q3 Explain what happens to a balloon when you blow it up.

Cross the Boxes

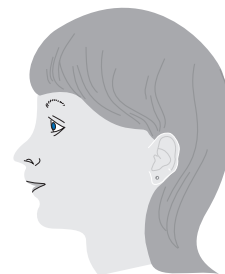
Q4 Which of the following are fruit? Cross each box.

- banana bicycle apple chair

Fill in the Table

Q5 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.

There are no part marks.

National Assessment Program – Science Literacy

Year 6

Science Literacy School Assessment

Marking Guide

2006 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 examples/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
CLASSIFICATION OF LIVING THINGS		
Q1	1	Multiple-choice response A: 1
Q2	1	Multiple-choice response D: They are both animals.
Q3	1	Multiple-choice response C: A rosella is a parrot.

Question	Score	Response: answers/examples/information
WATER QUALITY MONITORING		
Q4	1	Multiple-choice response C: 
Q5	1	<p>To compare/imply comparison e.g. have two sets of data.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • the data collected by Jack this time would provide (baseline) comparative data by which he could measure changes in the water quality of the stream over time • make a comparison over time • to see if it changes • to see if the stream becomes polluted <p>Examples of incorrect answers (Score 0):</p> <ul style="list-style-type: none"> • make a comparison

Question	Score	Response: answers/examples/information
PROPERTIES OF PLASTICS		
Q6	1	Multiple-choice response D: PP.
Q7	1	Multiple-choice response D: recycled to make other useful products.

Q8	1	<p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • the PET allows the food to be seen without opening the package • to see what's inside • so you can see if the food is off
Q9	1	<p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • grocery bags kill/choke/suffocate/block/get stuck in digestive systems of marine life • traps/tangles up marine life • they blow into the ocean and get caught in animals' throats • turtles mistake them for jellyfish and eat them (identifies intent) <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • they float • kill (<i>not enough information</i>) • endanger (<i>not enough information</i>) • animals eat them

Question	Score	Response: answers/examples/information
THE EFFECT OF TEMPERATURE ON ANIMAL SURVIVAL		
Q10	1	Multiple-choice Response C: mammals and birds
Q11	1	Multiple-choice Response D: lizard 22°C and pigeon 40°C
Q12	1	Multiple-choice Response B: decrease.
Q13	1	Multiple-choice Response C: between 9 and 11 mg/L

Question	Score	Response: answers/examples/information
FIBRE FORENSICS		
Q14	1	<p>Identifies a difference based on appearance.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • one is rougher than the other one • one has segments • one has lines • one is bumpy • one is twisted, the other is straight <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • one is natural and one is synthetic • different shapes • different patterns <p><i>NB. Different patterns or different shapes on their own are not sufficient answers. Detail needs to be given describing these differences e.g. the natural fibres are thicker.</i></p>
Q15	1	Multiple-choice response B: unlikely that the fibres came from Suspect A's jacket.

Question	Score	Response: answers/examples/information
NATURAL EVENTS		
Q16	1	Multiple-choice response C: most of the earthquakes occur on some of the edges of the tectonic plates.
Q17	1	Multiple-choice response B: high temperatures and high pressures.
Q18	1	Multiple-choice response B: conditions suitable for cyclones to form are present from December to April

Question	Score	Response: answers/examples/information
NATIVE GRASSLANDS AND THE STRIPED LEGLESS LIZARD		
Q19	1	<p>Suggests plausible answer that reflects an understanding that humans have impacted on the grassland ecosystem.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • use native grasslands for growing crops, livestock, agriculture/farming • use native grasslands for building, housing, industry sites • introduce non-native animals and plants • intentional lighting of fires • we affect the soil by polluting it which then kills the native grasslands <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • naturally occurring fires • knocking down trees (need to say why the trees are being destroyed e.g. to build houses)
Q20	1	<p>Multiple-choice response B:</p> <p><input type="radio"/> kangaroo grass ➡ black cricket ➡ striped legless lizard ➡ black-winged hawk</p>

Q21	1	<p>Understands that the pitfall traps show the types of invertebrates that live in the area</p> <p>AND</p> <p>Understands that the droppings indicate the food sources specific to the striped legless lizard.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • to see what animals are in the area <p>AND</p> <ul style="list-style-type: none"> • to find the diet of the lizard • to find out what the lizard eats <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • to catch the lizard • to catch animals for the lizard to eat • they can collect what the lizard eats • so the insects can drop their droppings in a container for the scientists
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Question	Score	Response: answers/examples/information
ENERGY TRANSFER		
Q22	1	<p>Indicates the marble falling (with kinetic energy) due to gravity (gravitational potential energy) is the energy source.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • gravity • the marble falling (or kinetic energy) • stored energy (potential energy) from the marble <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • the marble

Q23	1	<p>Explains that the energy is transferred through the movement of the ruler. (Answer must have a reference that indicates that the ruler moves.)</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> the energy goes through the ruler <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> the ruler
Q24	1	<p>Provides one example of loss of energy as sound.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> when the marble hits the ruler when the ruler hits the table when the plastic cube hits a surface when the glue stick rolls away <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> when the marble hits the cup

Question	Score	Response: answers/examples/information
FOOD WEB OF NATIVE ANIMALS		
Q25	1	<input checked="" type="checkbox"/> cockatoo <input checked="" type="checkbox"/> galah <input type="checkbox"/> kookaburra <input checked="" type="checkbox"/> rosella
Q26	1	<input checked="" type="checkbox"/> cockatoo <input checked="" type="checkbox"/> galah <input type="checkbox"/> kookaburra <input checked="" type="checkbox"/> lizard

Q27	1	<p>Must state effect and why (answer should note the secondary effect).</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • the kookaburra eats poisoned snails and/or lizards and can die (bio-amplification) • the kookaburra will starve because its sources of food –snails, lizard –have died • if the snail ate the poison and then the kookaburra ate the snail (explanation shows clear intent) • the kookaburra might be tricked into thinking the poison is food and die from eating it <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • if the kookaburra eats the poison • the kookaburra could die/become sick/starve
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Q28	1	<p>Examples of correct answers (score 1):</p> <p>Food source:</p> <ul style="list-style-type: none"> • to conserve native plants to ensure a food supply when they returned to the campsite • to encourage the birds that eat seed grasses to move back into the area in their absence • ‘good animals will eat the grasses which means it is good for animal populations’ <p>Landscape:</p> <ul style="list-style-type: none"> • bring birds/animals back • to cover where they had been camping • ‘more plants would grow and it would look better in the area they planted seeds’ <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • ‘animals might go live there’ • some plants require fire to regenerate/reproduce <i>(inadequate response as already stated in stimulus)</i>
-----	---	---

Question	Score	Response: answers/examples/information
MISSION TO MARS		
Q29	1	Multiple-choice response B: carbon dioxide.
Q30	1	Multiple-choice response B: jump higher
Q31	1	Multiple-choice response A: Orbital period of Mars: twice as long/Rotational period of Mars: similar

Q32	1	<p>Must give one consequence of the fact that the time of the journey will be increased.</p> <p><i>Note: It is not sufficient to state the journey will take longer (distance or time)</i></p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • more fuel • more food • more money • more oxygen/air • air will be needed • determine when they decide to leave <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • you will have to travel further • time is increased
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Question	Score	Response: answers/examples/information
MUSICAL INSTRUMENTS		
Q33	1	<p>Lists two of the four possible correct answers.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • thickness [string thickness] • length [string length] • tension [tension of the string, string tension] • strings are made of different materials
Q34	1	<p>Multiple-choice response C: The shorter the string, the higher the pitch of the sound.</p>

Q35	1	<p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • as the drum skin is loosened, it vibrates more slowly producing a lower pitch • as the drum skin is tightened, it vibrates more quickly producing a higher pitch <p>Any combination of 2 as long as it mentions whether it correctly lowers or increases the pitch e.g. loosened, therefore lower pitch; vibrates more slowly, therefore lower pitch.</p> <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • as the knobs are turned the pitch changes
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Question	Score	Response: answers/examples/information
STATES OF MATTER		
Q36	1	Multiple-choice response C: gas 1 had equal mass to gas 2.
Q37	1	<p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • 3 • three

MARKING GUIDE

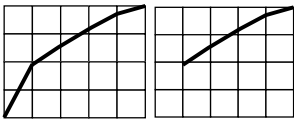
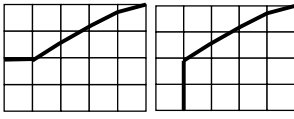
PART B (PRACTICAL TASK)

In the practical task, only the questions in Task B are marked.

Responses which are ‘other’ than those indicated in the examples/information are given ‘0’.

Question	Score	Response: answers/examples/information
GRAVITY EFFECTS – Experiment 1: Checking the effect of changing the mass of the bob		
Q1	1	<p>Provides a response consistent with the result recorded in Table 1 for trial 3, two-clip bobs only. Provides ONE result only. No units are required.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • 10 • 10 swings <p><i>(answer must be consistent with results recorded)</i></p> <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • our results are 10, 9 & 8 • they are all the same • 8 and 9 <i>(one incorrect answer combined with the correct answer)</i>
Q2	1	<p>Provides a response consistent with any of the results recorded in Table 1.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • the one-clip bob swung 8, 9, and 10 and the two-clip bob swung 10, 10 and 10 • <i>(answer must be consistent with results recorded)</i> <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • the bob kept hitting the table

Q3	1	<p>Indicates that an average takes into account variation in individual results.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • more exact, accurate, conclusive, reliable, consistent, precise • one trial might be incorrect • not all the trials could give the correct results • to check any mistakes • because one of the trials could be a fluke • do 3 trials so you have more results to compare <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • because it's more exciting • it's better • it can definitely change • because if you do 3 trials you get more of a score • it gives an overall score instead of just 1 score (repeating the question) • it tells you more information
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Question	Score	Response: answers/examples/information
GRAVITY EFFECTS – Experiment 2: Checking the effect of changing the length of the string		
Q4	1	Provides a response consistent with the results recorded in Table 2.
Q5	1	<p>Indicates need for fair comparison.</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> wouldn't be right wouldn't be correct with different bob-clips wouldn't know if it was the length of string or the mass the different results would be due only to the difference in the length of string then they are measuring the string and not the mass the weight of the two strings would be the same and the weight would therefore not matter <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> better results we were told to so we get an accurate reading every time because we already found out the different weights don't change the number of swings
Q6	1	Multiple-choice response A: the number of swings.
Q7	1	<p>Draws a line graph. Draws the line from the origin OR from the first pair of values. All five points must be correct (or nearly correct).</p> <p>Examples of correct answers (score 1):</p>  <p>Examples of incorrect answers (score 0):</p>  <ul style="list-style-type: none"> draws a bar (column) graph

Q8	1	<p>Indicates that the average swing time increases (by different amounts).</p> <p>Examples of correct answers (score 1):</p> <ul style="list-style-type: none"> • shorter string = faster swing • longer string = slower swing • average time increases with longer string • average time decreases with shorter string • the longer the string the more time it takes • the shorter the string the more swings <p>Examples of incorrect answers (score 0):</p> <ul style="list-style-type: none"> • The longer the string the more swings
Q9	1	Multiple-choice response B: Venus

Chapter 6

Student Standard and Performance Profile

Standard for Year 6 science 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 the expert group used their classroom experience and knowledge of the science curriculum in the various jurisdictions to examine the test items from the 2003 National Science 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 assessment.

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 Proficiency Levels can be found in Appendix A, Table A.1. The Proficient standard was found to be equivalent to Level 3.2; that is, students achieving at Level 3.2 or better 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 scale scores on the National Assessment Program – Science Literacy. In the latter, the students' raw scores on the scientific literacy scale were transformed into a scale with a mean of 400 and a standard deviation of 100.

This transformation was applied to assist in the interpretation of the raw scores and the assignment of Proficiency Levels. Therefore 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 attempted only the objective assessment, Table 6.1 provides the information needed to convert their scores to the national scale.

If your students 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	n.a	Level 2	<p>Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge.</p> <p>Identifies simple patterns in the data and/or interprets a data set containing some interrelated elements.</p> <p>Makes measurements or comparisons involving information or stimulus in a familiar context.</p>
1	n.a		
2	29		
3	72		
4	106		
5	135		
6	160		
7	183		
8	205		
9	225		
10	244		
11	262	Level 3.1	<p>Selects appropriate reason to explain reported observation related to personal experience.</p> <p>Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.</p>
12	279		
13	296		
14	313		
15	329		
16	345		
17	360		
18	376		
19	391	Level 3.2	<p>Interprets information in a contextualised report by application of relevant science knowledge.</p> <p>Interprets data and identifies patterns in – and/or relationships between – elements of the data.</p> <p>Collates and compares data set of collected information. Gives reason for controlling a single variable.</p>
20	406		
21	421		
22	437		
23	453		
24	468		
25	485		
26	502		
27	519	Level 3.3	<p>Applies knowledge of relationship to explain a reported phenomenon.</p> <p>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.</p>
28	537		
29	557		
30	577		
31	600		
32	625		
33	653	Level 4	<p>Explains interactions that have been observed in terms of an abstract science concept.</p> <p>Conclusion summarises and explains the patterns in the data in the form of a rule and is consistent with the data.</p> <p>When provided with an experimental design involving multiple variables, can identify the questions being investigated.</p>
34	687		
35	729		
36	790		
37	913		

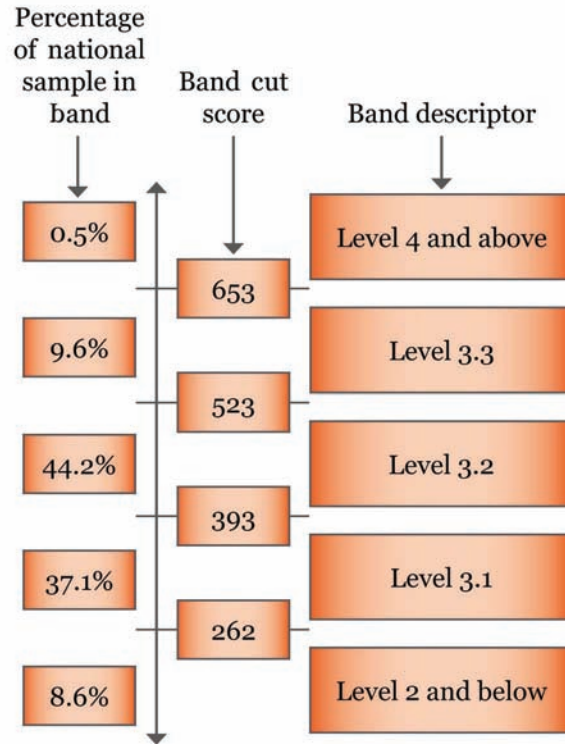
Table 6.2 Conversion of raw scores to scaled scores and level attained: **Objective Assessment and Practical Task**

Student raw score	Equivalent sample scaled score	Level attained	Level descriptors
0	n.a	Level 2	<p>Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge.</p> <p>Identifies simple patterns in the data and/or interprets a data set containing some interrelated elements.</p> <p>Makes measurements or comparisons involving information or stimulus in a familiar context.</p>
1	n.a		
2	14		
3	55		
4	88		
5	115		
6	138		
7	160		
8	179		
9	197		
10	214		
11	230		
12	245		
13	259		
14	274	Level 3.1	<p>Selects appropriate reason to explain reported observation related to personal experience.</p> <p>Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.</p>
15	287		
16	300		
17	313		
18	326		
19	339		
20	351		
21	363		
22	375		
23	388		
24	400	Level 3.2	<p>Interprets information in a contextualised report by application of relevant science knowledge.</p> <p>Interprets data and identifies patterns in – and/or relationships between – elements of the data.</p> <p>Collates and compares data set of collected information. Gives reason for controlling a single variable.</p>
25	412		
26	424		
27	436		
28	449		
29	461		
30	474		
31	487		
32	501		
33	515		
34	529	Level 3.3	<p>Applies knowledge of relationship to explain a reported phenomenon.</p> <p>Extrapolates from an observed pattern to describe an expected outcome or event.</p> <p>Demonstrates an awareness of the principles of conducting an experiment and controlling variables.</p>
35	544		
36	560		
37	577		
38	594		
39	614		
40	635		
41	658	Level 4	<p>Explains interactions that have been observed in terms of an abstract science concept.</p> <p>Conclusion summarises and explains the patterns in the data in the form of a rule and is consistent with the data.</p> <p>When provided with an experimental design involving multiple variables, can identify the questions being investigated.</p>
42	685		
43	718		
44	759		
45	819		
46	940		

Distribution of Year 6 student performance

Figure 6.1 below shows the distribution of students who achieved each Proficiency Level in the National Assessment Program – Science Literacy. The information draws on the distribution of students’ performances across Proficiency Levels as presented in Chapter 4 of the 2006 Public Report.

Figure 6.1 Percentages of students from the 2006 National Science Assessment sample 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
- record the number of students who score each category of the item for use in the analysis in Table 7.2.

Table 7.1 Year 6 Class record sheet

Year 6 Class record sheet		Question	Total	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	score	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
No	Name																											
1																												
2																												
3																												
4																												
5																												
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24																												
25																												
26																												
27																												
28																												
No. scoring zero																												
No. scoring 1 mark																												

Year 6 Class record sheet

No	Name	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	
		Possible score	1 mark																									
1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2																												
3																												
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25																												
26																												
27																												
28																												
		No. scoring zero																										
		No. scoring 1 mark																										

Item analysis sheet

The item analysis sheet (Table 7.2) provides 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:

$$\frac{\text{number of students scoring full marks or 1}}{\text{number of students assessed}} \times \frac{100}{1}$$

The percentage can be compared with the results reported in the National Assessment Program – Science Literacy 2006 Public Report, which are shown in the column headed ‘National test %’. 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

Number of students assessed				
Item Number	Proficiency Level	Number of students	(%) of students	National test %
1	2			87
2	3.2			53
3	3.2			61
4	3.1			69
5	3.3			27
6	2			90
7	3.1			82
8	3.3			28
9	3.1			69
10	3.1			84
11	3.3			33
12	3.1			84
13	3.2			47
14	3.3			36
15	3.2			46
16	3.1			80
17	3.2			48
18	3.1			82
19	3.2			60
20	3.2			52
21	4			13
22	3.3			28
23	3.2			41
24	3.3			35
25	3.2			48
26	4			14
27	3.2			60
28	3.3			19
29	3.1			84
30	3.1			69
31	3.3			37
32	3.3			19
33	3.3			37
34	3.2			60
35	3.3			31
36	2			90
37	3.2			64
Prac 1	3.1			67
Prac 2	3.2			60
Prac 3	3.2			39
Prac 4	3.1			68
Prac 5	3.3			21
Prac 6	3.1			72
Prac 7	3.3			38
Prac 8	4			13
Prac 9	3.2			61

Class analysis sheet

The class analysis sheet (Table 7.3 or 7.4) is designed to assist you in drawing a graph of class or school performance that enables comparisons to be made between your 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. A line can then be drawn by joining the midpoints of the maximum cell for each score to form the frequency polygram.

National test mean and distribution

The shaded vertical column at the scaled score of 400 represents the best estimate of the mean for the national test.

The shaded bars entitled 'National distribution' indicate the proportions of students falling within the lower 25th per cent, the middle 50th per cent and top 25th per cent in the October 2006 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 3 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 7.3 Class analysis sheet for students who attempted the **Objective Assessment only**

		sample mean																								Maximum score 37												
		24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1													
Scaled Score	n.a	n.a	29	72	106	135	160	183	205	225	244	262	279	296	313	329	345	360	376	391	406	421	437	453	468	485	502	519	537	557	577	600	625	653	687	729	790	913
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
Level Distribution	Level 2 or below										At Level 3 (3.2)										Level 4 or above																	
National Distribution	25% of National Sample										50% of National Sample										25% of National Sample																	

Table 7.4 Class analysis sheet for students who attempted both the **Objective Assessment and the Practical Task**

Number of students achieving score	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1																							
Sample mean																																															
Scaled Score	n.a	14	55	88	115	138	160	179	197	214	230	245	259	274	287	300	313	326	339	351	363	375	388	400	412	424	436	449	461	474	487	501	515	529	544	560	577	594	614	635	658	685	718	759	819	940	
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	41	42	43	44	45	46
Level Distribution	Level 2 or below												At Level 3 (3.2)							Level 4				Consolidated Level 3 (3.3)				Level 4																			
National Distribution	25% of National Sample												50% of National Sample							Beginning Level 3 (3.1)				25% of National Sample				25% of National Sample																			

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Page	Question	Text/Graphic	Copyright
6	Item stimulus	Table: Body temperatures of animals	Adapted with permission from Heinemann Interactive Science
10	Item stimulus	Plate tectonic map Earthquake locations map	© Commonwealth of Australia 2005, US Geological Survey
12	18	Graph: Frequency of cyclones off NW Australia	© Commonwealth of Australia 2005, Bureau of Meteorology
13	Item stimulus	Image of a striped legless lizard	© Nick Cleman
23	35	Image of a drum	© Corbis/RPL

Page references refer to the Science Literacy School Release materials.

Appendix A

National Assessment Program

– Science Literacy, Year 6, 2006:

Level Descriptors

Sample items and Proficiency Levels

As shown in Table 7.2, 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 A.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 sheet in Table 7.2, it may be expected that the percentage correct for the items increases as the Proficiency Level decreases.

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

Proficiency Level	Level descriptors
Level 2 or below	<p>Describes a choice for a situation based on first-hand concrete experience, requiring the application of limited knowledge.</p> <p>Identifies simple patterns in the data and/or interprets a data set containing some interrelated elements.</p> <p>Makes measurements or comparisons involving information or stimulus in a familiar context.</p>
Level 3.1 (Beginning level 3)	<p>Selects appropriate reason to explain reported observation related to personal experience.</p> <p>Interprets simple data set requiring an element of comparison. Makes simple standard measurements and records data as descriptions.</p>
Level 3.2	<p>Interprets information in a contextualised report by application of relevant science knowledge.</p> <p>Interprets data and identifies patterns in – and/or relationships between – elements of the data.</p> <p>Collates and compares data set of collected information. Gives reason for controlling a single variable.</p>
Level 3.3 (Consolidating level 3)	<p>Applies knowledge of relationship to explain a reported phenomenon.</p> <p>Extrapolates from an observed pattern to describe an expected outcome or event.</p> <p>Demonstrates an awareness of the principles of conducting an experiment and controlling variables.</p>
Level 4 and above	<p>Explains interactions that have been observed in terms of an abstract science concept.</p> <p>Conclusion summarises and explains the patterns in the data in the form of a rule and is consistent with the data.</p> <p>When provided with an experimental design involving multiple variables, can identify the questions being investigated.</p>

In terms of the Proficiency Levels described in Table A.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.

Appendix B

National Assessment Program

– Science Literacy, Year 6, 2006:

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–PISA 1999), include:

- demonstrating understanding of scientific concepts
- recognising scientifically investigable questions
- identifying evidence needed in a scientific investigation
- drawing or evaluating conclusions
- 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 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 Science Assessment, 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.

The process strands (Strands A and B) are based on the Western Australian and Victorian assessment profiles, as these most clearly describe these learning outcomes.

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 standards serve to further elaborate the progress map. Level 3 is now 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 B.1 Scientific Literacy Progress Map – July 2004 version from DEST Science Education Assessment Resource (SEAR) project

Level	SOLO taxonomy	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	Abstract relational	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: Abstract relational
5	Abstract multi-structural	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: Abstract multistructural
4	Abstract unistructural	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: Abstract unistructural

3	Concrete relational	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: Concrete relational
2	Concrete multi-structural	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: Concrete multistructural
1	Concrete unistructural	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: Concrete unistructural

Illustrative examples:

- For the definition of the strands, an additional description has been included to highlight the fact that Strands A and B are process strands, and Strand C is a conceptual strand.
- The inclusion of a summary phrase indicative of the SOLO classifications explicitly highlights this underlying development progression within the cells of Strand C.
- For Strand A, Level 4, the description has been expanded to include 'Collects and records data involving two or more variables', which is a logical extension of the Level 3 description 'Makes simple standard measurements'.
- For Strand C, Level 3, the aspect of 'cause and effect' has been explicitly included as being typical of the types of relationships likely to be recognised or familiar to students.

Appendix C

National Assessment Program – Science Literacy, Year 6, 2006: 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 will not be feasible to include all the listed concepts in instruments constructed for a specific testing cycle.

Table C.1 Major scientific concepts in the National Assessment Program – Science Literacy 2006

Major scientific concepts	Examples
<p>Earth and Beyond 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. The changing Earth: The Earth is composed of materials that are altered by forces within and upon its surface. Our place in space: The Earth and life on Earth are part of an immense system called the universe.</p>	<p>Features of weather, soil and sky and effects on me. 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. People use resources from the Earth; need to use them wisely. Rotation of the Earth and night/day, spatial relationships between Sun, Earth and Moon. Planets of our solar system and their characteristics.</p>
<p>Energy and Change Energy and us: Energy is vital to our existence and our quality of life as individuals and as a society. Transferring energy: Interaction and change involve energy transfers; control of energy transfer enables particular changes to be achieved. 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.</p>	<p>Uses of energy, patterns of energy use and variations with time of day and season. Sources, transfers, carriers and receivers of energy, energy and change. Types of energy, energy of motion – toys and other simple machines – light, sound. Forces as pushes and pulls, magnetic attraction and repulsion.</p>
<p>Life and Living Living together: Organisms in a particular environment are interdependent. Structure and function: Living things can be understood in terms of functional units and systems. Biodiversity, change and continuity: Life on Earth has a history of change and disruption, yet continues generation to generation.</p>	<p>Living vs non-living. Plant vs animal and major groups. Major structures and systems and their functions. Dependence on the environment: Survival needs – food, space and shelter. Change over lifetime, reproductions and lifecycles. Interactions between organisms and interdependence, e.g. simple food chains. Adaptation to physical environment.</p>
<p>Natural and Processed Materials Materials and their uses: The properties of materials determine their uses; properties can be modified. Structure and properties: The substructure of materials determines their behaviour and properties. Reactions and change: Patterns of interaction of materials enable us to understand and control those interactions.</p>	<p>Materials have different properties and uses. The properties of materials can be explained in terms of their visible substructure, such as fibres. Materials can change their state and properties. Solids, liquids and gases.</p>



