PrimaryConnections®
Linking science with literacy

Fully aligned with the Australian Curriculum

The PrimaryConnections program is supported by astronomer, Professor Brian Schmidt, Nobel Laureate

Package it better

Year 4

Chemical sciences

Primary**Connections project**

Professional learning program

Primary**Connections** comprises a professional learning program supported with exemplary curriculum resources to enhance teaching and learning in science and literacy. Research shows that this combination is more effective than using each in isolation.

Professional Learning Facilitators are available throughout Australia to conduct workshops on the underpinning principles of the program: the Primary**Connections** 5Es teaching and learning model, linking science with literacy, investigating, embedded assessment and collaborative learning.

The Primary**Connections** website has contact details for state and territory Professional Learning Coordinators, as well as additional resources for this unit. Visit the website at:
www.primaryconnections.org.au

PrimaryConnections®
Linking science with literacy

Fully aligned with the Australian Curriculum

Package it better

Year 4

Chemical sciences



Packaging has become a huge industry in the modern world. Everything from food to furniture can come in a package which might be made from materials such as metal foil or plastic film—materials that didn't exist even a few decades ago. Packages need to protect and preserve contents while being economical, attractive for marketing purposes and preferably having minimal environmental impact. Little wonder that they are often the product of imaginative design and rigorous testing.

The *Package it better* unit links science and technology with literacy in the classroom. It provides opportunities for students to develop an understanding of the design of packages and the choice of appropriate materials to use. Students design and test a package that will safely deliver a fragile gift. Through investigations students observe and gather information about what makes a successful package.

Australian Academy of Science

Published by the Australian Academy of Science.

GPO Box 783
Canberra ACT 2601
Telephone: (02) 9386 4544
Fax: (02) 9387 7755
Email: pc@science.org.au
www.primaryconnections.org.au

Typesetter: Sharyn Raggett
Font: Helvetica Neue, DIN
Print house: Daniels Printing Craftsmen
Cover images: Stock.xchng. www.sxc.hu

ISBN 978 0 85847 314 0

Acknowledgments

The Primary**Connections** – Linking Science with Literacy project is supported by the Australian Government.

Thanks to the trial teachers and students of the trial schools Australia-wide and Fellows of the Australian Academy of Science who contributed to this unit.

Contents

Foreword

The Australian Academy of Science is proud of its long tradition of supporting and informing science education in Australia. '*Primary**Connections:** linking science with literacy*' is its flagship primary school science program, and it is making a real difference to the teaching and learning of science in Australian schools.

The Primary**Connections** approach has been embraced by schools since its inception in 2004, and there is substantial evidence of its effectiveness in helping teachers transform their practice. It builds teacher confidence and competence in this important area, and helps teachers use their professional skills to incorporate elements of the approach into other areas of the curriculum. Beginning and pre-service teachers find the approach do-able and sustainable. Primary**Connections** students enjoy science more than in comparison classes, and Indigenous students, in particular, show significant increases in learning using the approach.

The project has several components: professional learning, curriculum resources, research and evaluation, and Indigenous perspectives. With the development of an Australian curriculum in the sciences by ACARA in December 2010, it is an exciting time for schools to engage with science, and to raise the profile of primary science education.

Students are naturally curious. Primary**Connections** provides an inquiry-based approach that helps students develop deep learning, and guides them to find scientific ways to answer their questions. The lessons include key science background information, and further science information is included on the Primary**Connections** website (www.primaryconnections.org.au).

Science education provides a foundation for a scientifically literate society, which is so important for engagement in key community debates, such as climate change, carbon emissions, and immunisation, as well as for personal decisions about health and well-being. The inquiry approach in Primary**Connections** prepares students well to participate in evidence-based discussions of these and other issues.

Primary**Connections** has been developed with the financial support of the Australian Government and has been endorsed by education authorities across the country. The Steering Committee, comprising the Department of Education, Employment and Workplace Relations and Academy representatives, and the Reference Group, which includes representatives from all stakeholder bodies including states and territories, have provided invaluable guidance and support. Before publication, the teacher background information on science is reviewed by a Fellow of the Academy. All these inputs have ensured an award-winning, quality program.

The Fellows of the Academy are committed to ongoing support for teachers of science at all levels. I commend Primary**Connections** to you and wish you well in your teaching.

Professor Suzanne Cory, AC PresAA FRS

President (2010–2013)

Australian Academy of Science

The Primary**Connections program**

Primary**Connections** is an innovative program that links the teaching of science and literacy in the primary years of schooling. It is an exciting and rewarding approach for teachers and students, with a professional learning program and supporting curriculum resources. Further information about professional learning and other curriculum support can be found on the Primary**Connections** website: (www.primaryconnections.org.au)

The Primary**Connections teaching and learning model**

This unit is one of a series designed to exemplify the Primary**Connections** teaching and learning approach, which embeds inquiry-based learning into a modified 5Es instructional model with the five phases: *Engage, Explore, Explain, Elaborate* and *Evaluate* (Bybee, 1997). The relationship between the 5Es phases, investigations, literacy products and assessment is illustrated below:

Primary**Connections 5Es teaching and learning model**

Phase	Focus	Assessment focus
ENGAGE	Engage students and elicit prior knowledge	**Diagnostic assessment**
EXPLORE	Provide hands-on experience of the phenomenon	**Formative assessment**
EXPLAIN	Develop scientific explanations for observations and represent developing conceptual understanding Consider current scientific explanations	**Formative assessment**
ELABORATE	Extend understanding to a new context or make connections to additional concepts through a student-planned investigation	**Summative assessment** of the Science Inquiry Skills
EVALUATE	Students re-represent their understanding and reflect on their learning journey, and teachers collect evidence about the achievement of outcomes	**Summative assessment** of the Science Understanding

More information on Primary**Connections** 5Es teaching and learning model can be found at: www.primaryconnections.org.au

Developing students' scientific literacy

The learning outcomes in Primary**Connections** contribute to developing students' scientific literacy. Scientific literacy is considered the main purpose of school science education and has been described as an individual's:

- scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues
- understanding of the characteristic features of science as a form of human knowledge and enquiry
- awareness of how science and technology shape our material, intellectual and cultural environments
- willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen (Programme for International Student Assessment & Organisation for Economic Co-operation and Development [PISA & OECD], 2009).

Linking science with literacy

PrimaryConnections has an explicit focus on developing students' knowledge, skills, understanding and capacities in science and literacy. Units employ a range of strategies to encourage students to think about and to represent science.

PrimaryConnections develops the literacies of science that students need to learn and to represent their understanding of science concepts, processes and skills. Representations in PrimaryConnections are multi-modal and include text, tables, graphs, models, drawings and embodied forms, such as gesture and role-play. Students use their everyday literacies to learn the new literacies of science. Science provides authentic contexts and meaningful purposes for literacy learning, and also provides opportunities to develop a wider range of literacies. Teaching science with literacy improves learning outcomes in both areas.

Assessment

Assessment against the year level Achievement standards of the Australian Curriculum: Science (ACARA, 2012) is ongoing and embedded in PrimaryConnections units. Assessment is linked to the development of literacy practices and products. Relevant understandings and skills for each lesson are highlighted at the beginning of each lesson. Different types of assessment are emphasised in different phases:

Diagnostic assessment occurs in the *Engage* phase. This assessment is to elicit students' prior knowledge so that the teacher can take account of this when planning how the *Explore* and *Explain* lessons will be implemented.

Formative assessment occurs in the *Explore and Explain* phases. This enables the teacher to monitor students' developing understanding and provide feedback that can extend and deepen students' learning.

Summative assessment of the students' achievement developed throughout the unit occurs in the *Elaborate* phase of the Science Inquiry Skills and in the *Evaluate* phase for the Science Understanding.

Alignment with the Australian Curriculum: Science

The Australian Curriculum: Science has three interrelated strands—Science Understanding, Science as a Human Endeavour and Science Inquiry Skills—that together 'provide students with understanding, knowledge and skills through which they can develop a scientific view of the world' (ACARA, 2012).

The content of these strands is described by the Australian Curriculum as:

Science Understanding	
Biological sciences	Understanding living things
Chemical sciences	Understanding the composition and behaviour of substances
Earth and space sciences	Understanding Earth's dynamic structure and its place in the cosmos
Physical sciences	Understanding the nature of forces and motion, and matter and energy
Science as a Human Endeavour	
Nature and development of science	An appreciation of the unique nature of science and scientific knowledge
Use and influence of science	How science knowledge and applications affect people's lives and how science is influenced by society and can be used to inform decisions and actions
Science Inquiry Skills	
Questioning and predicting	Identifying and constructing questions, proposing hypotheses and suggesting possible outcomes
Planning and conducting	Making decisions regarding how to investigate or solve a problem and carrying out an investigation, including the collection of data
Processing and analysing data and information	Representing data in meaningful and useful ways, identifying trends, patterns and relationships in data, and using evidence to justify conclusions
Evaluating	Considering the quality of available evidence and the merit or significance of a claim, proposition or conclusion with reference to that evidence
Communicating	Conveying information or ideas to others through appropriate representations, text types and modes

AC All the material in this table is sourced from the Australian Curriculum.

There will be a minimum of four Primary**Connections** units for each year of primary school from Foundation to Year 6—at least one for each Science Understanding sub-strand of the Australian Curriculum. Each unit contains detailed information about its alignment with all aspects of the Australian Curriculum: Science and its links to the Australian Curriculum: English and Mathematics.

Safety

Learning to use materials and equipment safely is central to working scientifically. It is important, however, for teachers to review each lesson before teaching to identify and manage safety issues specific to a group of students. A safety icon ⚠ SAFETY is included in lessons where there is a need to pay particular attention to potential safety hazards. The following guidelines will help minimise risks:

- Be aware of the school's policy on safety in the classroom and for excursions.
- Check students' health records for allergies or other health issues.
- Be aware of potential dangers by trying out activities before students do them.
- Caution students about potential dangers before they begin an activity.
- Clean up spills immediately as slippery floors are dangerous.
- Instruct students never to taste, smell or eat anything unless they are given permission.
- Discuss and display a list of safe practices for science activities.

References

Australian Curriculum Assessment and Reporting Authority (ACARA). (2014). *Australian Curriculum: Science*. www.australiancurriculum.edu.au

Bybee, R.W. (1997). *Achieving scientific literacy: from purposes to practical action*. Portsmouth, NH: Heinemann.

Programme for International Student Assessment & Organisation for Economic Co-operation and Development. (2009). *PISA 2009 assessment framework: key competencies in reading, mathematics and science*. Paris: OECD Publishing.

Unit at a glance

Package it better

Phase	Lesson	At a glance
ENGAGE	**Lesson 1** Packaging pandemonium	To capture students' interest and find out what they think they know about how natural and processed materials have a range of physical properties and that these properties can influence their use To elicit students' questions about packages, the materials used to make them and the design process
EXPLORE	**Lesson 2** Peering at packages	To provide students with hands-on, shared experiences of the characteristics of a range of packages
	Lesson 3 Plenty of properties	To provide students with hands-on, shared experiences of the properties of packaging materials
	Lesson 4 Lumps, bumps and crumbs	To support students to plan and conduct an investigation of the capacity of different materials to protect a biscuit from impact
	Lesson 5 Strong shapes	To provide students with hands-on, shared experiences of how shape contributes to design strength
EXPLAIN	**Lesson 6** Daring designs ***Session 1*** Guest speaker ***Session 2*** Package plan ***Session 3*** Prototype production	To support students to represent and explain their understanding of appropriate materials to meet design criteria, and to introduce current scientific views To provide opportunities for students to develop plans and make their package
ELABORATE	**Lesson 7** Package performance ***Session 1*** Product evaluation ***Session 2*** Product review	To support students to plan and conduct an investigation of the effectiveness of their prototype package and revise their package based on findings
EVALUATE	**Lesson 8** All wrapped up	To provide opportunities for students to represent what they know about how natural and processed materials have a range of physical properties and that these properties can influence their use, and to reflect on their learning during the unit

A unit overview can be found in Appendix 6, page 70.

Alignment with the Australian Curriculum: Science

This *Package it better* unit embeds all three strands of the Australian Curriculum: Science. The table below lists sub-strands and their content for Year 4. This unit is designed to be taught in conjunction with other Year 4 units to cover the full range of the Australian Curriculum: Science content for Year 4.

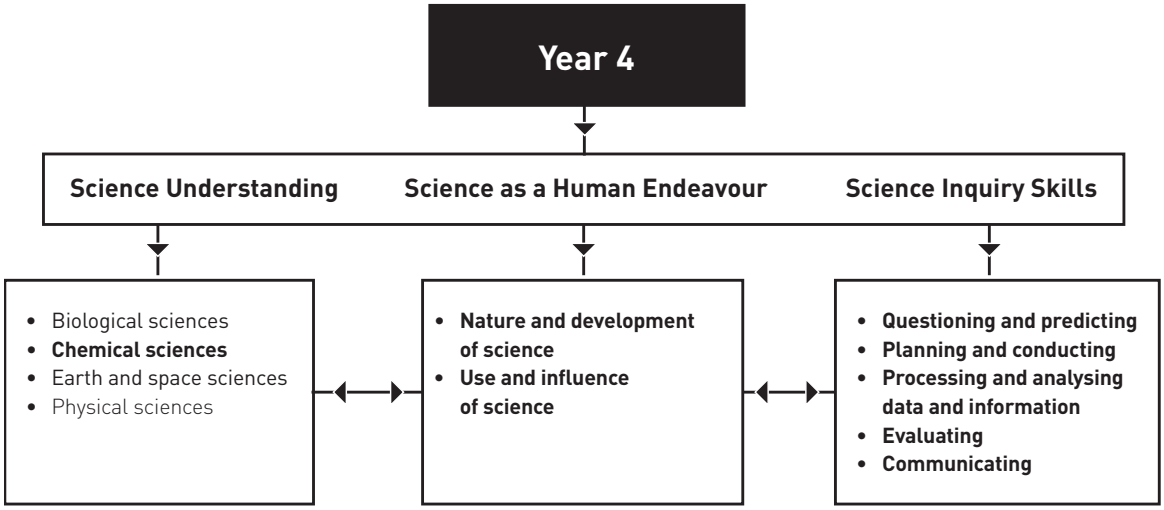
For ease of assessment the table below outlines the sub-strands and their aligned lessons.

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Science Understanding (SU)	**Chemical sciences**	ACSSU074	Natural and processed materials have a range of physical properties; These properties can influence their use	1–8
Science as a Human Endeavour (SHE)	**Nature and development of science**	ACSHE061	Science involves making predictions and describing patterns and relationships	1-8
	Use and influence of science	ACSHE062	Science knowledge helps people to understand the effect of their actions	1–8
Science Inquiry Skills (SIS)	**Questioning and predicting**	ACSIS064	With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge	3, 4, 5, 7
	Planning and conducting	ACSIS065	Suggest ways to plan and conduct investigations to find answers to questions	4, 5, 7
		ACSIS066	Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate	3, 4, 5, 7
	Processing and analysing data and information	ACSIS068	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends	4, 6
		ACSIS216	Compare results with predictions, suggesting possible reasons for findings	4, 5
	Evaluating	ACSIS069	Reflect on the investigation; including whether a test was fair or not	4, 5
	Communicating	ACSIS071	Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports	1, 6, 8

AC All the material in the first four columns of this table is sourced from the Australian Curriculum.

Interrelationship of the science strands

The interrelationship between the three strands—Science Understanding, Science as a Human Endeavour and Science Inquiry Skills—and their sub-strands is shown below. Sub-strands covered in this unit are in bold.



AC All the terms in this diagram are sourced from the Australian Curriculum.

Relationship to overarching ideas

In the Australian Curriculum: Science, six overarching ideas support the coherence and developmental sequence of science knowledge within and across year levels. In *Package it better* these overarching ideas are represented by:

Overarching idea	Incorporation in *Package it better*
Patterns, order and organisation	Students replicate tests and look for patterns in results to inform their packaging choices.
Form and function	Students investigate the physical properties of materials and their suitability for particular purposes.
Stability and change	Students identify which shapes provide the strongest structure in products.
Scale and measurement	Students use informal units of measurement to qualify the weight to test packaging strength. They use formal units of measurement to ascertain drop distance in an investigation.
Matter and energy	Students identify physical properties used by scientists to identify the suitability of materials for particular purposes.
Systems	Students consider the environmental effects of using recycled materials for packaging.

Curriculum focus

The Australian Curriculum: Science is described by year level, but provides advice across four year groupings on the nature of learners. Each year grouping has a relevant curriculum focus.

Curriculum focus Years 3–6	Incorporation in *Package it better*
Recognising questions that can be investigated scientifically and investigating them	Students identify variables and pose testable questions about the effect of different materials and drop height on the fragile product being packaged.

Achievement standards

The achievement standards of the Australian Curriculum: Science indicate the quality of learning that students typically demonstrate by a particular point in their schooling, for example, at the end of a year level. These standards will be reviewed regularly by ACARA and are available from the ACARA website.

By the end of this unit, teachers will be able to make evidence-based judgments on whether the students are achieving below, at or above the Australian Curriculum: Science Year 4 achievement standard. Rubrics to help teachers make these judgments will be available on the website (www.primaryconnections.org.au).

General capabilities

The skills, behaviours and attributes that students need to succeed in life and work in the 21st century have been identified in the Australian Curriculum as general capabilities. There are seven general capabilities and they are embedded throughout the units. For unit-specific information see the next page. For further information see: www.australiancurriculum.edu.au

For examples of our unit-specific general capabilities information see the next page.

Package it better—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	*Package it better* examples
Literacy	Literacy knowledge specific to the study of science develops along with scientific understanding and skills. Primary**Connections** learning activities explicitly introduce literacy focuses and provide students with the opportunity to use them as they think about, reason and represent their understanding of science.	In *Package it better* the literacy focuses are: • design portfolios • word walls • summaries • tables • oral presentations • interviews • procedural texts.
 **Numeracy**	Elements of numeracy are particularly evident in Science Inquiry Skills. These include practical measurement and the collection, representation and interpretation of data.	Students: • record results accurately in a table • estimate the weight of materials • measure results in a test.
Information and communication technology (ICT) competence	ICT competence is particularly evident in Science Inquiry Skills. Students use digital technologies to investigate, create, communicate, and share ideas and results.	Students are given optional opportunities to: • explore icons used in computer software and on desktops • use a digital camera to take photos of a guest speaker.
 **Critical and creative thinking**	Students develop critical and creative thinking as they speculate and solve problems through investigations, make evidence-based decisions, and analyse and evaluate information sources to draw conclusions. They develop creative questions and suggest novel solutions.	Students: • brainstorm ideas • pose creative questions • discuss alternative ideas • think about and plan what to do • explore 'what if?' ideas • give reasons for predictions.
Ethical behaviour	Students develop ethical behaviour as they explore principles and guidelines in gathering evidence and consider the implications of their investigations on others and the environment.	Students: • ask questions respecting each other's point of view • critically evaluate each other's products with respect for individuals.
 **Personal and social competence**	Students develop personal and social competence as they learn to work effectively in teams, develop collaborative methods of inquiry, work safely, and use their scientific knowledge to make informed choices.	Students: • participate in discussions • work collaboratively in teams • use equipment safely.
 **Intercultural understanding**	Intercultural understanding is particularly evident in Science as a Human Endeavour. Students learn about the influence of people from a variety of cultures on the development of scientific understanding.	• 'Cultural perspectives' opportunities are highlighted where relevant. • Important contributions made to science by people from a range of cultures are highlighted where relevant.

AC All the material in the first two columns of this table is sourced from the Australian Curriculum.

Cross-curriculum priorities

There are three cross-curriculum priorities identified by the Australian Curriculum:

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability.

For further information see: www.australiancurriculum.edu.au

Aboriginal and Torres Strait Islander histories and cultures

The PrimaryConnections Indigenous perspectives framework supports teachers' implementation of Aboriginal and Torres Strait Islander histories and cultures in science. The framework can be accessed at: www.primaryconnections.org.au

Package it better focuses on the Western science way of making evidence-based claims about how natural and processed materials have a range of physical properties and that these properties can influence their use.

Aboriginal and Torres Strait Islander Peoples might have other explanations for natural materials, their properties and the uses of those materials.

PrimaryConnections recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the PrimaryConnections website.

Sustainability

The *Package it better* unit provides opportunities for students to develop an understanding of how the function of materials is impacted by their properties, and how human innovation has influenced the design of synthetic materials. They reflect on the suitability of packaging materials based on their function, cost, availability, aesthetics and environmental impact. This can assist them to develop knowledge, skills and values for making decisions about individual and community actions that contribute to sustainable patterns of use of the Earth's natural resources.

Alignment with the Australian Curriculum: English and Mathematics

Strand	Sub-strand	Code	Year 4 content description	Lessons
English–Language	**Language for interaction**	ACELA1488	Understand that social interactions influence the way people engage with ideas and respond to others for example when exploring and clarifying the ideas of others, summarising their own views and reporting them to a larger group	2, 5, 6, 7
		ACELA1489	Understand differences between the language of opinion and feeling and the language of factual reporting or recording	1–8
	Text structure and organisation	ACELA1490	Understand how texts vary in complexity and technicality depending on the approach to the topic, the purpose and the intended audience	6
	Expressing and developing ideas	ACELA1498	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	7, 8
English–Literacy	**Interacting with others**	ACELY1688	Use interaction skills such as acknowledging another's point of view and linking students' response to the topic, using familiar and new vocabulary and a range of vocal effects such as tone, pace, pitch and volume to speak clearly and coherently	1–8
		ACELY1689	Plan, rehearse and deliver presentations incorporating learned content and taking into account the particular purposes and audiences	8
	Creating texts	ACELY1695	Reread and edit for meaning by adding, deleting or moving words or word groups to improve content and structure	6, 7
		ACELY1696	Write using clearly-formed joined letters, and develop increased fluency and automaticity	1, 2, 3, 4, 6
Mathematics–Measurement and Geometry	**Using units of measurement**	ACMMG084	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures	4, 5
Mathematics–Statistics and Probability	**Data representation and interpretation**	ACMSP095	Select and trial methods for data collection, including survey questions and recording sheets	8
		ACMSP096	Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values	4

AC All the material in the first four columns of this table is sourced from the Australian Curriculum.

Other links are highlighted at the end of lessons where possible. These links will be revised and updated on the website (www.primaryconnections.org.au).

Teacher background information

Science and technology

Science and technology are linked through human curiosity and the need to gather information to satisfy our needs. To create solutions and to meet needs, humans innovate through the use of investigation and insight. This creative merging of existing knowledge and new knowledge represents the relationship between science and technology.

As a result of this unit students will be better able to:

- understand the nature and consequences of technological change within society and respond appropriately
- participate in the design and development of innovative technological products across a range of present and possible future contexts
- respond appropriately to ethical dilemmas caused by the intended and unintended impacts of technological change on people and the environment.

Introduction to materials and packages

Materials are the substances from which things are made, though often the term is commonly applied to solid substances rather than liquids or gases. Materials are characterised and classified according to their properties. Some of the physical properties used by scientists to describe materials include strength, flexibility, elasticity, malleability, transparency, viscosity, porosity, density, opacity, hardness and brittleness. When we want to make something, we take these properties into account, as well as cost and availability, and select the most suitable material for our purpose.

The properties of different materials arise from the chemical and physical nature of the matter that makes up the material. If the composition of a material is changed, its properties are changed. Consider the differences between copper, brass (made from copper and zinc) and bronze (made from copper and tin). Adding boron to a basic glass mix will produce heat resistant 'Pyrex' glass but adding lead will produce hard 'crystal' glass. The properties of materials can also change by exposure to heat or cold, for example, freezing some materials makes them brittle.

Different materials have different properties and are therefore suitable for different uses. When materials are selected for packaging we need to consider whether or not the materials can be made into a package so that the contents of the package will fit, as well as considering how well the materials will protect the contents of the package.

Students' conceptions

Taking account of students' existing ideas is important in planning effective teaching approaches which help students learn science. Students develop their own ideas during their experiences in everyday life and might hold more than one idea about an event or phenomenon.

To access more in-depth science information in the form of text, diagrams and animations, refer to the Primary**Connections** Science Background Resource which has now been loaded on the Primary**Connections** website (www.primaryconnections.org.au).

Note: This background information is intended for the teacher only.

Lesson 1 Packaging pandemonium

AT A GLANCE

To capture students' interest and find out what they think they know about how natural and processed materials have a range of physical properties and that these properties can influence their use.

To elicit students' questions about packages, the materials used to make them and the design process.

Students:

- respond to the delivery of a battered package
- brainstorm ideas about packages, the materials used to make them, and the design and delivery of packages
- engage with a design brief.

Lesson focus

The focus of the *Engage* phase is to spark students' interest, stimulate their curiosity, raise questions for inquiry and elicit their existing beliefs about the topic. These existing ideas can then be taken account of in future lessons.

Assessment focus

Diagnostic assessment is an important aspect of the *Engage* phase. In this lesson you will elicit what students already know and understand about:

- how physical properties of materials influence their use, the relationship between packages and the properties of their materials and how to communicate their ideas in a design portfolio. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to represent their current understanding as they:

- explain the reasons for failure of a package
- identify packages and the properties of materials used to make them
- identify what they will need to do and find out in order to design an effective package.

Literacy

Students will be able to:

- identify the purpose and features of a design portfolio
- record ideas and questions to investigate
- contribute to the class learning centre to represent their understanding of materials, properties and packages.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

Context

In this unit the class receives a package which has been damaged during its delivery. Students investigate packages and develop designs and procedures for making a package to protect a fragile gift that is to be delivered to a special person. This includes understanding the properties of the materials used for packages and evaluating the design process and their product.

It is important to establish a context for the unit that is relevant to students. For example, the contents of the package might be a gift linking to a major event such as the delivery of ANZAC biscuits on ANZAC day, or the package might hold a gift for a school or other celebration.

Establish which gift is to be used in the unit. For example, decide if all students will send the same type of gift, if the gift will be negotiated with students or if you will decide this for the class context. The gift might need to be non-perishable if you are a long distance from where the package is to be delivered.

Select the destination and method for delivery of the package. For example, the package might be delivered by post, student couriers or a combination of methods. For example, one-third of class packages sent by post, one-third by commercial courier and one-third by student courier so the effects of different methods can be compared.

The design brief

A fragile gift for a special person needs to be delivered safely. Design a package that is:

- of a suitable size to hold the gift
- able to protect the gift
- low cost
- made of environmentally responsible materials
- aesthetically pleasing to the recipient.

Optional: The design brief can be modified to suit your context. For example, you might limit the supply of one type of material.

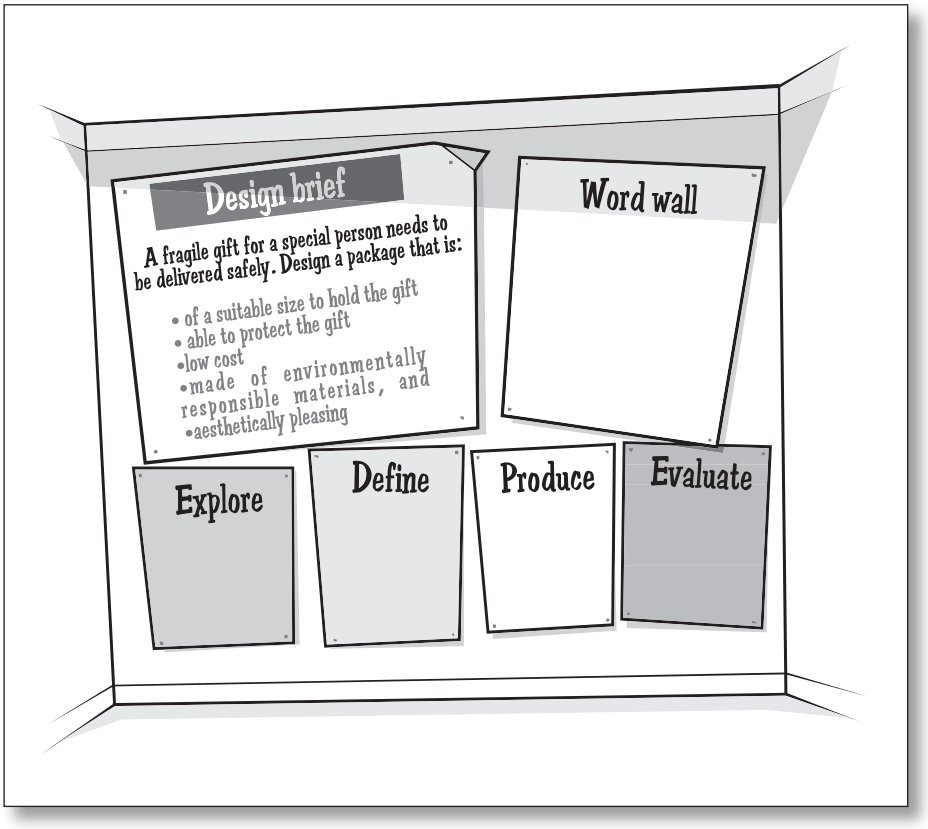
The delivery method will influence the criteria that students establish for making the package. For example, the package might need to be light if it is to be posted, or will need to be waterproof if it might get wet.

Design portfolio

In this unit, a design portfolio is used to record observations, ideas, experiences and reflections. In other Primary**Connections** units a science journal is used. The design portfolio has features which are described in 'How to use a design portfolio' (Appendix 2).

Class learning centre

Student learning is supported in the unit by using a class learning centre. It provides the opportunity for students and teachers to record shared ideas, questions and findings. The class learning centre incorporates the same four sections that are used in the design portfolio (see 'Appendix 2'). The word wall for the unit could also be a part of the class learning centre.



Sample class learning centre

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre (see 'Teacher background information')
- word wall
- 1 enlarged copy of the design brief (see 'Teacher background information')
- battered class package (see 'Preparation')
- 6 large sheets of paper (A2) for learning centre)

FOR EACH STUDENT

- design portfolio

Preparation

- Establish a context for the unit (see 'Teacher background information').
- Prepare the class learning centre (see 'Teacher background information').
- Read 'How to use a design portfolio' (Appendix 2). In *Package it better*, the design portfolio replaces the science journal used in other units.
- Prepare a class design portfolio, for example, large sheets of paper.
- Read 'How to use a word wall' (Appendix 3).
- Prepare an enlarged copy of the design brief.
- Prepare an ineffective, battered package linked to the context of the unit to arrive at the class, for example, a broken ANZAC biscuit, close to ANZAC Day.
- Organise a guest to deliver the battered package to the class (see Lesson step 1). The guest will bring the package to the class and at the same time could set the scene for the unit. For example, someone linked to the defence forces might talk to the class about comfort packages delivered to soldiers.

Lesson steps

1 Introduce the invited guest who delivers the battered package addressed to the class.

2 Draw students' attention to the condition of the package. Ask them to suggest possible reasons for the damage. Discuss how the damage might have affected the contents of the package.

3 Open the package to reveal the broken contents. Brainstorm ideas about the failure of the design and the materials used to make the package and record them in the 'Explore the task' section of the class science portfolio. Ask questions, such as:

- What is the package made of? Are the materials natural or processed? What makes you think that?
- Were the materials used to make the package effective in delivering the contents safely?
- What happened to the contents of the package?

- Why might this have happened?
- Are there other factors that made the package ineffective? (For example, the design or shape of the package.)
- What features would the package have needed to be successful in transporting the contents intact?

Note: In the *Engage* phase, do not provide any formal definitions or correct answers as the purpose is to elicit students' prior knowledge.

4 Discuss the need to design effective packages for the safe delivery of fragile items. Introduce the enlarged copy of the design brief. If appropriate, invite the guest to read and discuss the brief with the students.

5 Introduce the class design portfolio and discuss its purpose and features.

Literacy focus

Why do we use a design portfolio?

We use a **design portfolio** to record what we see, experience and think so we can review it later.

What does a design portfolio include?

A **design portfolio** includes a design brief and information to help with the design process. It might include text, drawings, sketches, labelled diagrams, graphic designs, photographs, tables and graphs.

Discuss with students how they might use each section of the design portfolio: 'Explore the task', 'Define the task', 'Produce solutions', 'Evaluate and reflect' (see 'Appendix 2').

6 Introduce the class learning centre and discuss how it includes the sections in the design portfolio. Explain that the learning centre is where students can record ideas, questions and findings during the unit. Add the design brief to the class learning centre.

7 Write the terms 'material', 'natural', 'processed', 'properties' and 'package' on the class word wall and brainstorm what the terms mean in this context. Discuss the purpose and features of a word wall.

Literacy focus

Why do we use a word wall?

We use a **word wall** to record words we know or learn about a topic. We display the **word wall** in the classroom so that we can look up words we are learning about and see how they are spelled.

What does a word wall include?

A **word wall** includes a topic title or picture and words that we have seen or heard about the topic.

Note: This is an opportunity to assess students' prior knowledge of materials, properties and packages and develop a shared understanding of the terms.

8 Ask students to write the design brief in the 'Define the task' section of their individual design portfolio. Ask them to record what they think they will need to do and find out about. For example, students might need to find out about properties of materials and how they are used to make packages, and the characteristics that make a package effective.

9 Add any ideas and questions to the class learning centre.

Curriculum links

English

- Research the conventions for addressing and sending parcels and accompanying letters.

Health and Physical Education

- Research the codes and guidelines associated with packaging food.

The Arts

- Design and make a card to include with the fragile gift.

Indigenous perspectives

- The craft of making containers from natural materials is practised by some Indigenous people throughout Australia. The materials and purpose of the containers depends on the availability of plants and food within a region. Where plant fibre is plentiful, it is spun, twisted, coiled or knotted to make functional articles needed for daily activities, including containers. For example, in desert areas, animal-based material is used to construct containers and in Tasmania, bull kelp is used to make water containers.
- View a clip of women collecting leaves and seeds in preparation for weaving and dyeing twine for fibre craft. See www.australianscreen.com.au/titles/merrepen/clip2 and www.australianscreen.com.au/titles/merrepen/clip3
- PrimaryConnections recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the PrimaryConnections website (www.primaryconnections.org.au).

Lesson 2 Peering at packages

AT A GLANCE

To provide students with hands-on, shared experiences of the characteristics of a range of packages.

Students:

- work in teams to explore the characteristics and uses of packages
- record observations of packages and the materials used to make them
- share and discuss findings.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of:

- how physical properties of materials influence their use, and the relationship between packages and the properties of their materials. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- identify and describe the characteristics of packages
- describe the purpose, function and use of packages
- identify materials that packages are made of.

Literacy

Students will be able to:

- participate in whole class and small group discussions
- use oral and written language to clarify and represent ideas about designs and materials of packages
- identify the purpose and features of a summary.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

During this lesson, students explore a wide range of packages to identify their characteristics, such as shape, colour, size and what it is made of. Exploring packages and the materials used to make them assists students to develop design criteria.

Materials scientists choose materials because of their suitability for the job. It is important to establish the characteristics of the package in order to be able to select a material with suitable properties for making a deliverable package that will ensure safe arrival of its contents. For example, if the package might get wet it should be made from material that is waterproof. The property 'being waterproof' means that the package will not allow water to penetrate it and subject the contents to moisture. In these lessons students will study the observable properties of materials rather than the particulate nature of materials.

Packages can be made from a variety of materials, such as glass, paper, metal, wood or plastic, or a combination of materials. Scientists are working on developing packaging materials made from protein, starch or sugars that will be compostable, combustible, renewable and carbon dioxide neutral. Researchers are trying to meet consumer demands that packaging protects the package contents, is convenient, respects the environment (both during production and waste management) and is low cost.

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's design portfolio
- 1 blank sheet of A4 paper
- 3 different packages to explore (see 'Preparation')

Preparation

- Read 'How to organise collaborative learning teams (Year 3–Year 6)' (Appendix 1). Display an enlarged copy of the team skills chart and the team roles chart in the classroom. Prepare role wristbands or badges and the equipment table.
- Collect a range of packages of different shapes, sizes, purposes and materials, such as post bags, pizza boxes, plastic bags, tissue boxes, Tetra juice boxes, milk containers, boxes, egg cartons, CD cases, kitchen wrap containers and gift boxes.

Lesson steps

1 Review the previous lesson and, using the class learning centre, invite students to reflect on the design brief.

2 Explain that to assist students with the design task they will be working in collaborative learning teams to explore the characteristics and uses of different packages and the materials used to make them.

If students are using collaborative learning teams for the first time, introduce and explain the team skills chart and the team roles chart. Explain that students will wear wristbands to help them (and you) know which role each team member has.

3 Draw students' attention to the equipment table and discuss its use. Explain that this is where Managers will collect and return equipment.

Choose one package and model how to describe its characteristics. Discuss the characteristics of the package and the materials used to make it. Ask questions, such as:

- What is the package made of? Are the materials natural or processed?
- What shape is the package?
- What is the purpose of the package?
- Why have these shapes and materials been chosen to make the package?

Focus students' attention on how the materials relate to the function and performance of the package. For example, a juice container is made from processed materials which make it attractive to look at and easy to hold: plastic-coated, smooth cardboard and silver foil which lines the package to prevent the juice from seeping out and to protect the contents from being affected by sunlight.

4 Form teams and allocate roles. Ask Managers to collect team equipment.

5 Ask each team member to observe the shapes and materials used to make their package and to record their observations using sketches and text in the 'Explore the task' section of their design portfolio.

6 Ask each team member to discuss and compare their findings within their team.

7 Ask each team to summarise their findings on an A4 sheet of paper. Discuss the purpose and features of a summary.

Literacy focus

Why do we use a summary?

We use a **summary** to present the main points of a topic or text.

What does a summary include?

A **summary** includes a concise description of the main points of a topic or text.

8 Invite each Speaker to share their team's findings with the class. Discuss and record findings in the 'Explore the task' section of the class design portfolio.

9 Ask students to review their design brief and suggest design criteria for their package. For example, if the design brief is to create a package that is environmentally responsible, a design criterion would be that the package is made of recyclable materials; if the package is to be posted it should be light-weight. Record suggestions in the 'Define the task' section of the class design portfolio.

10 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Curriculum links

Technology

- Explore the range of science and technology careers and how people from a range of careers frequently collaborate to produce innovative solutions, such as materials scientists, engineers, product designers and graphic designers.
- Conduct internet research of materials and materials science (www.strangematterexhibit.com).

Indigenous perspectives

- Collect images of baskets or nets that have been made using different materials and techniques by Indigenous people. Discuss the properties that make these natural materials suitable for their uses.

  See: www.nga.gov.au/Exhibition/Tactility/Default.cfm

  www.bulabula-arts.com

  www.textiletravels.com/australia/aboriginal.htm

- PrimaryConnections recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the PrimaryConnections website (www.primaryconnections.org.au).

Lesson 3 Plenty of properties

AT A GLANCE

To provide students with hands-on, shared experiences of the properties of packaging materials.

Students:

- explore the properties of materials that are used to make packages
- discuss the environmental impact of materials that are used to make packages.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of:

- how physical properties of materials influence their use, and the relationship between packages and the properties of their materials. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- conduct simple tests to explore the properties of materials
- identify how the properties of materials affect their use in packages
- discuss the environmental impact of the use of packages and the materials used to make them.

Literacy

Students will be able to:

- participate in whole class and small group discussions to compare the properties of different materials
- use oral and written language to discuss and record test results.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

Properties are the physical characteristics or attributes of a material. These include thermal properties (how well or poorly a material will conduct heat), electrical properties (how well or poorly a material will conduct electricity), chemical properties (how soluble a material is, how easily it will react with other substances) and magnetic properties (whether a material is magnetic or attracted by magnetic forces). Materials can be described and classified according to their properties.

Some of the physical properties used by scientists to describe materials include:

Strength: a material's ability to resist forces applied to it. The more force a material can resist, the stronger it is. Tensile strength refers to a material's ability to withstand being pulled end from end, while compressive strength refers to a material's ability to withstand being compressed or squashed.

Hardness: how easily the substance is worn away or scratched. Diamond is the hardest naturally occurring substance known, and can only be scratched by other diamonds.

Brittleness: a material is brittle if it is hard but breaks easily (like glass).

Transparency: how well light passes through a material. If a material can be seen through, it is described as transparent. If it lets light through but still obscures vision, it is translucent and if it doesn't let light through, it is opaque.

Elasticity: a material is elastic if it changes shape when a force is applied to it, and recovers its original shape when the force is removed. Rubber and many types of plastics are very elastic.

Malleability: how easily a material can be bent or shaped. A material that can be deformed or reshaped easily is said to be malleable.

Conductivity: how easily a material transmits heat and electricity. Most metals are very conductive, whereas plastics are usually good insulators, meaning they are not conductive.

Viscosity: how much a fluid resists flowing. Honey is quite viscous because it flows slowly whereas water flows easily and is not very viscous.

Density: the mass of a substance per unit of volume. Lead and gold are very dense, while cork is not.

Porosity: materials that allow water, air and other fluids to move into them are porous. A washing up sponge is porous.

When we want to make something, we take these properties into account (as well as cost and availability) and select the most suitable material for our purpose.

Materials science

Materials science is an inter-disciplinary field of study including the properties of matter and its application to various areas of science and technology. A materials scientist might be a ceramic or polymer engineer or a metallurgist. People from a variety of careers often collaborate to produce innovative solutions, for example, electronics experts work with medical scientists and doctors to design, produce and test cochlear implants.

Materials scientists consider connections between the underlying structure of a material, its properties and what the material can do (its performance). They manipulate and change materials based on their understanding of how the materials are constructed, often at the level of their atomic structure. For example, materials scientists develop composite materials, such as Kevlar, carbon fibres and fibreglass. These are innovative combinations of several materials embedded in resins in ways that dramatically increase their strength.

Recycling is a way to convert waste materials into reusable materials. Paper, glass, some metals (steel and aluminium) and some plastics can be collected and turned into new materials. Cardboard, used paper, and milk and juice cartons can be manufactured into recycled office paper, recycled toilet paper and recycled cardboard. Soft drink bottles and other bottles made from polyethylene terephthalate (PET) plastic (marked with a number '1') can be manufactured into detergent bottles, carpet and recycled fabric. Glass bottles and jars, sorted by colour and melted down, can be used to make new containers. Metal from aluminium and steel cans is used for making other aluminium and steel items. High-density polyethylene (HDPE) plastic (marked with a number '2') like milk bottles and shampoo containers can be recycled into wheelie bins, irrigation pipes and air conditioning hoses.

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall
- 1 enlarged copy of 'Observation record: Exploring materials' (Resource sheet 1)
- *optional:* computer
- *optional:* interactive whiteboard

FOR EACH TEAM

- role wristbands or badges for director, Manager and Speaker
- each team member's design portfolio
- 1 copy of 'Observation record: Exploring materials' (Resource sheet 1) per team member
- a range of materials per team member (see 'Preparation')

Preparation

- Prepare an enlarged copy of 'Observation record: Exploring materials' (Resource sheet 1).
- Prepare a range of natural and processed materials for teams to explore. If possible organise for each team member to explore a different material, such as paper, cardboard, plastic and foil of various thicknesses; corrugated and plastic coated cardboard; bubble wrap.

Lesson steps

1 Review previous lessons, discussing the design brief and design criteria. Ask students to reflect on what they need to find out about the properties of the materials they might use to make their package.

2 Explain that students will be materials scientists and work in collaborative learning teams to investigate the properties of a material.

3 Model how to explore and test properties of a material using an enlarged copy of 'Observation record: Exploring materials' (Resource sheet 1).

4 Form teams and allocate roles. Ask Managers to collect team equipment.

5 Allow time for students to explore properties. Ask questions, such as:

- Could you tell me more about this?
- What do you mean by that?
- Could you explain what you did?
- I wonder what would happen if…

6 Ask the Speaker from each team to share their team's observations. Record information in the 'Explore the task' section of the class design portfolio.

7 *Optional:* Students explore and discuss a range of 'what if' statements to extend their understanding of materials and their properties. For example:

- What if bed sheets were made of foil?
- What if plastic had never been invented?

8 Discuss with students some ways to identify recyclable materials. Ask questions, such as:

- Are there any marks or symbols on the piece of packaging material that indicate that it is recyclable?
- Why do we need recycling symbols?
- How are these symbols helpful?
- Why do we need to recycle?
- What are the environmental impacts of the use of packaging?

9 *Optional:* Use a computer with a projector or an interactive whiteboard to reinforce students' understanding of recycling symbols by looking at icons on computer desktops or in computer programs.

10 Ask each student to make a list of materials they might use for their package in the 'Define the task' section of their design portfolio, recording reasons for their choice.

11 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Curriculum links

Science

- Use fair testing to investigate the strength or elasticity of a material.

English

- Discuss the use of similes and metaphors and examine 'Material sayings'. For example, 'The joke went down like a lead balloon', 'Her hair is as smooth as silk', 'My legs feel like jelly'.

Technology

- Challenge students to prove or disprove the great paper folding myth as presented in 'great moments in science' by Dr Karl.
  www.abc.net.au/science/k2/moments/s1755956.htm

The Arts

- Make paper from recycled materials.

Indigenous perspectives

- Contact the local Indigenous Land Council or cultural heritage centre to make contact with local Indigenous community members. Consult with them about collecting natural materials and how they might be used for packaging or other practical purposes.
- Collect natural materials from the schoolyard, such as palm leaves, strappy grass plants, vines or bark. In consultation with local Indigenous community members and/or Indigenous education officers, investigate how some of these materials might have to be prepared before using them. See: www.anbg.gov.au/education/pdfs/aboriginal_plant_use_and_technology.pdf
- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website (www.primaryconnections.org.au).

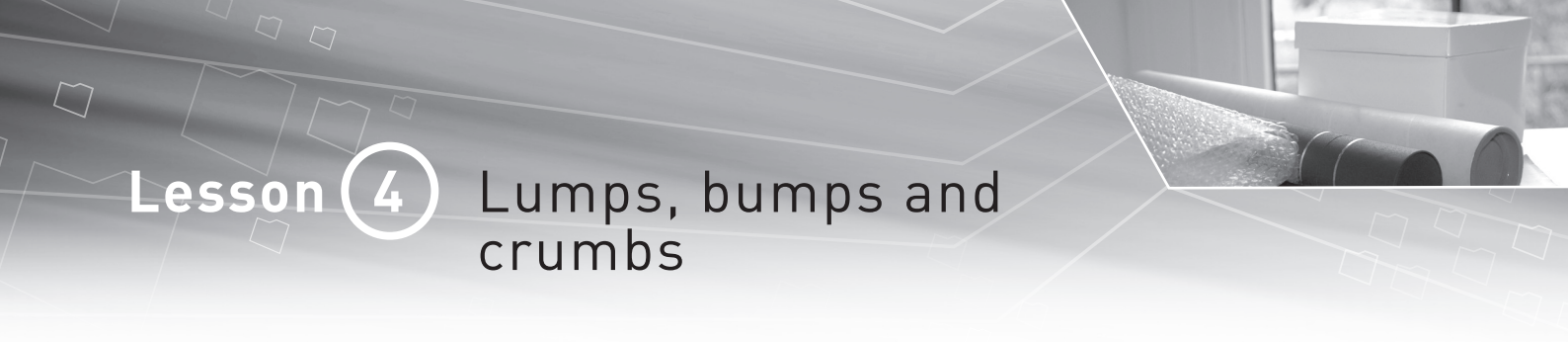
Observation record: Exploring materials

Name: _____ **Date:** _____

Other members of your team: _____

Material examined:	
What colour is it?	What does it feel like?
Draw and describe what happened when it was:	
scrunched	twisted
torn	wet
stretched	poked
Describe the properties of the material.	
Describe the results of other materials that your team explored in your design portfolio.	

 ISBN 978 0 85847 314 0



Lesson 4 Lumps, bumps and crumbs

AT A GLANCE

To support students to plan and conduct an investigation of the capacity of different materials to protect a biscuit from impact.

Students:

- work in collaborative learning teams to investigate the capacity of different materials to protect a biscuit from impact
- make predictions, observe and record the results of their investigations
- describe how the use of materials is determined by their properties.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of:

- how physical properties of materials influence their use, and the relationship between packages and the properties of their materials. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- plan and conduct an investigation that is a fair test
- make and record observations
- interpret observations and draw conclusions to answer the investigation question.

Literacy

Students will be able to:

- use oral and written language to discuss and record investigation results
- discuss ideas to compare evidence from investigations
- identify the purpose and features of a table.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

The investigation in this lesson is a test of the capacity of materials to protect an object from impact. In this lesson, impact refers to a force that can squeeze, crush, bump or push on the object.

Bubble wrap is often used to protect fragile items in packaging. It is made of plastic and air. The plastic holds bubbles of compressed air which help absorb impact. Attempting to pop bubbles of bubble wrap shows just how much impact the bubbles can absorb. Jiffy bags are filled with shreds of recycled paper to help absorb impact. Cardboard can be solid heavy duty paper or it can made from layers of corrugated paper sandwiched between sheets of smooth paper.

In this investigation the biscuit might break and will need to be replaced. This means that multiple tests cannot be performed using exactly the same biscuit. This type of investigation is known as a replication, since the investigation is carried out more than once and observations are made in similar conditions but not on identical biscuits. However, given that students wish to determine whether the materials protect biscuits in general, and not one particular biscuit at one particular time, this does not compromise the investigation. If one biscuit could be used for multiple tests, the investigation would be referred to as a repeat trial.

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall
- dictionary
- 1 enlarged copy of 'Impact investigation planner' (Resource sheet 2)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's design portfolio
- 1 copy of 'Impact investigation planner' (Resource sheet 2) per team member
- 3 different materials (see 'Preparation')
- 3 biscuits (eg, arrowroot, ANZAC)
- spare biscuits to replace breakages
- 1 x 1 m ruler or tape measure
- 1 x 250 g weight to drop on package

Preparation

- Read 'How to conduct a fair test' (Appendix 4).
- Prepare an enlarged copy of 'Impact investigation planner' (Resource sheet 2).
- Prepare an enlarged copy of the investigation question 'Which material best protects a biscuit from impact?'.
- Collect three types of material for each team, such as bubble wrap, cardboard and padded Jiffy bag material.

Lesson steps

1 Review the packaging explorations from the previous lesson, discussing the properties of materials that packages are made of.

2 Refer to the design brief and ask students to suggest what types of things a package might have to withstand during delivery.

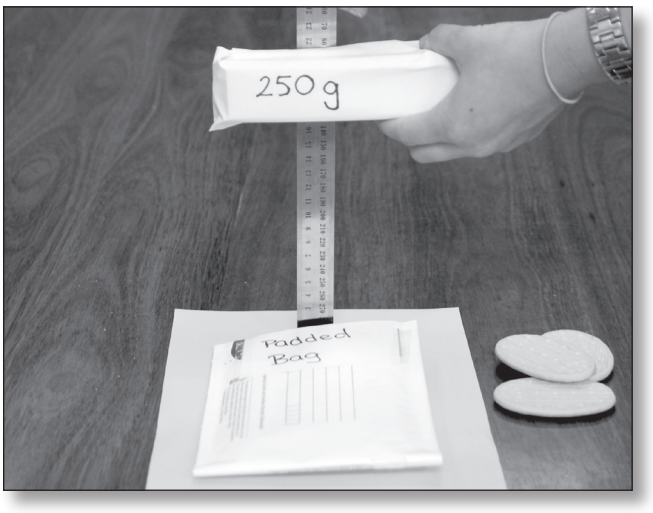
3 Discuss the term 'impact'. Ask students to describe what they think 'impact' means and, as a class, look up the term in a dictionary. Add ideas to the word wall, such as squeeze, crush, bump or push. Ask students what they would look for as evidence of impact.

4 Ask students to predict which type of material they think will provide the best protection for the fragile gift if the package is subjected to impact. Discuss and record students' predictions in the 'Explore the task' section of the class design portfolio. For example, 'I think thick cardboard will be the best because it won't bend easily'. Encourage students to give reasons for their predictions.

5 Explain that students will be working in collaborative learning teams to investigate the question 'Which material best protects a biscuit from impact?'. Explain that biscuits will be used in this test as a model of a fragile gift. Add the investigation question to the enlarged copy of the 'Impact investigation planner' (Resource sheet 2). Place the planner in the 'Explore the task' section of the class learning centre.

6 Ask students what things might affect whether or not a biscuit breaks from an impact. For example, the size of the biscuit, the type of biscuit, the weight of something dropped on it, and how high the weight is dropped from.

7 Explain that for this investigation each team will observe impact by dropping a weight onto material laid over a biscuit, increasing the height of each drop until the biscuit breaks. For example, students will drop a 250 g weight from 10 cm onto bubble wrap that is on top of a biscuit. If the biscuit does not break they will increase the drop to 20 cm, and continue until the biscuit breaks.



Setting up the investigation

EXPLORE

8 Introduce the term 'variables' as factors that can be changed, measured or kept the same in an investigation. For this investigation, discuss what teams will:

- **Change:** the type of material
- **Measure/Observe:** the drop height at which a weight first breaks the biscuit
- keep the **Same:** the weight and the type of biscuit.

Discuss how students will make this a fair test, for example, by only changing one variable and keeping all others the same. Ask questions, such as:

- What would happen if we used different weights to test the different materials?
- What would happen if we used a biscuit to test one type of material and a block of wood for another?
- What would happen if we started very high to test one material and not the others?

9 Form teams and allocate roles. Ask Managers to collect team equipment.

10 Invite team members to complete the first page of the 'Impact investigation planner' (Resource sheet 2).

11 Explain that students will use a table to record their results. Discuss the need to record results in an organised way and ask why this is an important part of the scientific investigation process. Refer to the class 'Impact investigation planner' (Resource sheet 2) and discuss the purpose and features of a table.

Literacy focus

Why do we use a table?

We use a **table** to organise information so that we can understand it more easily.

What does a table include?

A **table** includes a title, columns with headings and information organised under each heading.

12 Discuss why it is necessary to perform trials more than once and list possible reasons for variation, for example, the weight doesn't fall in the same way and the biscuits are identical. Ask questions, such as:

- Do you think the test will be identical every time?
- What might change?
- How might that affect the result?
- How might that affect our conclusions?

Explain that students will need to perform the trial three times for each different material and to calculate the average of the three results to account for the variations in each test.

13 Ask teams to conduct their investigation and complete the 'Impact investigation planner' (Resource sheet 2).

14 Ask teams to prepare an oral presentation about their conclusions and evaluation of the investigation. As part of their oral presentations, ask students to include answers to the following questions:

- Were all the results the same?
- Which material was the most resistant to impact?
- Was there a difference between natural and processed materials? What did you notice?
- How could you improve the investigation?

Discuss the purpose and features of an oral presentation.

Literacy focus

Why do we use an oral presentation?

We use an **oral presentation** to entertain or provide information for an audience.

What does an oral presentation include?

An **oral presentation** is a speech that has an introduction, main part and conclusion. It might be serious or funny depending on the topic and audience.

Discuss with students the elements of a good oral presentation, including:

- well-organised information
- clear, concise communication
- evidence of knowledge of the topic
- use of evidence and reasoning to support conclusions
- quality/creativity of the presentation.

15 Allow time for teams to prepare and perform their presentations.

16 Ask students to reflect on the findings and revise the list of materials they might use for their package in the 'Define the task' section of their design portfolio.

17 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Impact investigation planner

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate? Can you write it as a question?	What do you think will happen? Explain why. Give scientific explanations for your prediction

To make the test fair, what things (variables) are you going to:

Change? Change only one thing	Measure? What would the change affect?	Keep the same? Which variables will you control?

Describe how you will set up your investigation. Use drawings if necessary	What equipment will you need? Use dot points

 ISBN 978 0 85847 314 0

Recording results

Material tested	Height of drop (cm)			
	1st trial	2nd trial	3rd trial	Average

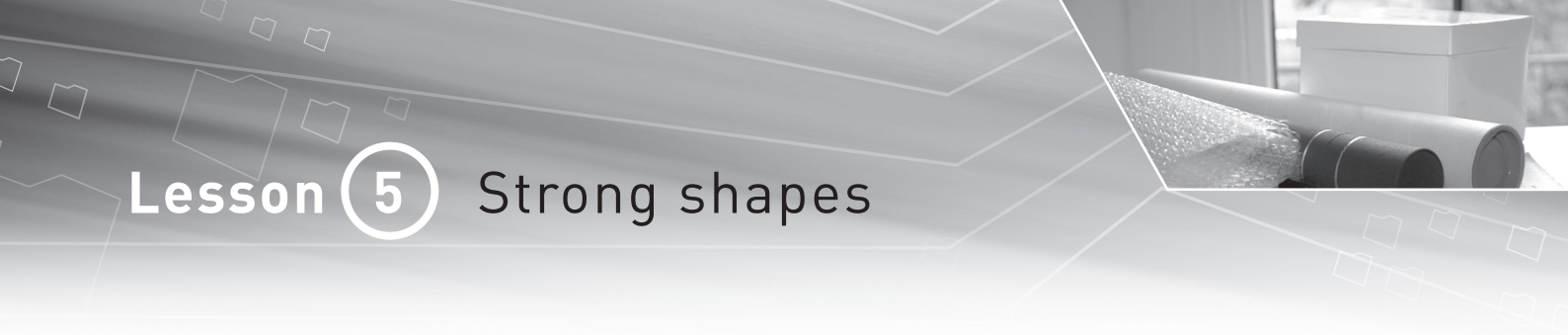
Explaining results

Write a statement to summarise your findings.	
Why did this happen?	Did the results match your prediction? Why or why not?

Evaluating the investigation

What challenges did you have doing this investigation?	How could you improve this investigation?

 ISBN 978 0 85847 314 0



Lesson 5 Strong shapes

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of how shape contributes to design strength.

Students:

- work in collaborative learning teams to investigate how to strengthen a sheet of paper by changing its shape
- discuss their results.

Lesson focus

The *Explore* phase is designed to provide students with hands-on experiences of the science phenomenon. Students explore ideas, collect evidence, discuss their observations and keep records, such as science journal entries. The *Explore* phase ensures all students have a shared experience that can be discussed and explained in the *Explain* phase.

Assessment focus

Formative assessment is an ongoing aspect of the *Explore* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of:

- how physical properties of materials influence their use and the relationship between packages and the properties of their materials. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- identify shapes that add strength to materials
- test their predictions
- observe, record and interpret the results of their investigation.

Literacy

Students will be able to:

- use oral, written and visual language to record and discuss investigation results
- discuss ideas and relate evidence from an investigation
- represent ideas about strengthening materials through shape.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

Materials scientists and product designers identify which shapes provide the strongest structure in products, using the smallest amount of material in order to ensure the effectiveness of the product and to keep costs at a minimum.

The package that students make needs to protect its contents whilst being a suitable size and shape for delivering the contents safely.

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's design portfolio
- several A4 sheets of paper
- 2 blocks (eg, books or boxes of tissues), to support the span of the bridge
- 1 container to hold small weights (eg, film canister, medicine measuring cup)
- small weights (eg, washers, paperclips, marbles, gravel or sand) that can be put in the container in measured increments
- 50 cm self-adhesive tape
- *optional:* measuring spoon (eg, teaspoon)

Preparation

- Read 'How to conduct a fair test' (Appendix 4).
- Prepare containers and weights for teams to test their shapes. For example, each team could have a film canister, some sand and a spoon to measure the amount of sand added.

Lesson steps

1 Review the previous lessons using the class learning centre.

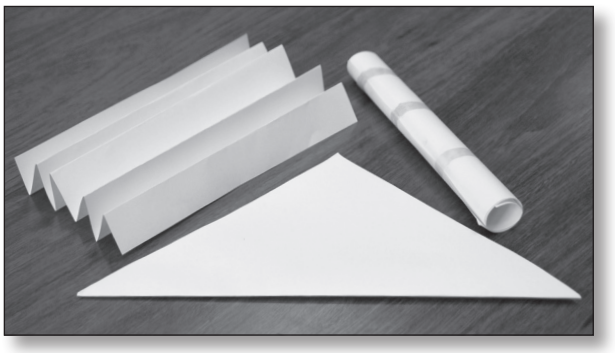
2 Suspend an A4 sheet of paper between two books. Ask students to predict how much weight the paper could support. For example, one spoonful of sand in a film canister. Test predictions.

Adding sand in measured increments

Suspended A4 paper with weight supported

3 Ask students to suggest how to change the paper to support more weight, and record their suggestions in the 'Explore the task' section of their design portfolio.

EXPLORE



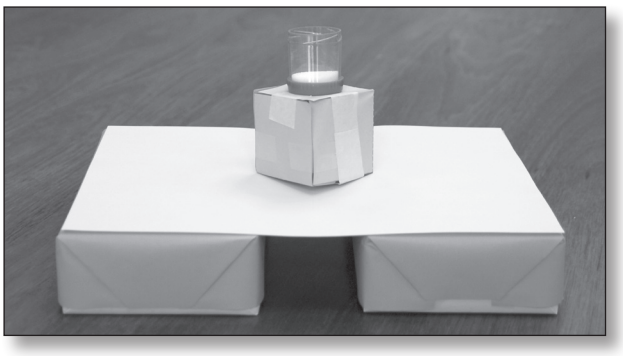
Examples of ways to fold paper

4 Explain that students will be working in collaborative learning teams to investigate 'Which shape of a sheet of paper best supports most weight?'.

5 Ask each team to make different shapes using the paper. Test the strength by adding weights to a container placed on the shape. Remind students that to make the test fair they need to:

- Change: the shape of the paper
- **Measure/Observe:** the weight (spoons of sand, number of paperclips) that the bridge can support
- **keep the Same:** the span of the bridge, the size of the piece of paper and the overlap of the paper on the supports.

Note: Emphasise that students can use self-adhesive tape to join the edges of a folded piece of paper. To keep the test fair, it cannot be used for reinforcing the paper.



Sample showing use of self-adhesive tape

6 Form teams and allocate roles. Ask Managers to collect team equipment.

7 Ask students to record their findings in the 'Explore the task' section of their design portfolio and to compare their results with their predictions.

8 Ask each team to describe the shape of the paper they found to be the strongest. Compare and discuss the findings, making records in the 'Explore the task' section of the class design portfolio.

9 Ask students to record how they could use shape to strengthen their package in the 'Define the task' section of their design portfolio.

10 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Curriculum links

Mathematics

- Explore the properties of shapes.

Technology

- Research the building of bridges.

Indigenous perspectives

- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website (www.primaryconnections.org.au).

Lesson 6 Daring designs

AT A GLANCE

To support students to represent and explain their understanding of appropriate materials to meet design criteria, and to introduce current scientific views.

To provide opportunities for students to develop plans and make their package.

Session 1 Guest speaker

Students:

- interview a guest speaker about effective package design and delivery
- identify factors for consideration in package design.

Session 2 Package plan

Students:

- review criteria for judging the success of packages
- identify properties of materials and how these influence their use in packages
- develop a procedural text plan for their design task.

Session 3 Prototype production

Students:

- apply their plans to make a prototype package
- amend their plan during the making of their package
- develop explanations about materials science and the design process.

EXPLAIN

Lesson focus

In the *Explain* phase students develop a literacy product to represent their developing understanding. They discuss and identify patterns and relationships within their observations. Students consider the current views of scientists and deepen their own understanding.

Assessment focus

Formative assessment is an ongoing aspect of the *Explain* phase. It involves monitoring students' developing understanding and giving feedback that extends their learning. In this lesson you will monitor students' developing understanding of:

- how physical properties of materials influence their use, and the relationship between packages and the properties of their materials. You will also monitor their developing science inquiry skills (see page 3).

You are also able to look for evidence of students' use of appropriate ways to represent what they know and understand about materials and their properties and how those properties influence their use, and give them feedback on how they can improve their representations.

Key lesson outcomes

Science

Students will be able to:

- discuss the function of different materials in package design
- explain how properties of materials influence their use
- select appropriate materials for a specific purpose and give reasons for their selection
- plan a design for a package that will protect a fragile gift.

Literacy

Students will be able to:

- use oral, written and visual language to develop a plan for the making of their package
- represent their ideas by annotating a drawing
- explain the purpose, structure and features of a procedural text
- engage in discussion to compare ideas and generate explanations.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

When selecting materials for packaging, designers and engineers need to consider how well the materials chosen for the package will protect the contents of the package. This includes determining whether or not the materials can be made into a package which will protect the contents and is large enough to accommodate them.

When designing, the cost of materials is often a major consideration. Materials scientists and designers need to know which shapes provide the strongest structure in products, using the smallest amount of material in order to ensure the effectiveness of the product and to keep costs at a minimum.

Additional factors that materials scientists take into account include the availability of the chosen material, alternative materials (is this the only material that will serve this purpose?), the aesthetic qualities desired in the final product and the environmental cost of the material.

Session 1 Guest speaker

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- word wall
- optional: camera

FOR EACH STUDENT

- design portfolio

Preparation

- During this phase, students will require access to a wide range of materials that have been included in their design brief for making their product.
- Organise a guest speaker, such as an Australia Post employee who handles the sorting or delivery of packages, a parent who works in the storage or delivery of packages or a local courier.

  Optional: Students compose a letter of invitation.
- *Optional:* Organise an excursion to the workplace of the guest speaker.

Lesson steps

1 Revisit the design brief and suggest to students that interviewing a guest could provide further ideas about packages and the delivery process.

2 Discuss the purpose and features of an interview.

Literacy focus

Why do we use an interview?

We use an **interview** to collect information and opinions from someone.

What does an interview include?

An **interview** includes one or more people asking questions and one or more people answering them. It might take place face-to-face or over distance, such as by telephone or video link.

3 Brainstorm questions that will elicit the required information about package design and delivery from a guest speaker. Encourage students to compose open questions that avoid 'yes' or 'no' answers. Record students' interview questions in the class design portfolio in the 'Explore the task' section. Possible questions include:

- What is your job?
- Do you often see damaged packages?
- What are the causes of the damage?
- What types of impact do packages need to withstand?
- What types of packages are most effective?
- What should be avoided when designing packages?

4 Organise a master of ceremonies and students to thank the guest speaker for their time and identify students to ask questions.

5 Review oral communication skills, such as looking at the audience and using appropriate voice, volume and pace. Conduct the interview.

6 *Optional:* Take photos of the guest speaker's visit to assist students to recall and review the information from the interview.

7 Invite students to record in the 'Define the task' section of their design portfolio, using drawing and writing, their explanations of effective package design.

8 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Session 2 Package plan

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall
- 1 enlarged copy of 'Procedure: Package plan' (Resource sheet 3)

FOR EACH TEAM

- wristbands for Director, Manager and Speaker
- each team member's design portfolio
- 1 copy of 'Procedure: Package plan' (Resource sheet 3) per team member

Teacher background information

During this lesson, students are introduced to 'Procedure: Package plan' (Resource sheet 3). A sample of a completed resource sheet has been provided below.

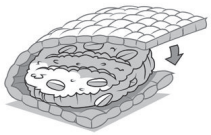
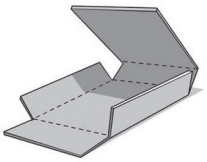
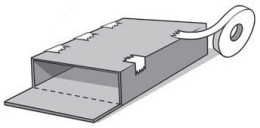
PrimaryConnections® Linking science with literacy *Package it better*

Procedure: Package plan

Name: Sarah **Date:** 15 February

Aim: To make a package that is able to protect a fragile gift.

Equipment	**Reasons for selecting this equipment**
sample biscuit cardboard self-adhesive tape bubble wrap	• as a model of a fragile gift • to make a strong package • to stick the sides of the cardboard together • to provide extra packaging for the biscuit

Activity steps	**Illustrations for the steps**
1 Wrap the sample biscuit in some bubble wrap.	
2 Fold the cardboard into a suitable-sized box shape.	
3 Use small pieces of self-adhesive tape to stick down and hold the sides together.	
4 Place the bubble-wrapped biscuit inside the cardboard box and seal the box.	

Resource sheet 3

Sample 'Procedure: Package plan' (Resource sheet 3)

Preparation

- Prepare an enlarged copy of 'Procedure: Package plan' (Resource sheet 3).
- Read the sample 'Procedure: Package plan' (Resource sheet 3) in the 'Teacher background information'.
- Prepare a sketch of a package to use in Lesson step 7.

Lesson steps

1. Reflect on the guest speaker's visit and revisit the design brief in the class learning centre.
2. Explain that students will be working in collaborative learning teams to review the design criteria in the 'Define the task' section of their design portfolio and plan a procedural text for making a prototype of their package.
3. Ask students to record their ideas in a criteria table in the 'Produce solutions' section of their design portfolio. Review the purpose and features of a table (see Lesson 4).

   For example, if the gift needs to stay dry then one criterion will be that the package needs to be waterproof.

A criteria table

Criteria	Options and ideas
waterproof	
able to be posted	
able to protect the gift from impact	
environmentally responsible	

4. Form teams and allocate roles.
5. Encourage students to share their table with their team members to ensure their options and ideas match the criteria.
6. Ask students to reflect on their design brief and draw, in the 'Produce solutions' section of their design portfolio, the package they intend to make. Encourage them to add labels naming parts of the package and the materials that they have selected.
7. Model how to write a procedural text for making a package using a prepared sketch (see 'Preparation') and an enlarged copy of 'Procedure: Package plan' (Resource sheet 3). Discuss the purpose and features of a procedural text.

Literacy focus

Why do we use a procedural text?

We use a **procedural text** to describe how something is done. We can read a **procedural text** to find out how to do things.

What does a procedural text include?

A **procedural text** includes a list of materials needed to do the task and a description of the sequence of steps used. It might include annotated diagrams.

8. Ask Managers to collect individual copies of 'Procedure: Package plan' (Resource sheet 3) for each student to write their own procedural text for making the package that they have designed.

EXPLAIN

9 Ask students to share their procedural text with their team members to confirm that they have included all steps and to place their 'Procedure: Package plan' (Resource sheet 3) in the 'Produce solutions' section of their design portfolio.

10 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Session 3 Prototype production

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's design portfolio
- each team member's completed 'Procedure: Package plan' (Resource sheet 3)
- materials for each team member's prototype

EXPLAIN

Preparation

- Organise materials as per lists in students' procedural texts.

Lesson steps

1 Explain that students will be working in collaborative learning teams to make their individual prototype package.

2 Form teams and allocate roles. Ask Managers to collect team equipment.

3 Ask students to make their package and record, using a different-coloured pen, any necessary changes to their procedural text that will make it more effective.

4 Ask students to discuss their package with team members. Encourage team members to ask questions to provide peer support and informal peer assessment of students' procedural text and package. Team members might ask questions, such as:

- Is the material natural or processed? Why did you use that material?
- How did you construct your package?
- What changes did you make to your procedural text? Why?
- What steps in your procedural text were not effective in the construction of your package?

5 Ask students to reflect on the process of writing and applying a procedural text in the 'Evaluate and reflect' section of their design portfolio.

6 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Curriculum links

English

- Read a variety of procedural texts to find common features.

Mathematics

- Express units of measurement in abbreviated form and compare objects using familiar metric units.

Studies of Society and Environment

- Research the packaging industry, the processes to make packaging materials and the environmental impact of the uses of packages.

The Arts

- Write procedural texts for the creation of artworks.

Indigenous perspectives

- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website (www.primaryconnections.org.au).

Procedure: Package plan

Name: _____ **Date:** _____

Aim: _____

Equipment	Reasons for selecting this equipment

Activity steps	Illustrations for the steps

 ISBN 978 0 85847 314 0

Lesson 7 Package performance

AT A GLANCE

To support students to plan and conduct an investigation of the effectiveness of their prototype package and revise their package based on findings.

Session 1 Product evaluation

Students:

- undertake product evaluation to determine the effectiveness of their prototype package to meet the design criteria.

Session 2 Product review

Students:

- evaluate their prototype package and recommend changes to the design
- modify their procedural text plan to reflect updated design features
- make a revised package
- develop an evaluation questionnaire to dispatch with the package.

Lesson focus

In the *Elaborate* phase students plan and conduct an open investigation to apply and extend their new conceptual understanding in a new context. It is designed to challenge and extend students' science understanding and science inquiry skills.

Assessment focus

Summative assessment of the Science Inquiry Skills is an important focus of the *Elaborate* phase (see page 2). Rubrics will be available on the website to help you monitor students' inquiry skills.

Key lesson outcomes

Science

Students will be able to:

- plan and conduct a product evaluation to determine the effectiveness of their prototype package
- make and record observations
- interpret observations and make a conclusion
- provide evidence to support their conclusion.

Literacy

Students will be able to:

- summarise findings
- engage in discussion to compare ideas and identify factors that improve the effectiveness of their prototype package
- develop a questionnaire to evaluate a package against functional, aesthetic and environmental performance criteria.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Teacher background information

Product evaluation

This investigation will test the performance of a package against its design criteria, for example, is it resistant to impact, waterproof and flexible? This type of evaluation is often used when solving a design problem.

In this lesson, students devise a test that will allow them to determine if their package meets the design criteria. This is the most difficult part of designing and planning investigations and evaluations and requires students to think carefully about the design criteria. For example, the design criteria might specify that a package should be waterproof. Students decide how to test whether or not their package is waterproof, such as by dunking it in water or spraying it with water.

Students must be prepared to give reasoned explanations for their choices. For example, 'I think that a package could be rained on when in transit but I don't think it will be submerged in water, therefore I tested it by spraying it with water'.

Note: Students might choose to test impact in a similar way to the investigation that they performed in Lesson 4, when they simulated other parcels landing on top of different package materials. In the *Elaborate* phase, they could decide to test impact in a different way, for example, by dropping the packages from a given height. (Unwrapped, the biscuit will break at approximately 15 cm. Wrapped in a 'post-pack' the package needs to be dropped from 2 m or higher.)

Students will not be comparing packages therefore there is no fair test. If they were to compare packages in a fair test the investigation question could be 'Which package best protects the contents?'. Students would need to identify the variables that they will change, measure and keep the same.

Session 1 Product evaluation

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- team roles chart
- team skills chart
- word wall
- 1 enlarged copy of the 'Product evaluation planner' (Resource sheet 4)

FOR EACH TEAM

- wristbands for Director, Manager and Speaker
- each team member's design portfolio
- each team member's prototype package from Lesson 6
- 1 copy of 'Product evaluation planner' (Resource sheet 4) per team member
- 3 biscuits (eg, arrowroot, ANZAC)
- spare biscuits to replace breakages

Preparation

- Prepare an enlarged copy of 'Product evaluation planner' (Resource sheet 4).

Lesson steps

1 Review the design brief and negotiate the evaluation question, for example, 'Will the package safely deliver the gift?'. Record the question on the enlarged copy of the 'Product evaluation planner' (Resource sheet 4). Place the planner in the 'Produce solutions' section of the class learning centre.

2 Discuss what criteria students' packages would need to meet in order to satisfy the evaluation question, for example, if the question is 'Will the package safely deliver the gift?' the criteria for the package is to be waterproof and resistant to impact. Refer students to the criteria tables they developed in Lesson 6.

3 Brainstorm ideas for testing the package against the criteria, such as spraying with water, dragging, squeezing, twisting, dropping the package and dropping things on the package. Explain that biscuits will be used in this test as a model of a fragile gift.

4 Explain that students will be working in collaborative learning teams to devise and conduct an evaluation, which might include more than one test.

5 Form teams and allocate roles. Ask Managers to collect team equipment.

6 Ask students to record what criteria their each team member's packages need to meet in the 'Criteria' section of their 'Product evaluation planner' (Resource sheet 4).

7 Ask students to negotiate what tests they will use and to provide reasons for their choices. For example, 'We chose to drop the package from a height of 2 m because it is unlikely the package will be dropped from higher than that, and spray it with water because the package might be rained on'.

8 Ask each student to complete the 'What equipment will you need?' list and the 'Diagram of how you will set up the equipment' section of their planner.

9 Invite teams to conduct the tests and complete their 'Recording results', 'Explaining results' and 'Evaluating' sections of their planner.

10 Invite each team to share their findings with the class. Students place their planner in the 'Produce solutions' section of their design portfolio.

11 Add new ideas, questions and findings to the class learning centre. Update the word wall with words and images.

Curriculum links

Science

- Use fair testing to investigate which package type best protects a particular object under given conditions.

The Arts

- Design symbols and labels for packages.

Indigenous perspectives

- In consultation with local Indigenous community members and/or Indigenous education officers, discuss the process of making glue using natural materials, such as combining kangaroo scats, resin, ash and water. Investigate the properties of Indigenous glue and commercial glue.

SAFETY

- PrimaryConnections recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the PrimaryConnections website (www.primaryconnections.org.au).

Product evaluation planner

Name: _____ **Date:** _____

Other members of your team: _____

Evaluation question: _____

Criteria What criteria should the packages meet?	**Tests** • How can you fairly evaluate the packages against these criteria? • Describe the test. • Explain reasons for your test choices.
What equipment will you need?	Diagram of how you will set up the equipment.

 ISBN 978 0 85847 314 0

Recording results

Test	Results

Explaining results

Did your package meet the design criteria? Why or why not?
Did the tests accurately evaluate the package against the design criteria? Why or why not?

Evaluating

What challenges did you have doing this evaluation?	How could you improve this 'Product evaluation'?

 ISBN 978 0 85847 314 0

Session 2 Product review

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- word wall

FOR EACH STUDENT

- design portfolio
- 'Procedure: Package plan' (Resource sheet 3) from Lesson 6
- A4 paper for questionnaire
- materials for making updated packages (see Lesson step 2)

Preparation

- Collect materials for making updated packages (see Lesson step 2).

Lesson steps

1. Using the findings from Session 1, ask students to evaluate their prototype package and recommend changes to their design.
2. Invite students to modify their 'Procedure: Package plan' (Resource sheet 3) to reflect updated design features and make an updated package with the fragile gift inserted.
3. Explain that each student will create a questionnaire to evaluate the success of their package, which will be delivered with the package.
4. Ask students to use the criteria table in the 'Define the task' section of their design portfolio (see Lesson 6), to prepare the questionnaire and to include a request for the questionnaire to be returned. Examples of the types of questions students might write include:
    - Was the package damaged and if so, how was it damaged?
    - Was the fragile gift intact or broken?
    - If the package is not damaged but the fragile gift is damaged, do you think the gift broke because:
        - the package was dropped or got wet?
        - the package was not strong enough?
    - If the fragile gift was not broken, what were the effective characteristics about the package?
    - What other information might help to improve the package?
5. Send or deliver the packages and a copy of the questionnaire. Allow time for feedback to arrive.

Lesson 8 All wrapped up

AT A GLANCE

To provide opportunities for students to represent what they know about how natural and processed materials have a range of physical properties and that these properties can influence their use, and to reflect on their learning during the unit.

Students:

- evaluate the performance of their package using feedback from a questionnaire
- reflect on their learning about materials, their properties, and the design process
- plan and give an oral presentation summarising findings about their design and the design process.

Lesson focus

In the *Evaluate* phase students reflect on their learning journey and create a literacy product to re-represent their conceptual understanding.

Assessment focus

Summative assessment of the Science Understanding descriptions is an important aspect of the *Evaluate* phase. In this lesson you will be looking for evidence of the extent to which students understand:

- how physical properties of materials influence their use, and the relationship between packages and the properties of their materials.

Literacy products in this lesson provide useful work samples for assessment using the rubrics provided on the Primary**Connections** website.

Key lesson outcomes

Science

Students will be able to:

- analyse feedback to evaluate their package against design criteria
- explain how properties of materials influence their use
- evaluate the success of the design process
- describe reasons for the performance of their package.

Literacy

Students will be able to:

- represent their ideas about packages and materials in a presentation
- present their learning about the design process to an audience.

This lesson also provides opportunities to monitor the development of students' general capabilities (highlighted through icons, see page 5).

Equipment

FOR THE CLASS

- class design portfolio
- class learning centre
- word wall

FOR EACH STUDENT

- design portfolio
- 'Assessment check' (Resource Sheet 5)

Preparation

- Read Lesson step 1 and organise the presentation event. The presentation might take the form of a TV talk show, such as 'Ingenious inventors', a design conference or a design show. The audience might include another class, the guest who presented the battered package to the class in Lesson 1, an Australia Post representative or other community members. Allocate a time for each presentation.

Lesson steps

1. Invite students to prepare a presentation about how well the chosen materials performed, the properties of materials which were most important to their design brief and some ideas about what students would do to improve their package, the design of their product and their planning.
2. Draw students' attention to the class learning centre, their design portfolio, and the questionnaires as sources of information for their presentation. For example, assist students to prepare their presentation by asking questions, such as:
    - What did you choose as a fragile gift and why?
    - What design criteria did your package need to meet?
    - Why did you design the package the way you did?

- What have you learned about selecting materials for making things?
- Did your fragile gift arrive safely? Why or why not?
- What would you change about your package next time?

Optional: Review oral communication skills, such as looking at the audience and using appropriate voice, volume and pace.

3 Arrange for students to make their oral presentations.

4 Conduct self, peer and/or teacher evaluation of each package using 'Assessment check' (Resource sheet 5) and place in the 'Evaluate and reflect' section of each student's design portfolio. A sample of a completed resource sheet has been provided below.

PrimaryConnections® Linking science with literacy — *Package it better*

Assessment check

Name of package maker: Andrew

Name of assessor: Kate **Date:** 21 February

On a scale of 1 to 10, circle the rating that indicates how well the package satisfied the selected criteria. (1 is low and 10 is high.)

Is the package:

A suitable size to hold the gift?	1 2 3 4 5 6 7 (8) 9 10
Able to protect the gift?	1 2 3 (4) 5 6 7 8 9 10
Low cost?	1 2 3 4 (5) 6 7 8 9 10
Made of environmentally responsible materials?	1 2 3 4 5 6 7 8 (9) 10
Aesthetically pleasing?	1 2 (3) 4 5 6 7 8 9 10
Average rating	1 2 3 4 5 (6) 7 8 9 10

Resource sheet 5

Sample 'Assessment check' (Resource sheet 5)

EVALUATE

Curriculum links

Indigenous perspectives

- Invite students to prepare a presentation on their investigation findings comparing Indigenous glue with commercial glue.
- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website (www.primaryconnections.org.au).

Assessment check

Name of package maker: _____

Name of assessor: _____ **Date:** _____

On a scale of 1 to 10, circle the rating that indicates how well the package satisfied the selected criteria. (1 is low and 10 is high.)

Is the package:

A suitable size to hold the gift?	1 2 3 4 5 6 7 8 9 10
Able to protect the gift?	1 2 3 4 5 6 7 8 9 10
Low cost?	1 2 3 4 5 6 7 8 9 10
Made of environmentally responsible materials?	1 2 3 4 5 6 7 8 9 10
Aesthetically pleasing?	1 2 3 4 5 6 7 8 9 10
Average rating	1 2 3 4 5 6 7 8 9 10

 ISBN 978 0 85847 314 0

Appendix 1

How to organise collaborative learning teams (Year 3–Year 6)

Introduction

Students working in collaborative teams is a key feature of the Primary**Connections** inquiry-based program. By working in collaborative teams students are able to:

- communicate and compare their ideas with one another
- build on one another's ideas
- discuss and debate these ideas
- revise and rethink their reasoning
- present their final team understanding through multi-modal representations.

Opportunities for working in collaborative learning teams are highlighted throughout the unit.

Students need to be taught how to work collaboratively. They need to work together regularly to develop effective group learning skills.

The development of these collaborative skills aligns to descriptions in the Australian Curriculum: English. See page 7.

Team structure

The first step towards teaching students to work collaboratively is to organise the team composition, roles and skills. Use the following ideas when planning collaborative learning with your class:

- Assign students to teams rather than allowing them to choose partners.
- Vary the composition of each team. Give students opportunities to work with others who might be of a different ability level, gender or cultural background.
- Keep teams together for two or more lessons so that students have enough time to learn to work together successfully.
- If you cannot divide the students in your class into teams of three, form two teams of two students rather than one team of four. It is difficult for students to work together effectively in larger groups.
- Keep a record of the students who have worked together as a team so that by the end of the year each student has worked with as many others as possible.

Team roles

Students are assigned roles within their team (see below). Each team member has a specific role but all members share leadership responsibilities. Each member is accountable for the performance of the team and should be able to explain how the team obtained its results. Students must therefore be concerned with the performance of all team members. It is important to rotate team jobs each time a team works together so that all students have an opportunity to perform different roles.

For Year 3–Year 6, the teams consist of three students—Director, Manager and Speaker. (For Foundation–Year 2, teams consist of two students—Manager and Speaker.) Each member of the team should wear something that identifies them as belonging to that role,

such as a wristband, badge, or colour-coded peg. This makes it easier for you to identify which role each student is doing and it is easier for the students to remember what they and their team mates should be doing.

Manager

The Manager is responsible for collecting and returning the team's equipment. The Manager also tells the teacher if any equipment is damaged or broken. All team members are responsible for clearing up after an activity and getting the equipment ready to return to the equipment table.

Speaker

The Speaker is responsible for asking the teacher or another team's Speaker for help. If the team cannot resolve a question or decide how to follow a procedure, the Speaker is the only person who may leave the team and seek help. The Speaker shares any information they obtain with team members. The teacher may speak to all team members, not just to the Speaker. The Speaker is not the only person who reports to the class; each team member should be able to report on the team's results.

Director (Year 3–Year 6)

The Director is responsible for making sure that the team understands the team investigation and helps team members focus on each step. The Director is also responsible for offering encouragement and support. When the team has finished, the Director helps team members check that they have accomplished the investigation successfully. The Director provides guidance but is not the team leader.

Team skills

Primary**Connections** focuses on social skills that will help students work in collaborative teams and communicate more effectively.

Students will practise the following team skills throughout the year:

- Move into your teams quickly and quietly
- Speak softly
- Stay with your team
- Take turns
- Perform your role.

To help reinforce these skills, display enlarged copies of the team skills chart (see the end of this Appendix) in a prominent place in the classroom.

Supporting equity

In science lessons, there can be a tendency for boys to manipulate materials and girls to record results. Primary**Connections** tries to avoid traditional social stereotyping by encouraging all students, irrespective of their gender, to maximise their learning potential. Collaborative learning encourages each student to participate in all aspects of team activities, including handling the equipment and taking intellectual risks.

Observe students when they are working in their collaborative teams and ensure that both girls and boys are participating in the hands-on activities.

TEAM ROLES

Manager

Collects and returns all materials the team needs

Speaker

Asks the teacher and other team speakers for help

Director

Makes sure that the team understands the team investigation and completes each step

TEAM SKILLS

1 Move into your teams quickly and quietly

2 Speak softly

3 Stay with your team

4 Take turns

5 Perform your role

Appendix 2
How to use a design portfolio

Introduction

A design portfolio is a record of observations, experiences and reflections. It might include a series of dated entries, written text, drawings, sketches, labelled diagrams, graphic designs, photographs, tables and graphs. It includes the design brief and information to assist students to develop design criteria and to evaluate products.

Using a design portfolio allows students to be engaged in an authentic opportunity to resolve a design challenge. Students can use their design portfolio as a self-assessment tool as they reflect on their learning and how their ideas have changed and developed during a unit.

Monitoring students' design portfolios allows you to identify students' non-scientific ideas, find evidence of students' learning and plan future learning activities in science, technology and literacy.

A design portfolio is organised to facilitate the dynamic, reiterative nature of the design process and includes four sections:

- **Explore the task** – students identify with the design situation and use this section to explore and review the design brief. They identify critical factors for success. For example, students identify possible fragile gifts and explore, record and reflect on their exploration of package characteristics and designs which will safely deliver a fragile gift.
- **Define the task** – students review the design brief and specify the design criteria for their package. They identify appropriate materials and processes to use.
- **Produce solutions** – students plan for and record the processes to make an effective product.
- **Evaluate and reflect** – students record their evaluation of their product and the processes involved in its production. They record their reflections on their learning.

Each section of the design portfolio for this unit is described below.

Using a design portfolio

Use a loose-leaf folder or a manila folder to allow new pages to be added to each section during the unit.

1. When introducing a design portfolio emphasise the importance of including pictorial representations as well as written entries. Entries can include narrative, poetry and prose as students represent their ideas in a range of styles and forms.
2. Explain to students that they will use their design portfolio to keep dated records of their observations, ideas and thoughts about all activities, adding them to the appropriate section.
3. Use a large project book or A3 paper in a large ring binder to make a class design portfolio. This can be used at all year levels to model design portfolio entries.
4. Make time to use the design portfolio. Provide opportunities for students to plan

procedures and record predictions and their reasons for predictions before an activity.

5 Provide guidelines in the form of questions and headings and facilitate discussion about recording strategies, such as note-making, lists, summaries, tables and concept maps. Use the class design portfolio to show students how they can modify and improve their recording strategies.

6 Refer students to display charts, pictures, diagrams, word walls and phrases about the topic displayed around the classroom. Revisit and revise this material during the unit. Explore the vocabulary, visual texts and ideas that have developed from the unit, and encourage students to use them in their design portfolio.

7 Combine the use of resource sheets with design portfolio entries. After students have pasted their completed resource sheets in their design portfolio, they might like to add their own drawings and reflections.

8 Use the design portfolio to assess student learning in science, technology and literacy. For example, during the *Engage* phase, use design portfolio entries for diagnostic assessment as you identify students' prior knowledge. This allows you to take account of students' existing ideas when planning future learning experiences.

9 Discuss the importance of entries in the design portfolio during the *Explain* and *Evaluate* phases. Demonstrate how the information in the design portfolio will help students develop literacy products, such as posters, brochures, letters and oral or written presentations.

Section 1
Explore the task

This section is where students record information from their explorations which might assist them through the design process. Students have the opportunity to:

- recognise the design situation
- investigate packaging materials and designs used for commercial packaging to examine existing ideas and meet new ones
- describe and name the materials used to make the packages
- describe some features of these materials, such as soft, strong, flexible
- describe features of the packages, such as it is the same shape as the contents, it has air in it to cushion the contents, it is made of plastic to be waterproof
- conduct some simple tests to compare the effectiveness of commercial packaging
- identify the properties of packages
- gather information to make informed decisions about their designs.

Section 2
Define the task

In this section students record the design brief and develop a list of design criteria and the materials needed to make their product. It includes:

- the design brief

- the design criteria. For example, in order for the package to be successful it will be:
  - of a size suitable to hold the gift (dimensions)
  - able to protect the gift
  - low cost
  - waterproof
  - able to be posted
  - able to protect the gift from impact
  - environmentally responsible.
- a list of options against design criteria and a materials list
- what to explore to inform the design process
- confirmation of the fragile gift that is to be packaged and delivered
- critical factors for the success of the delivery of the fragile gift to develop the design criteria.

Section 3
Produce solutions

In this section, students collect ideas for how they will make their product. This includes diagrams and ideas, including steps in the procedure, and is where students:

- develop a plan and write a procedure for producing the product
- draw an annotated design sketch
- produce packaging according to design considerations and criteria
- prepare a presentation.

Section 4
Evaluate and reflect

This is where ongoing evaluation that occurs throughout the unit is recorded. It includes evaluation of materials, designs, ideas and processes, and is an opportunity for students to:

- make dated chronological entries as they reflect on their learning throughout the unit, including diagrams, sketches, tables and graphs
- evaluate packaging against the criteria
- evaluate the design process and products to determine ideas for improvement
- record new learning and reflect on their progress throughout the unit, including self-assessment
- compare ideas and findings with initial predictions and reasons and provide evidence that supports their ideas, reasons and reflections.

Appendix 3
How to use a word wall

Introduction

A word wall is an organised collection of words and images displayed in the classroom. It supports the development of vocabulary related to a particular topic and provides a reference for students. The content of the word wall can be words that students see, hear and use in their reading, writing, speaking, listening and viewing.

Goals in using a word wall

A word wall can be used to:

- support science and literacy experiences of reading, viewing, writing and speaking
- provide support for students during literacy activities across all key learning areas
- promote independence in students as they develop their literacy skills
- provide a visual representation to help students see patterns in words and decode them
- develop a growing bank of words that students can spell, read and/or use in writing tasks
- provide ongoing support for the various levels of academic ability in the class
- teach the strategy of using word sources as a real-life strategy.

Organisation

Position the word wall so that students have easy access to the words. They need to be able to see, remove and return word cards to the wall. A classroom could have one main word wall and two or three smaller ones, each with a different focus, for example, high-frequency words.

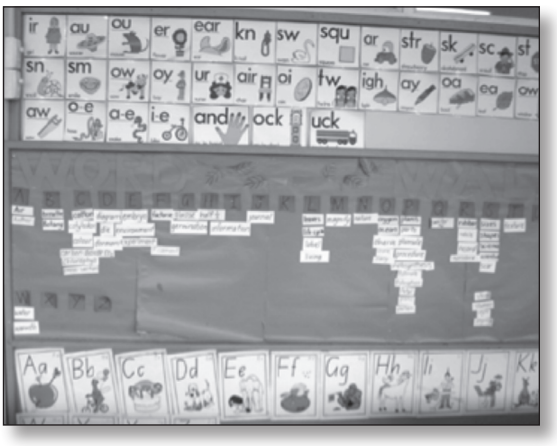
Choose robust material for the word cards. Write or type words on cardboard and perhaps laminate them. Consider covering the wall with felt-type material and backing each word card with a self-adhesive dot to make it easy for students to remove and replace word cards.

Word walls do not need to be confined to a wall. Use a portable wall, display screen, shower curtain or window curtain. Consider a cardboard shape that fits with the unit, for example, an apple for a needs unit.

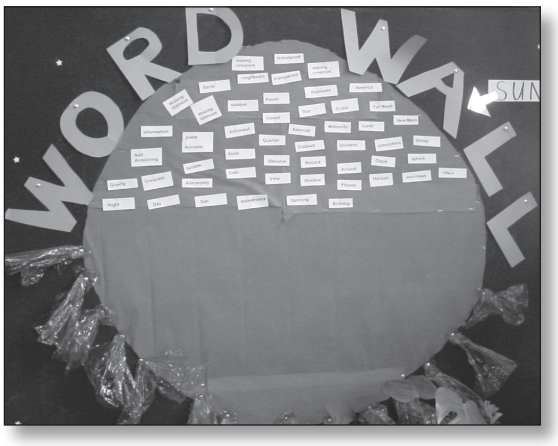
The purpose is for students to be exposed to a print-rich environment that supports their science and literacy experiences.

Organise the words on the wall in a variety of ways. Place them alphabetically, or put them in word groups or groups suggested by the unit topic, for example, words for a *Package it better* unit might be organised using headings, such as ‘Materials’, ‘Properties’ and ‘Investigative words’.

Invite students to contribute different words from different languages to the word wall. Group words about the same thing, for example, different names of processed materials, on the word wall so that the students can make the connections. Identify the different languages used, for example, by using different-coloured cards or pens to record the words.



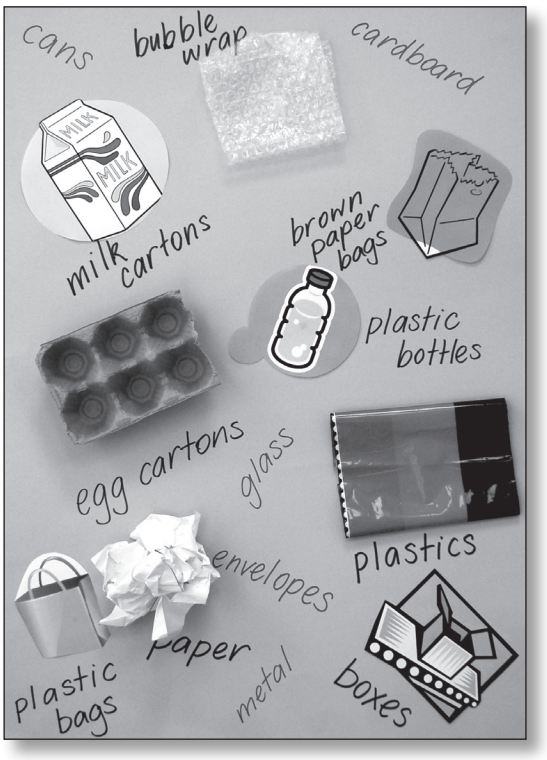
***Plants in action* word wall**



***Spinning in space* word wall**

Using a word wall

1. Limit the number of words to those needed to support the science and literacy experiences in the classroom.
2. Add words gradually, and include images where possible, such as drawings, diagrams or photographs. Build up the number of words on the word wall as students are introduced to the scientific vocabulary of the unit.
3. Encourage students to interact with the word wall. Practise using the words with students by reading them and playing word games. Refer to the words during science and literacy experiences and direct students to the wall when they need a word for writing. Encourage students to use the word wall to spell words correctly.
4. Use the word wall with the whole class, small groups and individual students during literacy experiences. Organise multi-level activities to cater for the individual needs of students.



***Package it better* word wall**

Appendix 4
How to conduct a fair test

Introduction

Scientific investigations involve posing questions, testing predictions, planning and conducting tests, interpreting and representing evidence, drawing conclusions and communicating findings.

Planning a fair test

In *Package it better*, students investigate which material best protects a product.

All scientific investigations involve *variables*. Variables are things that can be changed (independent), measured/observed (dependent) or kept the same (controlled) in an investigation. When planning an investigation, to make it a fair test, we need to identify the variables.

It is only by conducting a fair test that students can be sure that what they have changed in their investigation has affected what is being measured/observed.

'**C**ows **M**oo **S**oftly' is a useful scaffold to remind students how to plan a fair test:

Cows: **Change** one thing (independent variable)

Moo: **Measure/Observe** another thing (dependent variable)

Softly: keep the other things (controlled variables) the **Same**.

To investigate whether moisture has an effect on mould growth, students could:

CHANGE	the type of material	Independent variable
MEASURE/ OBSERVE	the drop height at which a weight first breaks the biscuit	Dependent variable
KEEP THE **SAME**	the weight the types of biscuit	Controlled variables

Appendix 5
Packaging it better equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	3	4	5	6	6	6	7	7	8
		SESSION						1	2	3	1	2	
Equipment and materials													
biscuits													
– biscuits (eg, arrowroot, ANZAC)	3 per team					●					●		
– biscuits, spare to replace breakages	several per team					●					●		
blocks (eg, books or boxes of tissues) to support the span of the bridge	2 per team						●						
container to hold small weights (eg, film canister, medicine measuring cup)	1 per team						●						
design brief, enlarged	1 per class		●										
dictionary	1 per class					●							
materials													
– to explore (eg, paper, cardboard, plastic, foil, bubble wrap)	collection per team				●								
– to explore (eg, paper, cardboard, plastic, foil, bubble wrap)	3 per team					●							
– range to make packages as per 'Procedure: Package plan' (RS3)	collection per student									●			
– materials, for making updated packages	collection per student											●	
measuring spoon (eg, teaspoon) *optional*	1 per team						●						
packages													
– package, battered	1 per class		●										
– to explore (eg, pizza box, post bags, juice boxes, tissue boxes, milk containers, CD cases, egg cartons, cardboard boxes)	3 per team			●									
– prototype package from Lesson 6	1 per student										●		

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	3	4	5	6	6	6	7	7	8
		SESSION						1	2	3	1	2	
Equipment and materials (continued)													
paper													
– A4 blank sheets	1 per team			●									
– A4 blank sheets	several per team						●						
– A4 for questionnaire	1 sheet per student											●	
– large (A2) for learning centre	6 per class		●										
ruler or tape measure, 1 m	1 per team					●							
self-adhesive tape	50 cm per team						●						
weight, 250 g	1 per team					●							
weights, small (eg, washers, paperclips, marbles, gravel or sand)	several per team						●						
Resource sheets													
'Observation record: Exploring materials' (RS1)	1 per student				●								
'Observation record: Exploring materials' (RS1), enlarged	1 per class				●								
'Impact investigation planner' (RS2)	1 per student					●							
'Impact investigation planner' (RS2), enlarged	1 per class					●							
'Procedure: Package plan' (RS3)	1 per student								●	●		●	
'Procedure: Package plan' (RS3), enlarged	1 per class								●				
'Product evaluation planner' (RS4)	1 per student										●		
'Product evaluation planner' (RS4), enlarged	1 per class										●		
'Assessment check' (RS5)	1 per student												●

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	3	4	5	6	6	6	7	7	8
		SESSION						1	2	3	1	2	
Teaching Tools													
class design portfolio	1 per class		●	●	●	●	●	●	●	●	●	●	●
class learning centre	1 per class		●	●	●	●	●	●	●	●	●	●	●
role wristbands or badges for Director, Manager and Speaker	1 set per team			●	●	●	●		●	●	●		
team roles chart	1 per class			●	●	●	●		●	●	●		
team skills chart	1 per class			●	●	●	●		●	●	●		
student design portfolio	1 per student		●	●	●	●	●	●	●	●	●	●	●
word wall	1 per class		●	●	●	●	●	●	●	●	●	●	●
Multimedia													
camera *optional*	1 per class							●					
computer *optional*	1 per class				●								
interactive whiteboard *optional*	1 per class				●								

Appendix 6
Package it better unit overview

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to represent their current understandings as they:	Students will be able to:	Students:	
ENGAGE	**Lesson 1** Packaging pandemonium	• explain the reasons for failure of a package • identify packages and the properties of materials used to make them • identify what they will need to do and find out in order to design an effective package.	• identify the purpose and features of a design portfolio • record ideas and questions to investigate • contribute to the class learning centre to represent their understanding of materials, properties and packages.	• respond to the delivery of a battered package • brainstorm ideas about packages, the materials used to make them, and the design and delivery of packages • engage with a design brief.	**Diagnostic assessment** • Design portfolio entries • Discussions
EXPLORE	**Lesson 2** Peering at packages	• identify and describe the characteristics of packages • describe the purpose, function and use of packages • identify materials that packages are made of.	• participate in whole class and small group discussions • use oral and written language to clarify and represent ideas about designs and materials of packages • identify the purpose and features of a summary.	• work in teams to explore the characteristics and uses of packages • record observations of packages and the materials used to make them • share and discuss findings.	**Formative assessment** • Design portfolio entries • Summaries

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 3** Plenty of properties	• construct simple tests to explore the properties of materials • identify how the properties of materials affect their use in packages • discuss the environmental impact of the use of packages and the materials used to make them.	• participate in whole class and small group discussions to compare the properties of different materials • use oral and written language to discuss and record test results.	• explore the properties of materials that are used to make packages • discuss the environmental impact of materials that are used to make packages.	**Formative assessment** • 'Observation record: Exploring materials' (Resource sheet 1)
	Lesson 4 Lumps, bumps and crumbs	• plan and conduct an investigation that is a fair test • make and record observations • interpret observations and draw conclusions to answer the investigation question.	• use oral and written language to discuss and record investigation results • discuss ideas to compare evidence from investigations • identify the purpose and features of a table.	• work in collaborative learning teams investigate the capacity of different materials to protect a biscuit from impact • make predictions, observe and record the results of their investigations • describe how the use of materials is determined by their properties.	**Formative assessment** • Design portfolio entries • 'Impact investigation planner' (Resource sheet 2)

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 5** Strong shapes	• identify shapes that add strength to materials • test their predictions • observe, record and interpret the results of their investigation.	• use oral, written and visual language to record and discuss investigation results • discuss ideas and relate evidence from an investigation • represent ideas about strengthening materials through shape.	• work in collaborative learning teams to investigate how to strengthen a sheet of paper by changing its shape • discuss their results.	**Formative assessment** • Design portfolio entries

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLAIN	**Lesson 6** Daring designs ***Session 1*** Guest speaker ***Session 2*** Package plan ***Session 3*** Prototype production	• discuss the function of different materials in package design • explain how properties of materials influence their use • select appropriate materials for a specific purpose and give reasons for their selection • plan a design for a package that will protect a fragile gift.	• use oral, written and visual language to develop a plan for the making of their package • represent their ideas by annotating a drawing • explain the purpose, structure and features of a procedural text • engage in discussion to compare ideas and generate explanations.	***Session 1*** **Guest speaker** • interview a guest speaker about effective package design and delivery • identify factors for consideration in package design. ***Session 2*** **Package plan** • review criteria for judging the success of packages • identify properties of materials and how these influence their use in packages • develop a procedural text plan for their design task. ***Session 3*** **Prototype production** • apply their plans to make a prototype package • amend their plan during the making of their package • develop explanations about materials science and the design process.	**Formative assessment** • Design portfolio entries • 'Procedure: Package plan' (Resource sheet 3) • Each student's prototype package

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
ELABORATE	**Lesson 7** Package performance ***Session 1*** Product evaluation ***Session 2*** Product review	• plan and conduct a product evaluation to determine the effectives of their prototype package • make and record observations • interpret observations and make a conclusion • provide evidence to support their conclusion.	• summarise findings • engage in discussion to compare ideas and identify factors that improve the effectives of their prototype package • develop a questionnaire to evaluate a package against functional, aesthetic and environmental performance criteria.	***Session 1*** **Product evaluation** • undertake product evaluation to determine the effectiveness of their prototype package to meet the design criteria. ***Session 2*** **Product review** • evaluate their prototype package and recommend changes to the design • modify their procedural text plan to reflect updated design features • make a revised package • develop an evaluation questionnaire to dispatch with the package.	**Summative assessment** of Science Inquiry Skills • Design portfolio entries • 'Product evaluation planner' (Resource sheet 4) • 'Procedure: Package plan' (Resource sheet 3)

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EVALUATE	**Lesson 8** All wrapped up	• analyse feedback to evaluate their package against design criteria • explain how properties of materials influence their use • evaluate the success of the design process • describe reasons for the performance of their package.	• represent their ideas about packages and materials in a presentation • present their learning about the design process to an audience.	• evaluate the performance of their package using feedback from a questionnaire • reflect on their learning about materials, their properties, and the design process • plan and give an oral presentation summarising findings about their design and the design process.	**Summative assessment** of Science Understanding • Design portfolio entries • Student presentations • 'Assessment check' (Resource sheet 5) • Questionnaire results

* These lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page 2 for Science and page 7 for English and Mathematics.

PrimaryConnections®
Linking science with literacy

Order your next unit at
www.primaryconnections.org.au

Year	Biological sciences	Chemical sciences	Earth and space sciences	Physical sciences
F	*Staying alive*	*What's it made of?*	*Weather in my world*	*On the move*
1	*Schoolyard safari*	*Spot the difference*	*Up, down and all around*	*Look! Listen!*
2	*Watch it grow!*	*All mixed up*	*Water works*	*Push pull*
3	*Feathers, fur or leaves?*	*Melting moments*	*Night and day*	*Heating up*
4	*Plants in action*	*Material world*	*Beneath our feet*	*Smooth moves*
	Friends and foes	*Package it better*		
5	*Desert survivors*	*What's the matter?*	*Earth's place in space*	*Light shows*
6	*Marvellous micro-organisms*	*Change detectives*	*Earthquake explorers*	*It's electrifying*
				Essential energy

PrimaryConnections®
Linking science with literacy

*Primary**Connections**: Linking science with literacy* is an innovative program linking the teaching of science with the teaching of literacy in primary schools.

The program combines a sophisticated professional learning component with exemplary curriculum resources.

Primary**Connections** features an inquiry-based approach, embedded assessment and incorporates Indigenous perspectives.

The Primary**Connections** curriculum resources span Years F–6 of primary school.

www.primaryconnections.org.au

Australian Government

Australian Academy of Science

ISBN 978-0-85847-314-0

PC:4:C1P