PrimaryConnections®
Linking science with literacy

Fully aligned with the Australian Curriculum

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

Material world

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

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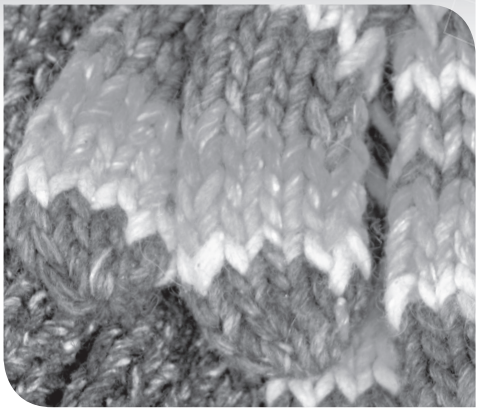

New materials have revolutionised modern life. Plastics have been used instead of glass in bottles and windows, and even instead of metals in aeroplanes. Lighter, stronger, warmer fabrics have made extreme weather conditions more comfortable. Designers incorporate new materials in clothes and bags to better suit our needs. Materials scientists are now researching materials that have desirable properties but have less impact on the environment.

The *Material world* unit is an ideal way to link science with literacy in the classroom. This unit provides opportunities for students to develop an understanding of the properties of materials and how they relate to use. Through investigations, students explore how to test the properties of materials fairly and how to use this knowledge to choose materials wisely.

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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

Primary**Connections** 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.

Primary**Connections** develops the literacies of science that students need to learn and to represent their understanding of science concepts, processes and skills. Representations in Primary**Connections** 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, 2014) is ongoing and embedded in Primary**Connections** units. Assessment is linked to the development of literacy practices and products. Relevant understandings and skills 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 for 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, 2014).

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 

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 — *Material world*

Phase	Lesson	At a glance
ENGAGE	**Lesson 1** Curious clothes ***Session 1*** Fanciful fiction ***Session 2*** Gripping gloves	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 how these properties can influence their use To elicit students' questions about the properties of materials and uses of materials in everyday life
EXPLORE	**Lesson 2** What a rotter ***Session 1*** That's not fair! ***Session 2*** Rot or remain?	To provide students with hands-on, shared experiences of fair testing and the decomposition of materials
	Lesson 3 Leak, soak or repel?	To provide students with hands-on, shared experiences of the absorbency of materials
	Lesson 4 Snap, tear or stretch?	To provide students with hands-on, shared experiences of the tensile strength of materials
EXPLAIN	**Lesson 5** Choosey consumers ***Session 1*** Bags of fun ***Session 2*** Puzzling plastics	To support students to represent and explain their understanding of the properties of materials and how they relate to use, and to introduce current scientific views
ELABORATE	**Lesson 6** Investigating insulation	To support students to plan and conduct an investigation of the thermal insulation capacity of materials
EVALUATE	**Lesson 7** Material matters	To provide opportunities for students to represent what they know about how natural and processed materials have a range of physical properties, how these properties can influence their use, and to reflect on their learning during the unit

A unit overview can be found in Appendix 8, page 85.

Alignment with the Australian Curriculum: Science

This *Material world* 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.

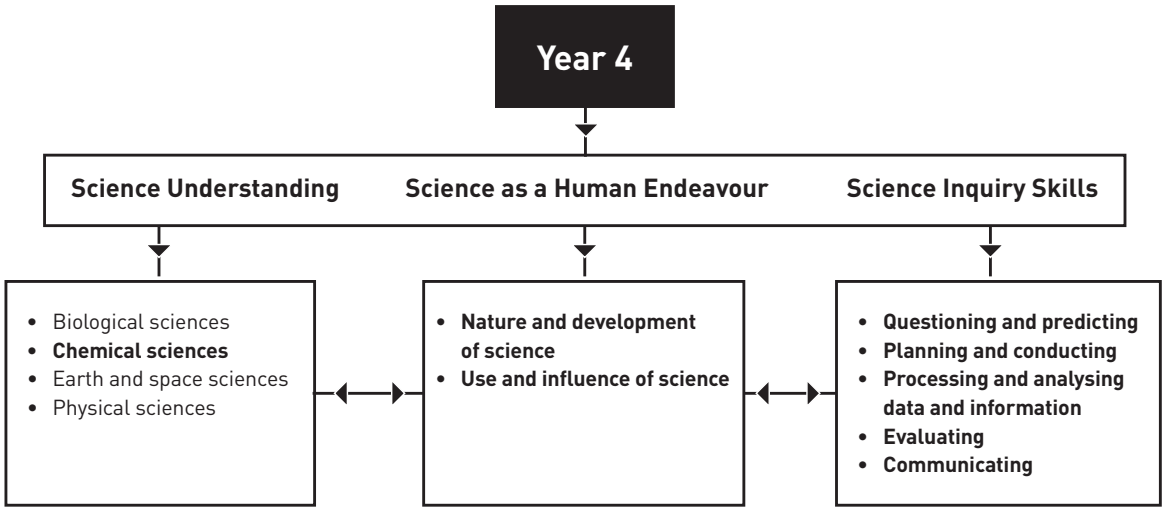
For ease of assessment the table below outlines the sub-strands and their aligned lessons.

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	1–7
Science as a Human Endeavour (SHE)	**Nature and development of science**	ACSHE061	Science involves making predictions and describing patterns and relationships	1–7
	Use and influence of science	ACSHE062	Science knowledge helps people to understand the effect of their actions	1, 2, 3, 4, 5, 7
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	2, 3, 4, 6
	Planning and conducting	ACSIS065	Suggest ways to plan and conduct investigations to find answers to questions	6
		ACSIS066	Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate	2, 3, 4, 6
	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	2, 3, 4, 6
		ACSIS216	Compare results with predictions, suggesting possible reasons for findings	4, 6
	Evaluating	ACSIS069	Reflect on the investigation; including whether a test was fair or not	2, 3, 4, 6
	Communicating	ACSIS071	Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports	1, 6, 7

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 *Material world* these overarching ideas are represented by:

Overarching idea	Incorporation in *Material world*
Patterns, order and organisation	Students conduct repeat fair tests and look for patterns in results to inform their choices of materials for particular purposes.
Form and function	Students investigate the physical properties of materials and their suitability for particular uses.
Stability and change	Students explore how the speed of decomposition of a material depends on environmental conditions and their chemical nature.
Scale and measurement	Students use formal units of measurement and equipment to measure the temperature of water to decide if materials are good insulators.
Matter and energy	Students identify physical properties used by scientists to identify the suitability of materials used to make clothes and bags.
Systems	Students consider the environmental effects of using recycled materials and plastics for making bags.

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 *Material world*
Recognising questions that can be investigated scientifically and investigating them	Students use fair tests to investigate decomposition, absorbency, tensile strength and thermal insulation capacity of materials and develop explanations based on their results.

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.

Material world—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	*Material world* 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 *Material world* the literacy focuses are: • science journals • word walls • glossaries • annotated drawings • tables • role-plays • factual texts • graphs.
 **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 in a table • use a tally system • use a thermometer accurately • record findings in a graph.
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: • use a digital camera to record observations.
 **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: • give reasons for choices • predict and give reasons for predictions • discuss ideas • brainstorm variables • give possible solutions • analyse and compare graphs.
Ethical behaviour	Students develop ethical behaviour as they explore ethical principles and guidelines in gathering evidence and consider the ethical implications of their investigations on others and the environment.	Students: • ask questions respecting each other's point of view • discuss the environmental implications of using plastics.
 **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 Primary**Connections** 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

Material world focuses on the Western science way of making evidence-based claims about the way materials have properties that influence their use.

Aboriginal and Torres Strait Islander Peoples might have other explanations for the observed phenomenon of physical properties of natural and processed materials.

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.

Sustainability

The *Material world* unit provides opportunities for students to develop an understanding of how natural and processed materials have different physical properties that affect their use. People combine materials to make them more useful and scientists develop new materials based on their properties. This can assist students 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 descriptions	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	1, 2, 4, 6, 7
		ACELA1489	Understand differences between the language of opinion and feeling and the language of factual reporting or recording	1, 2, 4, 6, 7
	Expressing and developing ideas	ACELA1498	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	1–7
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, 2, 4, 6, 7
		ACELY1689	Plan, rehearse and deliver presentations incorporating learned content and taking into account the particular purposes and audiences	5
Mathematics–Measurement and Geometry	**Using units of measurement**	ACMMG084	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures	6
Mathematics–Statistics and Probablility	**Data representation and interpretation**	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	2, 6

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

Introduction to materials

In this unit, the term 'material' refers to what objects are made of, such as plastic, rubber, glass or paper. The properties of an object depend on what materials are used to make it. For example, a raincoat made from plastic (material) is strong and waterproof (properties of plastic). Some properties of the object, however, do not depend on the materials chosen, such as the style and size of a raincoat.

Materials have properties that can be used to describe and classify them. The properties of materials come from the chemical and physical nature of the substances that are used to make them. Some of the physical properties used by scientists to describe materials include absorbency, strength, flexibility, elasticity, malleability, transparency, viscosity, porosity, density, opacity, hardness and brittleness.

Different materials have different properties and are therefore suitable for use in different objects. For example, stockings require a material with some elasticity to allow them to change shape when a force is applied, and recover their original shape when the force is removed. Winter coats need materials that are good thermal insulators, for example, wool, to keep the wearer's warmth close to their body. Gardening boots need to be made of a material that is supple and waterproof, for example, rubber.

Clothes can be made from a variety of natural and manufactured materials, including fabrics. Fabrics are usually made from yarn which is then woven, knitted or twisted into other things, such as cloth, rope and braid. Cotton, silk and wool are natural fibres, while nylon and polyester are synthetic fibres. Both can be used for making fabric materials. Some special fabrics can be made from links of metal or from rubber.

Students' conceptions

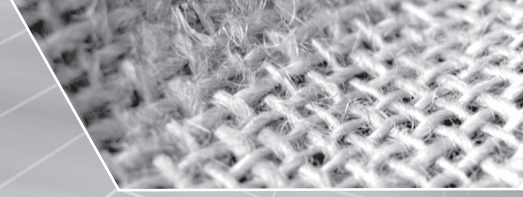
Taking account of students' existing ideas is important in planning effective teaching approaches which help students learn science. Students develop their own ideas during their experiences in everyday life and might hold more than one idea about an event or phenomenon.

Students might know a range of meanings for the word 'material', such as fabric or written information, and for the term 'property', such as land, real estate or possessions. For this unit, the term 'material' refers to what an object is made of, and 'properties' are qualities or attributes.

Many students might be unaware that the properties of a material determine how useful it is for particular purposes. For instance, they might just accept that rubber is commonly used in the soles of shoes without considering the properties which make them suitable for wear including flexibility and durability.

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 Curious clothes

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 how these properties can influence their use.

To elicit students' questions about the properties of materials and uses of materials in everyday life.

Session 1 Fanciful fiction

Students:

- use a narrative and discussion to explore the relationship between properties of materials and their uses
- construct a snapshot of what they know about the properties of materials and their uses.

Session 2 Gripping gloves

Students:

- identify the uses of different gloves
- explore the materials used to make different types of gloves.

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively and to represent their ideas in an annotated drawing.

Key lesson outcomes

Science

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

- discuss the properties of materials
- explore how the properties of materials relate to their use.

Literacy

Students will be able to:

- contribute to discussions about properties and uses of materials
- understand the purpose and features of an annotated drawing
- develop scientific vocabulary about materials and properties
- record ideas about materials and properties in a science journal.

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

Teacher background information

The properties of an object depend on the materials that are used to make it and how those materials are put together. A ski glove (object) has an outer layer made of a waterproof material, for example, plastic, and an inner layer that keeps the hands warm, for example, wool. The purpose of the glove is to keep a hand warm and dry. Whether or not the glove achieves its purpose, depends on the properties of the two different materials used to make it, and the way in which they were put together.

Students' conceptions

Students may not be able to differentiate between meanings of different words, such as 'hard' or 'strong'. Students may also associate 'weak' with 'light' and 'heavy' with 'strong'. As students' language is context specific, it is important that students develop appropriate language to describe and compare the properties of materials. Most students are able to distinguish between an object and the material from which it is made. They may, however, have difficulty distinguishing between the properties of the object, such as size, shape and weight, and the properties of the materials used to make the object, such as durability and flexibility.

Session 1 Fanciful fiction

Equipment

FOR THE CLASS

- class science journal
- word wall
- narrative text – *Animals Should Definitely Not Wear Clothing* or *Mr Tuggle's Trouble* (see 'Preparation')
- 1 piece of clothing (see Lesson step 4)
- 1–2 large sheets of cardboard

FOR EACH STUDENT

- several self-adhesive notes

Preparation

- Read 'How to use a science journal' (Appendix 2).
- Read 'How to use a word wall' (Appendix 3).
- Read 'How to use a glossary' (Appendix 4). Decide where to compile a class glossary, such as in the back of the class science journal, as part of the word wall or electronically.
- Find a narrative text that introduces clothes and how the properties of the materials used to make them, affect their suitability for different uses. For example, *Animals Should Definitely Not Wear Clothing* by Judi Barrett or *Mr Tuggle's Trouble* by LeeAnn Blankenship.

  Optional: If you cannot locate a narrative text, write one telling of a day when you wore inappropriate clothes. Alternatively, ask students to create a text as a literacy lesson.
- Prepare a class materials snapshot display area using 1–2 large sheets of cardboard. Decide on a title, for example, 'What we know about materials'.
- Begin collecting eye-droppers (see Lesson 3) and thermometers (see Lesson 6).

Lesson steps

1. Introduce the selected narrative text about how the properties of the materials used to make clothes affect their suitability for different uses (see 'Preparation'). Ask questions relating to the text, such as:
   - When would you wear gumboots? Why?
   - Would you wear a jumper in the desert? Why/Why not?
2. Introduce the class science journal and explain the purpose and features of a science journal.

ENGAGE

Literacy focus

Why do we use a science journal?

We use a **science journal** to record what we see, hear, feel and think so that we can look at it later to help us with our claims and evidence.

What does a science journal include?

A **science journal** includes dates and times. It might include written text, drawings, measurements, labelled diagrams, photographs, tables and graphs.

Record in the class science journal some ideas about materials that clothes are made of, and why these materials are chosen.

3 Introduce the class word wall and discuss its purpose and features.

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.

4 Write the terms 'object', 'material' and 'properties' on cards for the class word wall and ask students to describe what they think the terms might mean. Introduce a piece of clothing, for example, a raincoat, and ask questions, such as:

- What is this? Is it an object?
- What material(s) is it made of?
- Is the material natural or processed? Why do you think that?
- Why do you think this material was chosen?

Record responses to the questions in the science journal using the following sentence structures:

- The object is a…(The object is a raincoat.)
- The…is made of…(The raincoat is made of plastic.)
- …was used because…(Plastic was used because it is light and waterproof.)

Draw students' attention to the last sentence and explain that scientists call 'light' and 'waterproof' the properties of materials. Repeat this Lesson step using other objects.

Note: This is an opportunity to assess students' prior knowledge of objects, materials they are made of and their properties, and to develop a shared understanding of the terms (see 'Teacher background information').

5 Discuss the purpose and features of a glossary.

Literacy focus

Why do we use a glossary?

We use a **glossary** to provide definitions of technical terms that relate to a particular subject matter or topic.

What does a glossary include?

A **glossary** includes a list of technical terms in alphabetical order, accompanied by a description or an explanation of the term in the context of the subject.

Write in the glossary an agreed description of the terms 'object', 'material' and 'properties'.

6 Write the term 'fabric' on the word wall and compare it with the term 'material' as used in this unit. Add an agreed description of the term 'fabric' to the glossary.

Note: Materials are what objects are made of and include materials, such as fabric, metal, wood and plastic.

7 Explain that the class is going to build a materials snapshot. Ask each student to record words, sentences or drawings of what they know about materials, properties and their uses, on self-adhesive notes. Ask students to put their initials on the reverse side. Encourage students to think of a variety of materials, not just those used to make clothes. Model some contributions, such as:

- Plastic is waterproof and is used in raincoats.
- Rubber is bendy and can be used in shoes.
- Paper is flat, tears easily and is good for writing on.

Note: Use the students' initials on the self-adhesive notes for diagnostic assessment of individual students' prior knowledge of materials and their properties.

8 Display students' contributions on display area (see 'Preparation') to create the class materials snapshot of what they know about materials, their properties and their uses.

9 Update the word wall and glossary with words and images.

Session 2 Gripping gloves

ENGAGE

Equipment

FOR THE CLASS

- class science journal
- word wall
- class materials snapshot from Lesson 1, Session 1
- 1 enlarged copy of 'Glove guide' (Resource sheet 1)
- collection of different gloves (eg, woollen, ski, gardening, evening, rubber (dishwashing), latex, see 'Preparation')
- large box (see 'Preparation')
- *optional:* 1 enlarged copy of 'Information note for families' (Resource sheet 2)
- *optional:* 1 enlarged copy of 'Bags at home' (Resource sheet 3)

FOR EACH STUDENT

- science journal
- 1 copy of 'Glove guide' (Resource sheet 1)
- *optional:* 1 copy of 'Information note for families' (Resource sheet 2)
- *optional:* 1 copy of 'Bags at home' (Resource sheet 3)

Preparation

- Collect gloves made with different materials and for different uses, such as woollen gloves, ski gloves, gardening gloves, evening gloves, rubber (dishwashing) gloves and latex gloves.

  Optional: Borrow gloves from members of the community, such as a police officer, a fire-fighter or a butcher.

  Note: Include gloves which are both familiar and unfamiliar to students.
- Label a large box 'Glove box' and put one of each pair of gloves from the collection in it.
- Write these two sentence starters on separate pages in the class science journal:
  - Things I think I know about the properties and uses of materials are…
  - Things I'm interested in finding out about are…

  Optional: Organise a date for students to present their 'Bags at home' (Resource sheet 3) and write this information on 'Information note for families' (Resource sheet 2). Students' presentations are best completed before the *Explain* phase.

Lesson steps

1. Review the class materials snapshot created in Session 1. Explain that students will be exploring the materials used for clothes and accessories, for example, bags.
2. Introduce the 'Glove box' (see 'Preparation'). Explain that the box is full of gloves and students are going to try and work out what each glove might be used for.
3. Take a glove from the box and model describing its properties of the object. This will include observations about how heavy it is and what size it is, and then model identifying the materials it is made of, for example, 'An oven glove is big and looks like a mitten. It is made of thick fabric.'
4. Ask a student to take one of the gloves out of the box. Ask questions, such as:
   - What might this glove be used for?
   - What is the glove made of?
   - Do you think that material is natural? Why or why not?
   - Why do you think it is made of that material?
   - What else could the glove be used for?

   Encourage students to think of uses for the glove and to provide reasons for their choice. For example, the oven glove can be used to protect hands because the heat goes into the thick material before it reaches the hand.

   Note: In the *Engage* phase, do not provide any formal definitions or correct any answers as the purpose is to elicit students' prior knowledge.
5. Introduce the enlarged copy of 'Glove guide' (Resource sheet 1). Explain that students will draw a type of glove on the picture of each hand to show what they know about the materials of the glove, their properties and possible uses. Encourage students to include gloves that are not represented in the 'Glove box'.
6. Discuss the purposes and features of an annotated drawing.

Literacy focus

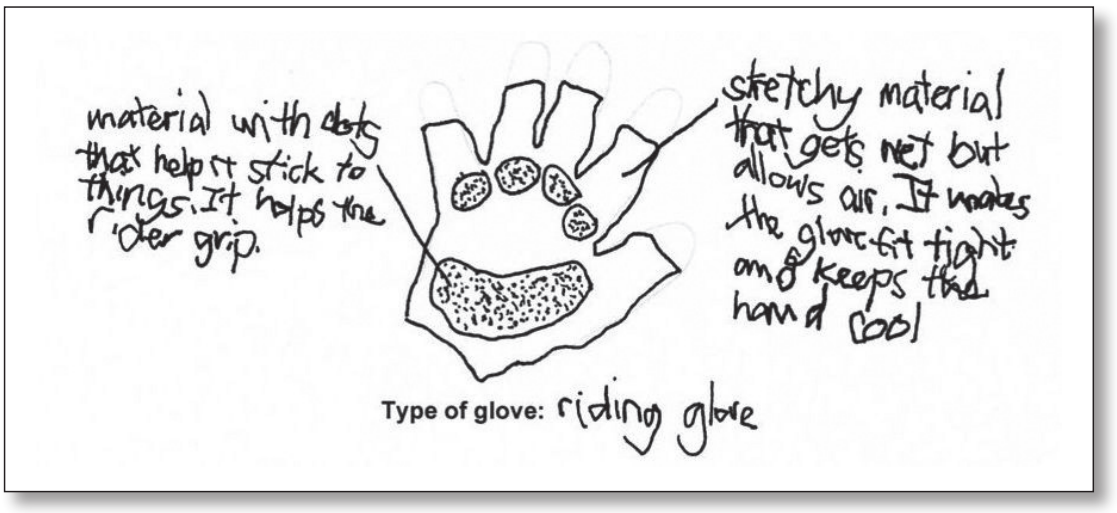
Why do we use an annotated drawing?

We use an **annotated drawing** to show an idea or object.

What does an annotated drawing include?

An **annotated drawing** includes a picture and words or descriptions about the idea or object.

7. Model, on the enlarged copy of 'Glove guide' (Resource sheet 1), an annotated drawing of a glove, including information about the materials used to make the glove,



Student work sample of one section of 'Glove guide' (Resource sheet 1)

properties of those materials and possible uses for the glove.

8 Ask students to complete their copy of 'Glove guide' (Resource sheet 1) and share it with a partner.

9 *Optional:* Introduce the enlarged copy of 'Information note for families' (Resource sheet 2) and 'Bags at home' (Resource sheet 3). Model an entry about a schoolbag and discuss how students will record information about bags at home.

10 Model a science journal entry in the class science journal by completing the following sentence starters:

- Things I think I know about the properties and uses of materials are…
- Things I'm interested in finding out about are…

Ask students to write their own science journal entry using the same sentence starters.

11 Update the word wall and glossary with words and images.

Curriculum links

Indigenous perspectives

- Read *Ernie dances to the didgeridoo* by Alison Lester, focusing on the children shown wearing clothes that are appropriate for the conditions around them.
- 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).

Glove guide

Name: _____ **Date:** _____

Draw the glove on the hand and annotate the drawing.

Type of glove:

Type of glove:

Type of glove:

 ISBN 978 0 85847 316 4

Information note for families

Name: _____ **Date:** _____

Introducing the 'Bags at home' project

This term our class will explore how the different properties of materials affect how they are used. As part of the *Material world* unit, students will be examining what different bags are made of in their home. This might include fabric, plastic, rubber or cardboard.

Tasks to do

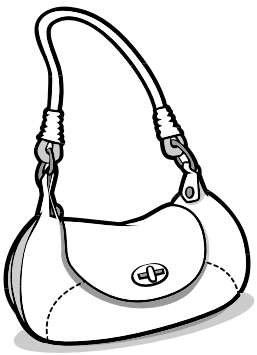
Each student will have a 'Bags at home' sheet to record information on including drawings. Students will be asked to examine the bags and determine what material(s) they are made of. Students are encouraged to take photographs or bring in any unusual bags or materials they find.

Where possible, students are also asked to bring in a bag that can be cut up and used for investigations, for example a bag made of: plastic, paper, fabric or a combination of materials.

Students are also asked to talk to parents and grandparents about what bags were made of before plastic became widespread.

Students will be asked to share their observations with classmates on _____.

Class Teacher



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Bags at home

Name: _____ **Date:** _____

Search around your home for bags. Draw pictures of the bags found, and write when they are used and what materials they are made of.

Bag When is the bag used? _____ _____ _____ What materials is the bag made of? _____ _____	Bag When is the bag used? _____ _____ _____ What materials is the bag made of? _____ _____
Bag When is the bag used? _____ _____ _____ What materials is the bag made of? _____ _____	Bag When is the bag used? _____ _____ _____ What materials is the bag made of? _____ _____

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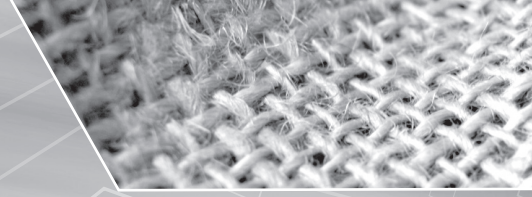


Lesson 2 What a rotter

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of fair testing and the decomposition of materials.

Session 1 That's not fair!

Students:

- consider the 'fairness' of a dress-up relay
- record their ideas about fair testing in their science journals.

Session 2 Rot or remain?

Students:

- make predictions about decomposition of materials
- investigate the decomposition of materials showing an awareness of the need for fair testing.

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- identify the features of a fair test
- identify variables to investigate
- make predictions about the decomposition of materials and give reasons for their predictions
- test materials for decomposition.

Literacy

Students will be able to:

- contribute to discussions about fair testing and the decomposition of materials
- develop scientific vocabulary about decomposition
- describe the purpose and features of a table
- record ideas in a science.

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

Session 1 That's not fair!

Equipment

FOR THE CLASS

- class science journal
- word wall
- collection of clothes (eg, jumpers, gloves, hats, scarves, dresses, aprons, shirts, see 'Preparation')
- 3 markers for a relay (eg, witches hats, cones, see Lesson step 2)

FOR EACH STUDENT

- science journal

Preparation

- Read 'How to conduct a fair test' (Appendix 5).
- For the 'clothes relay' find a collection of large clothes for students to put on over their school clothes, such as jumpers, gloves, hats, scarves, dresses, aprons and shirts.
- As students will be running during the relay session, they will need to wear appropriate shoes and clothing. Avoid clothes that students could trip on, for example, trousers.

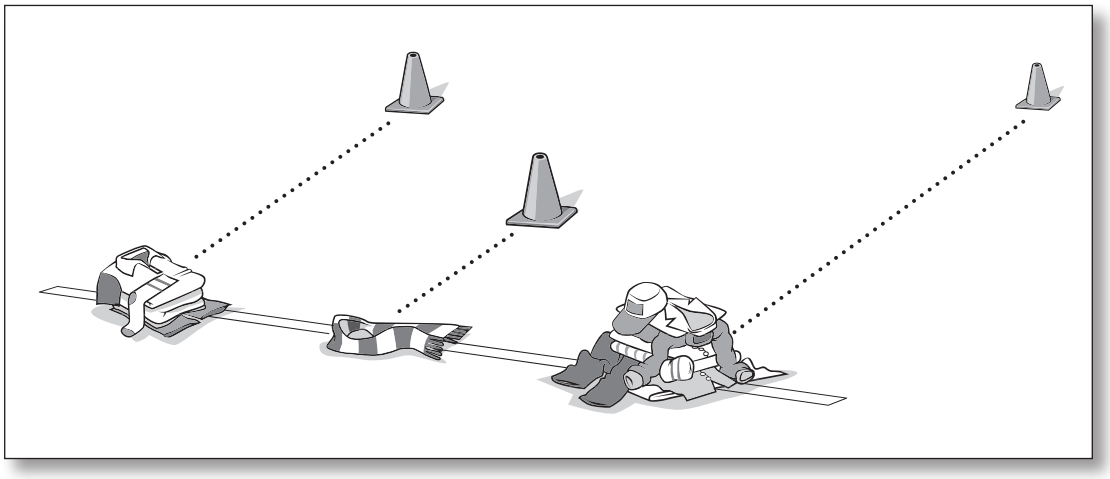
  Check that students are not allergic to any of the materials chosen, such as feathers, wool or rubber.
- Organise an area for the relay.

SAFETY

SAFETY

Lesson steps

1. Introduce some items of clothing and explain that you are going to set-up a 'clothes relay'.
2. Ask the class to watch as you create three unequal piles of clothing, for example, piles containing one, four and eight items of clothing. Place them at three different spots along a start line and place three markers at different distances from them. Place the largest amount of clothing opposite the marker the furthest away from the start line. Form three teams for the relay. Explain that the first team member has to put on the clothes at the start line, run around the marker and back, and then transfer the clothes to the second team member, and so on.
3. Run the relay.
4. Ask students if it was a fair relay and which things made it unfair. For example, if one team has to run further it will take longer, or if one team has more clothes to put on that will slow them down.



Sample of set up for an unfair dress-up relay

5. Ask students to suggest things that could affect how long a team will take to get through the relay.
6. Introduce the term 'variables' as factors that can affect the outcome of a test, such as the number of clothes, the length of the run, the number of team members, the type of ground run on and the speed of the runners. Add the term 'variable' to the word wall and glossary.
7. Discuss how to ensure the variables don't affect the outcome of the relay, for example, they need to be kept the same.
8. Ask students to write the heading 'What is a fair test?' in their science journals and record responses to questions, such as:
   - What makes a test, contest or relay fair or unfair? (For example, rules and standard equipment; keeping some things the same like starting lines.)
   - Why is it important to make science tests/investigations fair? (So we know what caused the observed changes; to get reliable results we can trust.)

   Note: Explain that students will return to this page later in the unit to review and add to their comments about fair testing.

9 *Optional:* Run a fair relay with the class and discuss what made it a fair race, highlighting how some things need to be kept the same.

10 Update the word wall and glossary with words and images.

Curriculum links

Mathematics

- Measure distances for the relay race.

Health and Physical Education

- Discuss and practise fair play in games.

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).

Session 2 Rot or remain?

Teacher background information

Materials decompose because of the normal activities of the environment, such as the effects of wind, rain and the Sun. Materials that are biodegradable are able to be broken down and used by living organisms. When an object is no longer useful, being made of biodegradable materials is an advantage since it will decompose quickly in the right environment.

The speed at which materials decompose depends on environmental conditions and their chemical nature. Generally, the more humid and moist the surrounding conditions, the faster a material decomposes. Fungi and bacteria are more active in moist, warm conditions, so they can break down biodegradable materials faster. The materials can also be susceptible to the effects of water and warmth.

Most natural materials are biodegradable, such as wool, paper, bamboo and packing beads made from corn starch.

Plastics are common materials that are often not biodegradable. Because plastics are so useful, materials scientists are working to develop biodegradable plastics. Some scientists are exploring making plastics from plant or bacterial products, while others are researching additives for oil-based plastics to make them biodegradable in the environment.

Sometimes, biodegradability is not desirable. For example, when used for items that are required to last for long periods outside, such as building materials and farm equipment.

Equipment

FOR THE CLASS

- class science journal
- word wall
- team roles chart
- team skills chart
- 3 cm x 3 cm material sample (eg, newspaper)
- 1 marking pen
- 1 clear plastic container, at least 10 cm deep (eg, a takeaway food container)
- *optional:* digital camera

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 3 or more 3 cm x 3 cm material samples (eg, paper, plastic and fabric bags, see 'Preparation')
- 1 marking pen
- 1 clear plastic container, at least 10 cm deep (eg, a takeaway food container)
- 1 apple core
- soil, enough to fill a plastic container 10 cm deep

Preparation

- Read 'How to organise collaborative learning teams' (Appendix 1). Display an enlarged copy of the team skills chart and the team roles chart in the classroom. Prepare role wristbands or badges for Directors, Managers and Speakers, and the equipment table.
- Collect 3 cm x 3 cm square material samples of similar thickness for each team and the class from bags made from materials, such as paper, plastic and fabric.
- If students have brought in dispensable bags from home, ask them to cut a 3 cm x 3 cm square of the material used, to be included in their team's investigation.

  Note: It is important to include samples of paper bags, fabric bags and non-biodegradable plastic bags to develop links between lessons in the *Explore* and *Explain* phases.
- Collect something organic which rots easily, for example, an apple core, for each team. This will provide something to compare with the material samples.
- Prepare clear, plastic food containers for each team. Students place the samples at the bottom and cover them with moist soil. Students observe the samples through the bottom of the container. (The samples will be removed from the soil at the *Explain* phase.)

  Note: The soil will need to be kept moist.
- Prepare the heading 'Keeping the decomposition test fair' in the class science journal.
- Prepare a 'Rot or remain?' table in the class science journal, for example:

Rot or remain?

Materials we think will rot or decompose	Materials we think will not rot or decompose

Lesson steps

1. Review the previous session, focusing students' attention on fair testing.
2. *Optional:* Ask students to report what they have learned about materials that bags are made of in the home.
3. Discuss what happens to household items that are no longer needed.

   Ask questions, such as:

   - Has anybody got any new clothes or bags?
   - What happens to your old clothes or bags?
   - What happens to clothes and bags when they are of no use to anyone?
   - If no one ever threw their clothes out, how much space would our old clothes take up?
   - If we put our rags in the bin, and it goes to landfill or the dump, what happens then?
4. Ask students what it might mean if something can decompose. Add 'decomposition', and associated terms, such as 'rot' and 'biodegradable', to the word wall and glossary.

   Note: 'Biodegradable' products are able to be broken down by living organisms. 'Decomposition' includes biodegradability, weathering and other changes that may break down a material.

5. Ask students which everyday materials they think can decompose and which cannot, such as apple flesh or a plastic bag. Discuss how apple flesh is a natural material and a plastic bag is a processed material, and if this will help decide which materials will decompose. Record their answers in the 'Rot or remain?' table in the class science journal. 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.

EXPLORE

6 Explain that students will be working in collaborative learning teams to set up a decomposition investigation.

7 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 role wristbands or Director, Manager and Speaker badges to help them (and you) know which role each team member should doing.

8 Introduce the samples of materials and explain that students will bury them in moist soil. Discuss why the soil needs to be kept moist (see 'Teacher background information').

9 Ask students to predict and give reasons about what they think will happen to each material. Encourage students to record their predictions and reasons in their science journals, using the following sentence structure:

I think _____ because _____.

10 Review the term 'variables' (see 'Appendix 5'). Ask students to suggest variables that will affect how long it takes for a piece of material to rot. Ask students how they could make this a fair test and record their suggestions under the 'Keeping the decomposition test fair' heading in the class science journal. For example:

- The pieces of material will have to be the same size.
- The samples will be buried at the same depth in the soil.
- The area of soil will receive the same amount of water to keep it moist.

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

12 Demonstrate how to place a material at the bottom of the container and cover with 10 cm of moist soil. Use a marking pen to model labelling the side of the container with initials and the date of burial.

Note: Keep all containers in a similar location out of direct sunlight or classroom lighting to avoid large differences in temperature.

13 *Optional:* Trace the outline of each sample on the bottom of the container for comparison, tape an original sample of each material to the top of the container or use a digital camera to photograph the original sample.

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

15 Allow time for teams to bury their samples of materials.

16 Ask students to write the heading 'Rotten results' in their science journals, on the page next to their predictions, in preparation for their observations in the *Explain* phase.

Note: Roster students to check daily that the soil is kept moist. Apply enough water to keep the soil damp, not muddy nor dry. Organise students to monitor their samples and record any observable changes.

17 Update the word wall and glossary with words and images.

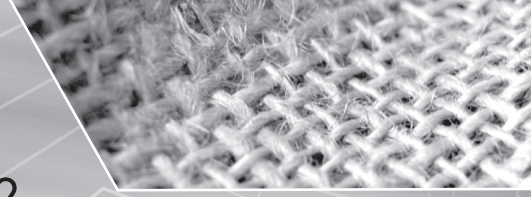
Curriculum links

Science

- Research and read about the process of making and using compost to benefit living things in the garden.

Indigenous perspectives

- Traditional Indigenous people used a range of materials for implements and tools. Some materials, such as wood and plant fibres, will decompose over time. However, hard materials, for example, stone, will not decompose as quickly. Middens are places where shells and bones have accumulated because food was caught nearby and eaten there. Shells and bones do not decompose as fast as flesh, wood and fibre.
- 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 3 Leak, soak or repel?

AT A GLANCE

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

Students:

- explore the absorbency of materials
- conduct a fair test about absorbency.

EXPLORE

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- describe the elements of a fair test
- make predictions about the absorbency of materials
- plan and conduct a test of the absorbency of materials
- interpret results by identifying uses for materials.

Literacy

Students will be able to:

- use oral, written and visual language to report observations on the absorbency of materials
- develop scientific vocabulary about the absorbency of materials
- use a table to record predictions and observations.

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

Teacher background information

Absorbency refers to the ability of a material to take in water and other fluids. Absorbent materials have surfaces that attract water (hydrophilic) and contain small spaces called pores into which liquids can enter. Paper, sponge and most woods are absorbent. The higher the number of pores, the greater the volume of liquid that can potentially enter the material. If wet, absorbent materials are twisted or squeezed, the liquid may be released.

When absorbent materials are saturated, they cannot absorb any more. For example, if a sponge is saturated with water and additional water drips on it, the same amount of water will drip out of it. A very absorbent material will soak up a lot of water before becoming saturated and leaking. A less absorbent material, for example, nylon, used in some swimwear, even if it were as thick as the sponge, will leak water quickly as it is not very absorbent. It will also dry quickly after being soaked as it does not hold much water.

Waterproof materials, such as plastics and rubber do not absorb water, nor are they affected by it. Their surfaces repel water (hydrophobic) and the materials do not have pores. Absorbent materials can be made waterproof by being coated or sprayed with another material which fills the surface pores and repels water, such as wax, plastic or oil-based paints.

Equipment

FOR THE CLASS

- class science journal
- word wall
- team roles chart
- team skills chart
- class materials snapshot from Lesson 1, Session 1
- 1 enlarged copy of 'Leak, soak or repel?' (Resource sheet 4)
- food colouring (to colour 1 cup of water for each team)
- coloured water
- 15 cm x 15 cm square of tissue paper
- 1 eye-dropper
- 1 transparent container (eg, plastic cup)
- 1 cup of coloured water
- 1 elastic band
- *optional:* 1 can waterproofing spray (eg, shoe or lounge spray)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy 'Leak, soak or repel?' (Resource sheet 4) per team member
- 4 or more 15 cm x 15 cm material samples of similar thickness (eg, paper, plastic and fabric bags, see 'Preparation')
- 1 eye-dropper
- 1 transparent container (eg, plastic cup)
- 1 cup of coloured water
- 1 elastic band

Preparation

- Collect eye-droppers, for example, from old food-dye bottles, or purchase from equipment catalogues.
- Collect material samples of a similar thickness for each team, for example, a 15 cm x 15 cm square cut from paper, plastic and fabric bags, and something which is very absorbent, such as a very thin sponge or absorbent cloth, to compare them with.

  If students have brought in dispensable bags from home, ask them to cut a 15 cm x 15 cm square to be included in their team's investigation.

  Note: Including samples of paper bags, fabric bags and non-biodegradable plastic bags is important to develop links between lessons in the *Explore* and *Explain* phases.
- Prepare coloured water for the investigation.

  SAFETY

  Remind students not to put the water in their mouths in case of allergic reactions and to use the dropper to apply the water.
- Test the activity beforehand, to check that the fabrics chosen for the investigation are appropriate (see Lesson step 4).
- Prepare a page in the class science journal with the question for investigation 'Which type of material soaks up the most water?'.
- Draw a variables table in the class science journal, for example:

'Leak, soak or repel?' variables table

We will **change**	
We will **measure/observe**	
We will keep the **same**	

Lesson steps

1 Review the class materials snapshot and ask questions, such as:

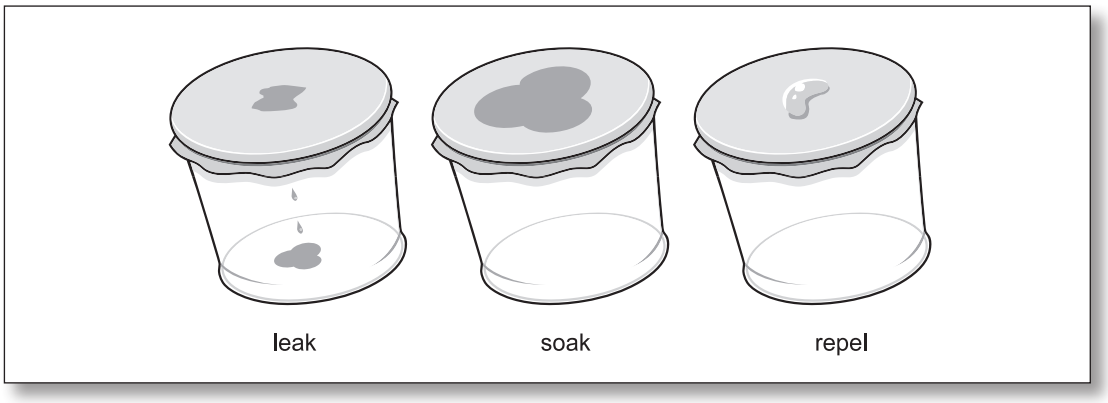
- Why do we wear swimmers and not woollen jumpers when going swimming?
- What kind of material would you want your library bag to be made of if it were raining?
- When wiping a spilt glass of water, what kind of material would you want the cloth to be made of?

2 Explain that students will be working in collaborative learning teams to investigate the question 'Which type of material soaks up the most water?', and display the question in the class science journal. Discuss ways to test the investigation question.

3 Introduce the samples of materials that the students will test. Ask questions, such as:

- What do you think this material is?
- What do you think this material might be used for?
- What is the same about these materials?
- What is different about these materials?

4 Model how to set up the 'Leak, soak or repel?' investigation by placing the square of tissue paper over the top of the transparent container and securing it with an elastic band. Drop the coloured water into the centre of the material, at a steady pace, until a drop drips through.



Observable results for absorbency test

5 Discuss the meaning of the terms 'leak', 'soak' and 'repel', and add them to the word wall. Ask students to describe what they might see if a material leaked, soaked or repelled the water during the investigation. Discuss when to stop counting drops, for example, when a drop drips through or if it seems that the water is never going to drip through, say after 20 drops.

6 Introduce the variables table in the class science journal. Discuss and record what teams will:

- **change:** the material tested
- **measure/observe:** the number of drops added before a drop falls into the container, and whether the water soaks in or rests on top of the material.

7 Discuss what makes a test fair.

8 Ask students to brainstorm what variables they would need to keep the same and record suggestions on the variables table. Suggestions might include the size of the material, the thickness of the material, the way the material is attached, the kind of liquid added, the height of the eye-dropper, the amount and rate of drops added, and the length of time the material is observed.

9 Explain that when a variable is kept the same, it is said to be 'controlled'. Ask students why it is important to keep some things the same when you are measuring changes, for example, to make the test fair and so we know what caused the observed changes.

10 Introduce the enlarged copy of 'Leak, soak or repel?' (Resource sheet 4). Remind students to record both their prediction and their reasons for their prediction, before they test each material. Discuss the use of a tally system to keep count of the number of drops. Explain how to keep the drops at a steady pace, for example, by saying 'banana' between each drop.

Students tallying drops

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

12 Provide teams with time to test the materials and record their findings on 'Leak, soak or repel?' (Resource sheet 4).

13 When students have completed their investigation, discuss the results using their completed copies of 'Leak, soak or repel?' (Resource sheet 4). Ask questions, such as:

- Which materials soaked up a lot of water? What happened to the water?
- Which materials didn't soak up any water? What happened to the water?
- Which materials soaked up a little water then leaked? What happened to the water?
- Which material soaked up the most water?

14 Discuss how to use this knowledge to select material for specific purposes.

Ask questions, such as:

- What kinds of things use materials that soak up a lot of water?
- What kinds of things use materials that don't soak up water?
- What kinds of things use materials that soak up a little water and then leak?

15 *Optional:* Spray samples with a waterproofing spray, re-conduct the tests and compare results.

16 Discuss how the investigation could be improved, for example, the need to use careful timing or bigger pieces of material. Discuss how repeating the test could be used to check accuracy.

17 Discuss the meaning of the terms 'absorb' and 'waterproof' in the context of this unit. Discuss how they link to the terms 'soak', 'leak' and 'repel'. Ask students to develop descriptions of each term. Record the terms on the word wall and add descriptions to the glossary.

18 Ask students to record in their science journal what they have learned about how materials are affected by water and how this might affect the way the material is used. Ask students to add new ideas to their notes about fair testing.

19 *Optional:* Ask students to report what they have learned about materials that bags are made of in the home.

20 Update the word wall and glossary with words and images.

Curriculum links

Science

- Test the absorbency of three cotton fabrics that have been woven differently, such as muslin, cotton gabardine and cotton canvas.

Mathematics

- Measure the number of drops using standard units of measurement, for example, by counting the number of drops into a medicine measuring cup with small increments and reading the number of millilitres.

Technology

- Conduct a 'product test' comparing different brands of a product that is absorbent, such as paper towelling or disposable nappies.

Indigenous perspectives

- Some Indigenous people use different materials to carry water. Containers can be made out of kelp or woven tightly from grass or reeds depending on what materials are available. Some Indigenous people also fashion bark from trees into canoes which they use for travel and fishing.
- 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).

Leak, soak or repel?

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate? _____

First material

Type of material?	
What do you predict will happen? Explain why.	Tally:
	Write about and draw your observations of what happened.

Second material

Type of material?	
What do you predict will happen? Explain why.	Tally:
	Write about and draw your observations of what happened.

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Leak, soak or repel?

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate? _____

Third material

Type of material?	
What do you predict will happen? Explain why.	Tally:
	Write about and draw your observations of what happened.

Fourth material

Type of material?	
What do you predict will happen? Explain why.	Tally:
	Write about and draw your observations of what happened.

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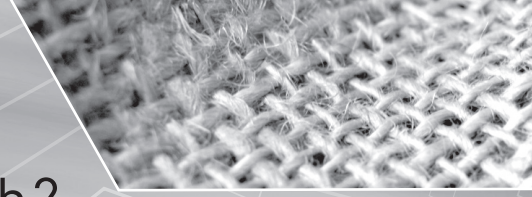


Lesson 4 Snap, tear or stretch?

AT A GLANCE

To provide students with hands-on, shared experiences of the tensile strength of materials.

Students:

- explore the tensile strength of materials
- plan and conduct a fair test of tensile strength of materials
- record results in a table and interpret findings.

EXPLORE

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- make predictions about the tensile strength of materials
- plan and conduct a test of the tensile strength of materials
- record results in a table and interpret findings.

Literacy

Students will be able to:

- contribute to discussions about tensile strength of materials
- use a table to record predictions and observations
- develop scientific vocabulary about tensile strength.

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

Teacher background information

Tensile strength measures the force required to pull or stretch a material to the point where it breaks. The term tensile refers to being under tension or having a stretching force applied. To make a rope that could be used to tow a car, it is useful to use material with high tensile strength so that it does not break.

Materials with high tensile strength do not snap, tear or stretch under tension. Materials that stretch but do not snap have medium tensile strength. Materials with low tensile strength snap or tear easily under tension. Some materials have different tensile strength depending on whether they are wet or dry. For example, a wet paper towel is not as strong as a dry paper towel. Materials that contain short fibres often tear under tension. Each fibre breaks separately so the edge of the fabric becomes uneven during the tearing process. Materials which are not made of fibres may snap and make a clean break when pulled, whereas other materials may stretch. Materials that can be stretched without snapping are said to be ductile, for example, chewed chewing gum. The more ductile a material is, the higher its tensile strength.

Materials that can be hammered into sheets or pressed permanently out of shape are malleable. Malleable materials may or may not have high tensile strength. For example, plasticine is malleable but it snaps when stretched and so has low tensile strength.

Elastic materials will stretch under tension and then return to their original shape or size when the force is removed. Even elastic materials have limits, however, as to how much force they can withstand before they are stretched irreversibly and do not go back to their original shape. The more force needed for elastic materials to reach that elastic limit, the higher the tensile strength of the material.

Students' conceptions

Students might associate strength with 'strong' and therefore 'hard', yet some hard things might break easily, for example, thin ice.

Equipment

FOR THE CLASS

- class science journal
- word wall
- team roles chart
- team skills chart
- class materials snapshot from Lesson 1, Session 1
- 1 enlarged copy of 'Snap, tear or stretch?' (Resource sheet 5)
- 1 large clothes peg
- 1 cm x 15 cm strip of newspaper (see 'Preparation')

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Snap, tear or stretch?' (Resource sheet 5) per team member
- several large clothes pegs
- 4 or more 1 cm x 15 cm strips of material (see 'Preparation')
- 1 magnifying glass

Preparation

- Cut a strip of newspaper 1 cm wide x 15 cm long for modelling the investigation in Lesson step 4. This measurement covers the average clothes peg, measure your pegs to check. Test the demonstration by wrapping a strip around the clothes peg and squeezing until it breaks or the peg is wide open (see Lesson step 4).

  Note: Model the investigation test using materials other than those that the students will be using for their investigation.
- Collect material samples of similar thickness for each team, for example, a 1 cm x 15 cm strip cut from paper, plastic and fabric bags, and something which is stretchy, for example, a rubber glove, to compare them with.

  If students have brought in dispensable bags from home, ask them to cut a 1 cm x 15 cm strip to be included in their team's investigation.

  Note: Including samples of paper bags, fabric bags and non-biodegradable plastic bags is important to develop links between lessons in the *Explore* and *Explain* phases.

Lesson steps

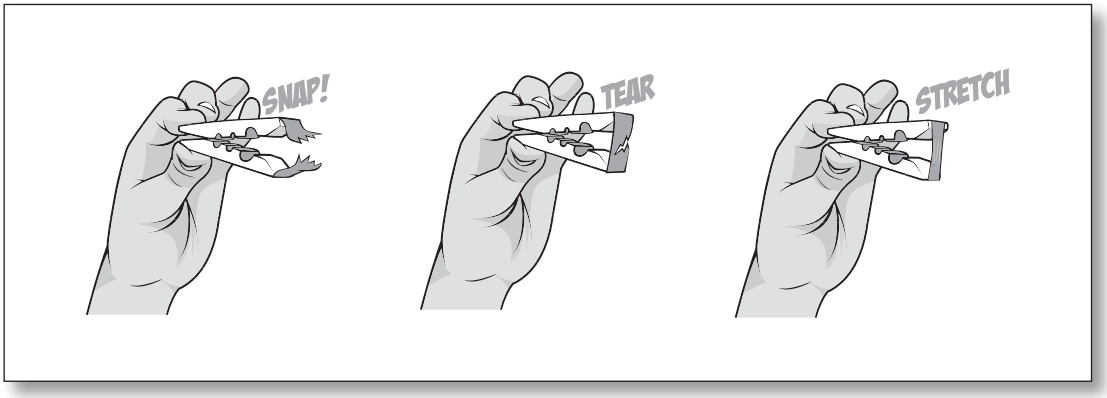
1 Review the class materials snapshot and ask questions, such as:

- If you had something heavy to carry, what kind of material would you want your bag to be made of?
- What would you select to wear if you want to perform gymnastics?
- Why would you select to wear those clothes and not something like tight jeans?

2 Ask students if they have ever had a material from their clothes, bags or other accessories snap, tear or stretch. Discuss the meaning of the terms 'snap', 'tear' and 'stretch', and add terms to the word wall.

3 Explain that students will be working in collaborative learning teams to investigate the question 'What happens to the material when pulled by the ends of a peg?'.

4 Model how to wrap the strip of newspaper around the clothes peg, how to hold it and how to squeeze the ends of the peg until the material breaks or the peg opens to its limit.



Observable results for the 'Snap, tear or stretch?' investigation

5 Ask students what variables could affect whether the material snaps, tears or stretches. Suggestions might include the size of the strips, the amount of force and the time taken to apply the force.

6 Ask students what they might observe if something snaps, tears or stretches. Model how to use the magnifying glass to examine the snap, tear or stretch in the material.

7 Introduce the enlarged copy of 'Snap, tear or stretch?' (Resource sheet 5). Ask students to think about what they will write in the 'Keeping it fair' section, for example:

- **change:** the material tested
- **observe:** using a magnifying glass, if the material snaps, tears or stretches
- keep the **same:** the size of the material, the way the material is wrapped around the peg, how hard the peg is pushed to open it (the force) and how fast the peg is opened.

8 Model how to fill out the 'Recording results' section of the enlarged copy of 'Snap, tear or stretch?' (Resource sheet 5). Review the features and purpose of a table (see Lesson 2).

Note: Remind students to record both their prediction and their reasons for the prediction, before they test each material.

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

10 Ask selected Speakers to report on what happened to each material and how their team predictions compared to their findings.

11 Discuss the term 'tensile strength' and how it links to the terms 'snap', 'tear' and 'stretch'. Add 'tensile strength' to the word wall and glossary. Discuss how to rate the materials according to their tensile strength, such as 'high', 'medium' and 'low' (see 'Teacher background information'). Record in the class science journal a description of each rating and examples of findings, for example, the piece of fabric had high tensile strength because it didn't change when pulled.

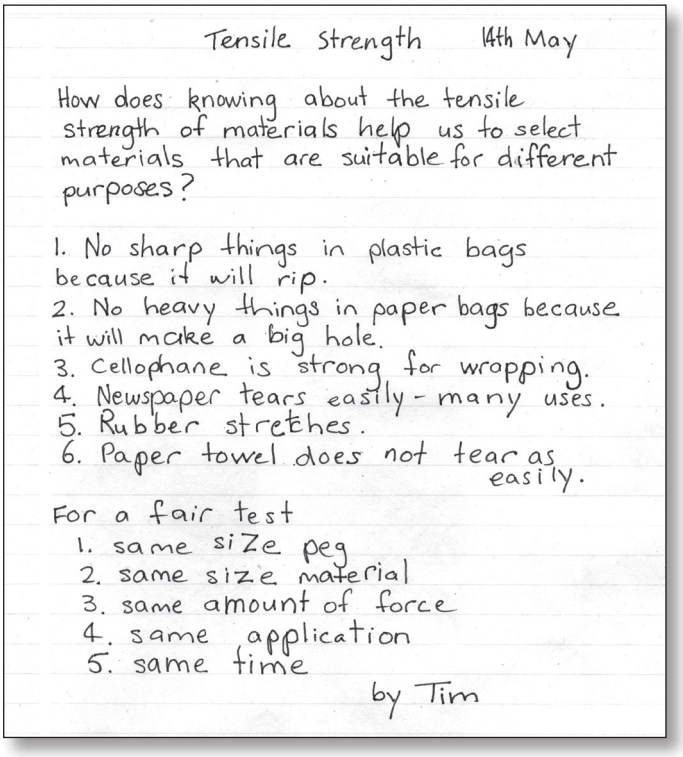
12 *Optional:* Ask students to wet the materials and repeat the investigation. Ask students to compare the results to see how moisture affects the tensile strength of materials.

13 Ask students to record in their science journal what they have learned about the tensile strength of materials and to add new ideas to their notes about fair testing.

Ask students to reflect on how knowing about tensile strength can be useful in selecting materials for particular purposes, such as to make clothes and bags or ropes.

14 *Optional:* Ask students to report what they have learned about materials that bags are made of in the home.

15 Update the word wall and glossary with words and images.



Tensile Strength 14th May

How does knowing about the tensile strength of materials help us to select materials that are suitable for different purposes?

1. No sharp things in plastic bags because it will rip.
2. No heavy things in paper bags because it will make a big hole.
3. Cellophane is strong for wrapping.
4. Newspaper tears easily - many uses.
5. Rubber stretches.
6. Paper towel does not tear as easily.

For a fair test
1. same size peg
2. same size material
3. same amount of force
4. same application
5. same time

by Tim

Student work sample of a science journal entry

EXPLORE

Curriculum links

Science

- Explore other methods that could be used to apply force to the samples to test their strength.
- Test three different types of paper for their tensile strength, such as home-made recycled paper, tissue paper and blotting paper.

Mathematics

- Measure the length and width of material strips.

Indigenous perspectives

- 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).

Snap, tear or stretch?

Name: _____ **Date:** _____

Other members of your team: _____

Question for investigation: _____

_____

Keeping it fair

Things (variables) you are going to:		
Change?	Observe?	Keep the same?

Recording results

What happened to each material?			
Material	**Prediction**	**Reasons for prediction**	**Result**

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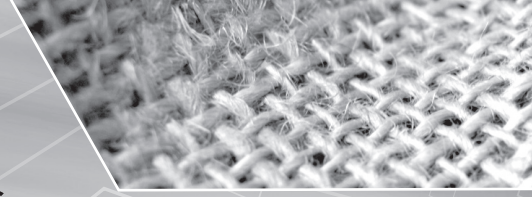


Lesson 5 Choosey consumers

EXPLAIN

AT A GLANCE

To support students to represent and explain their understanding of the properties of materials and how they relate to use, and to introduce current scientific views.

Session 1 Bags of fun

Students:

- select suitable bags based on the properties of their materials to transport particular objects
- identify properties of materials and how they relate to use.

Session 2 Puzzling plastics

Students:

- explore the results of the decomposition investigation
- read a factual text about the properties of plastics
- explain their understanding of the properties and uses of plastic materials through role-play.

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively. You will also monitor their developing science inquiry skills (see page 2).

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

Key lesson outcomes

Science

Students will be able to:

- describe and compare the properties of materials
- explain how the properties of materials make them suitable for different uses
- describe the positives and negatives of using certain types of materials for certain uses.

Literacy

Students will be able to:

- use oral and written language to represent their understanding of how the properties of materials relate to use
- record observations and explanations about the decomposition of materials
- read a factual text about the properties of plastics
- understand the features and purpose of role-plays and factual texts
- use scientific vocabulary appropriately in their writing and talking.

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

Session 1 Bags of fun

Equipment

FOR THE CLASS

- class science journal
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of 'Carrying dilemma' (Resource sheet 6)
- 5 different bags (eg, calico, thick plastic, paper, thick fabric, thin plastic, see 'Preparation')

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Carrying dilemma' (Resource sheet 6) per team member

Preparation

- Collect, number and label five bags for the 'Carrying dilemma' (Resource sheet 6):
  - a thin material bag (for example, a calico library bag)
  - a thick plastic bag (for example, from clothes shops)

- a paper bag (for example, a homemade bag made from newspaper)
- a thick fabric bag (for example, the fabric bags from supermarkets)
- a thin plastic bag (for example, a disposable supermarket bag).

Note: It is preferable to find bags of about the same size so that the students compare the properties of the material not the properties of the object, for example, the size of the bag.

Lesson steps

1 Review the word wall, the glossary and the class science journal, focusing students' attention on the properties of the materials they have explored.

2 Discuss how specific properties make materials suitable or unsuitable for making certain objects. Ask questions, such as:

- What properties does the material for a sponge need?
- What properties might you want the materials of a raincoat to have?
- Would you make a shopping bag out of bricks? Why/Why not?
- Would you make a belt out of marshmallow? Why/Why not?

3 Discuss with students what they have learned about materials that bags are made of in the home. Ask students why they think the designers chose to make the bags with those materials.

4 Ask students if they have had a difficult experience when carrying something in a bag. Ask students to discuss their experiences referring to properties of the materials used to make the bag. For example, 'I tried putting lots of heavy things in a plastic bag that stretched and snapped because this plastic has low tensile strength'.

Note: Encourage students to draw on their knowledge and language developed in the *Explore* phase.

5 Explain that students will be working in collaborative learning teams to solve a carrying dilemma using their knowledge of the properties of materials.

6 Introduce the collection of five numbered, labelled bags (see 'Preparation') and an enlarged copy of 'Carrying dilemma' (Resource sheet 6). Explain that students will match one bag with each item illustrated at the bottom of the sheet, without using the same bag twice. Model how to complete one entry in the table.

7 Form teams and allocate roles.

8 Ask students to discuss, in collaborative learning teams, the possible solutions to the carrying dilemma, and then to individually complete their copy of 'Carrying dilemma' (Resource sheet 6).

EXPLAIN

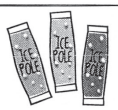
Material world

Carrying dilemma

Name: Erin **Date:** May 14th

You and four friends have a dilemma: you need to carry five items in five different bags. Which object would be best placed in which bag?

Identify what each bag is made of, glue the picture of your chosen object beside it, and explain your choice.

Bag made of	Object	Why did you make that choice?
Thin material	 A plastic binder	Fabric doesn't rip like plastic when you put sharp objects in it.
Thick plastic	 A wet towel	The plastic has high tensile strength for the heavy towel and is waterproof.
Paper	 Some muddy shells	The paper bag is disposable, so it doesn't matter if it gets muddy
Thick material	 A watermelon	The material can take the weight of the watermelon without snapping, stretching or tearing.
Thin plastic	 Some frozen ice poles	The ice poles aren't heavy but they might be wet so they can be put in a bag with low tensile strength that is waterproof.

Student work sample of a possible solution to the 'Carrying dilemma'

Note: Encourage students to explore a variety of possible solutions before completing their sheet.

9 Organise teams to share their solutions with the class.

10 *Optional:* Arrange for students to enact their solution to the dilemma to test whether it works. Spare bags may be needed to replace breakages.

11 *Optional:* Discuss inappropriate items to put in the different bags, such as an echidna in a plastic bag or a surprise gift in a transparent bag.

12 Update the word wall and glossary with words and images.

EXPLAIN

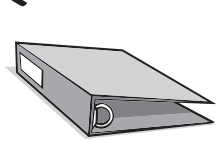
Carrying dilemma

Name: _____ **Date:** _____

You and four friends have a dilemma: you need to carry five items in five different bags. Which object would be best placed in which bag?

Identify what each bag is made of, glue the picture of your chosen object beside it, and explain your choice.

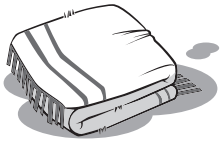
Bag made of	Object	Why did you make that choice?



A plastic binder

Some muddy shells

A watermelon



A wet towel

Some frozen ice poles

 ISBN 978 0 85847 316 4

Session 2 Puzzling plastics

Teacher background information

Plastic is the name given to a wide group of materials characterised by their:

- chemical structure, generally made from long molecular chains, and
- ability to be moulded into different shapes, such as films, fibres and solid objects.

Most plastics are synthetic and are often produced from bi-products of crude oil and natural gas, which are non-renewable resources. Two examples of synthetic plastics are cling wrap and Polyethylene terephthalate (PET) used to make drink bottles. There are also a few natural plastics, for example, natural rubber.

Plastics have many useful properties. For example, they are generally light, waterproof and cheap to produce. Plastics do not conduct heat or electricity very well which makes them good insulators. Plastic lenses in spectacles are much lighter than glass; however they tend to scratch more easily. Plastic bank notes last longer than paper, don't disintegrate if washed in the washing machine and are harder to counterfeit. Plastic dishes don't break when dropped on the floor. Plastic parts make cars lighter.

Most plastics can be recycled, but the process is currently labour-intensive and costly. Plastic shopping bags can be recycled at some supermarkets. Recycling bins only accept certain types of plastic, including those used to make containers for things like soft drink, detergent, milk, shampoo and cordial.

The ubiquitous nature of plastics and their durability can lead to difficulties when plastic objects are discarded. Plastics can float in oceans, rivers and lakes. Burning some plastics will release toxic fumes. Because they are not biodegradable, some plastics decompose extremely slowly and may remain in landfills for hundreds of years. Material scientists are working on developing new types of plastic that will be biodegradable.

For information about biodegradable plastics, see the Australian Academy of Science's *Nova: Science in the News* topic 'Making packaging greener—biodegradable plastics' (www.science.org.au/nova/061/061key.htm).

Equipment

FOR THE CLASS

- class science journal
- word wall
- team roles chart
- team skills chart
- 1 enlarged copy of 'Puzzling over plastics' (Resource sheet 7)
- factual texts about plastics (see the Primary**Connections** website for suggestions)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- material samples buried in Lesson 2
- tray to hold samples
- 1 copy of 'Puzzling over plastics' (Resource sheet 7) per team member

Preparation

- Decide how students will read 'Puzzling over plastics' (Resource sheet 7). For example, read as a whole class, in collaborative learning teams or in guided reading groups.
- Draw a table in the class science journal with the headings from Edward De Bono's Plus-Minus-Interesting (PMI) strategy:

Non-biodegradable materials

Plus	Minus	Interesting

Lesson steps

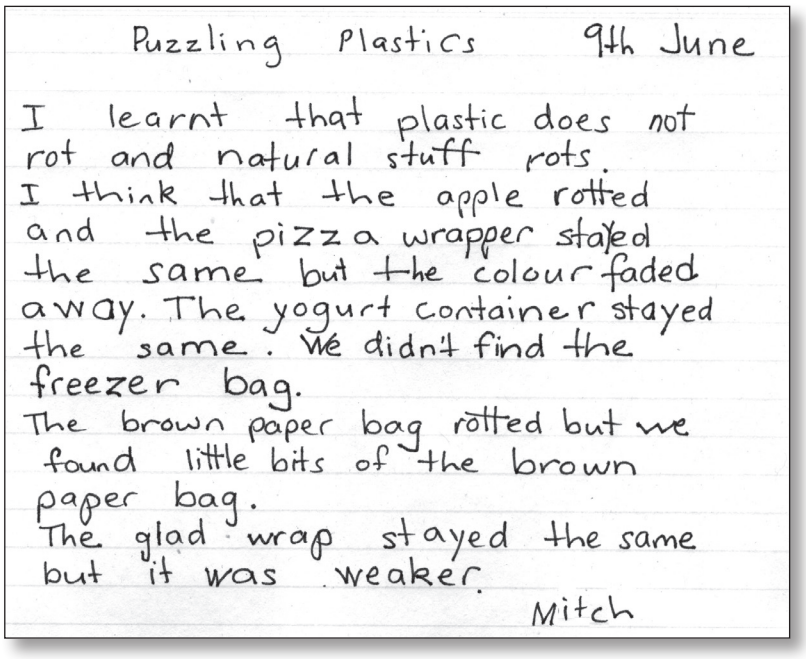
1 Review the decomposition investigation started in Lesson 2, including the class 'Rot or remain?' table and the predictions recorded in their science journals.

2 Explain that the students will retrieve the samples and record their observations under the 'Rotten results' heading they prepared in their science journals (see Lesson 2).

SAFETY

Instruct students not to inhale as they open the containers, to avoid inhalation of spores and also to wash their hands after handling soil and samples.

3 Model how to record what has happened to the samples. For example, 'The apple core is now much smaller, brown and shrivelled', or, 'The plastic sample looks the same and is still the same size'.



Puzzling Plastics 9th June

I learnt that plastic does not rot and natural stuff rots.
I think that the apple rotted and the pizza wrapper staied the same but the colour faded away. The yogurt container stayed the same. We didn't find the freezer bag.
The brown paper bag rotted but we found little bits of the brown paper bag.
The glad wrap stayed the same but it was weaker.

Mitch

Student work sample of the results of a decomposition investigation

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

5 After teams have retrieved their samples and recorded their findings, discuss the results as a class. Ask students why some materials did not decompose (they were not biodegradable and were not affected by the water). Ask questions, such as:

- What types of materials rotted?
- Which types of materials did not rot?
- What might have caused things to rot?
- Why might some things rot while others don't?
- Was there a pattern between natural and processed materials rotting? What did you notice?

Note: Change of colour may be the result of dye leeching out, not decomposition.

6 Discuss non-biodegradable materials by asking students questions, such as:

- What would happen if a non-biodegradable plastic bag flew off into the wind?
- What would happen if CDs were biodegradable?
- What are the positive things about non-biodegradable materials?
- What are the negative things about non-biodegradable materials?
- What is interesting about non-biodegradable materials?

Record students' answers in the PMI table prepared in the class science journal (see 'Preparation').

7 Explain that students will work in their collaborative learning teams to use a factual text to prepare a role-play about the positives and negatives of using plastics. Discuss the purpose and features of a role-play.

Literacy focus

Why do we use a role-play?

We use a **role-play** as a physical representation of a system, process or situation.

What does a role-play include?

A **role-play** might include speech, gestures, actions and props.

8 Introduce the enlarged copy of 'Puzzling over plastics' (Resource sheet 7) and discuss the purpose and features of a factual text.

Literacy focus

Why do we use a factual text?

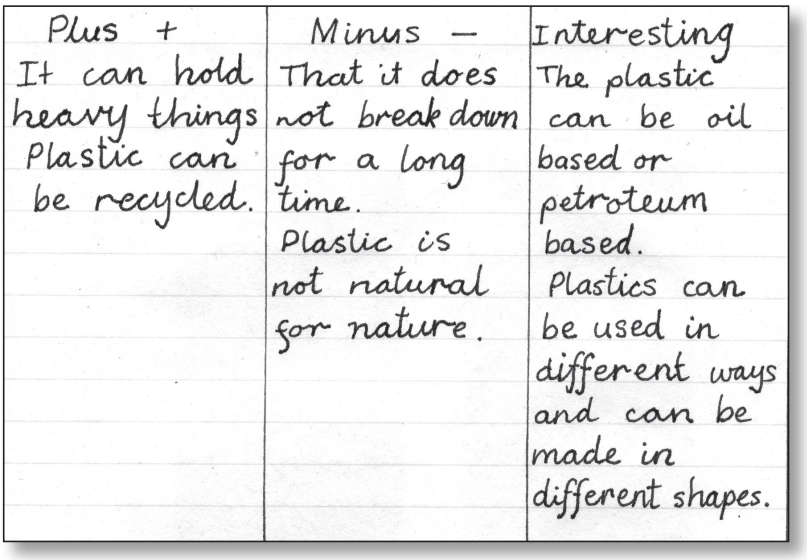
We use a **factual text** to inform, teach or persuade someone reading it. We can read a **factual text** to collect information.

What does a factual text include?

A **factual text** includes a title, text and pictures. It might include labels, diagrams, maps and photographs.

9 Read 'Puzzling over plastics' (Resource sheet 7) (see 'Preparation'). Remind students that they can find additional information about plastics in their science journals and in the other factual texts provided. Encourage students to also refer to information gathered from their 'Bags at home' (Resource sheet 3) and discussions with adults about what bags used to be made of.

Optional: Ask students to organise their ideas about plastics by creating a PMI table in their science journals.



Plus +	Minus −	Interesting
It can hold heavy things Plastic can be recycled.	That it does not break down for a long time. Plastic is not natural for nature.	The plastic can be oil based or petroleum based. Plastics can be used in different ways and can be made in different shapes.

Student work sample of a Plus-Minus-Interesting table about plastics

10 Ask teams to choose a situation they will role-play to demonstrate the positives and negatives of plastics, for example:

- a designer thinking about what materials to use in his product is visited by his good conscience and his bad conscience
- a show host interested in plastics invites a plastics supporter and a plastics sceptic onto his show
- a news reporter interviews people about plastics
- a plastics manufacturer talks to consumers who are demanding that plastic bags be disallowed
- an animal rights meeting includes someone who thinks plastic, as opposed to glass, is good for animal safety, someone who prefers synthetic products to animal products, and someone worried about the impact of waste on animals, for example, marine animals choking on plastic bags.

11 Ask teams to present their role-plays to the class. Discuss the ideas generated and the implications for the use of plastics in our world. For example, the reuse and recycling of plastic materials and alternatives to plastics.

12 Update the word wall and glossary with words and images.

Curriculum links

Studies of Society and Environment

- Research and read about recycling and link to units on environmental studies.

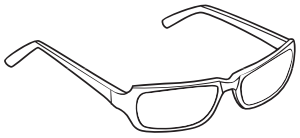
Indigenous perspectives

- Research types of bags and other carrying equipment used by traditional Indigenous people, such as bags and baskets woven out of pandanus leaves or a dilly bag woven from paperbark fibre. Discuss the properties of these materials and why they are appropriate for their purpose.
- 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).

Puzzling over plastics

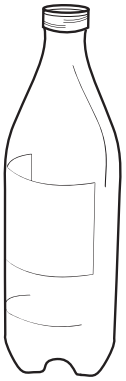
Name: _____ **Date:** _____

Plastics are a processed material used to make things such as bank notes, milk containers, toys and clothing.



Where do plastics come from?

Most plastics today are manufactured from oil which is a valuable, limited resource. Some plastics can be recycled.



Properties and uses of plastic

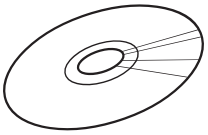
All plastics are easy to shape. Objects made from plastics are generally lighter than similar objects made of other materials.

Some plastics do not let electricity or heat pass through them, and can be used to keep us safe. Unlike glass, most plastics do not shatter when dropped and so will not break or cut people.

Plastics are waterproof. They will not rot like wood or rust like steel. This means that objects made from plastic last for a long time.

The future

Scientists are researching ways to develop biodegradable plastics that are made from renewable resources such as plants. For example, one Australian company has invented a new type of plastic made from corn starch.



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Lesson 6 Investigating insulation

AT A GLANCE

To support students to plan and conduct an investigation of the thermal insulation capacity of materials.

Students:

- measure water temperature to investigate the thermal insulation capacity of materials
- observe, record and interpret results.

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 an investigation into the thermal insulation capacity of materials, showing an awareness of the need for fair testing
- describe the features of fair testing
- record findings in a table and interpret results as a graph
- identify which materials are the best thermal insulators
- generate explanations about the thermal insulation capacity of materials.

Literacy

Students will be able to:

- use language and visual representations to design and record an investigation into the thermal insulation capacity of materials
- use a table and a graph to record and represent findings
- identify the features and purpose of a graph
- participate in discussions about the thermal insulation capacity of materials.

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

Teacher background information

Materials that transmit heat well are called thermal conductors. Those materials that do not transmit heat well are called thermal insulators. Thermal insulation works by reducing the movement of heat energy from warm areas to cooler areas. Air and other gases are good insulators, provided there is no air movement or convection. Many insulating materials, therefore, have lots of small pockets of gas, for example, styrofoam. Fur and feathers are good insulators, especially when fluffed up to trap more air. Similarly chimpanzees get goose-bumps to trap more air in their fur, which slows down the movement of warm air away from their bodies.

When designing clothing for use in a cold climate it is important to choose materials with good thermal insulation properties. Woollen fibres in jumpers trap air close to the body, slowing the transfer of heat from the warm body to the cold environment. Wearing a number of layers also increases the amount of small pockets of insulating air that can be trapped. Therefore a number of thin layers can often be a better insulator than a single heavy layer.

Because the human body is continually producing heat, it is not easy to compare the thermal insulation capacity of materials by wearing them. The rate at which the temperature of warm water declines when wrapped in the materials gives scientists an idea of how efficiently the heat is being transferred. A material which keeps water warm in a cool room is a good insulator and therefore can be used to make clothes which will keep the wearer warm.

When designing clothing for use in a warm climate, materials that are poor thermal insulators are best. Open weave and thin fabrics assist the transfer of heat from our bodies to the outside air.

Equipment

FOR THE CLASS

- class science journal
- word wall
- 1 enlarged copy of 'Keeping it warm investigation planner' (Resource sheet 8)
- 200 mL hot water (<50ºC)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Keeping it warm investigation planner' (Resource sheet 8) per team member
- 3 identical metal containers (eg, tins or cans to hold 200 mL warm water, see 'Preparation')
- 3 different materials (eg, wool, cotton and plastic, see 'Preparation')
- 1 thermometer
- 600 mL hot water (<50ºC)
- 1 x 200 mL measuring cup
- 1 funnel
- elastic bands
- 1 timing device (eg, a stopwatch or a watch with a second hand)

Preparation

- Read 'How to construct and use a graph' (Appendix 6).
- Prepare a page in the class science journal with the investigation question 'Which material keeps things the warmest?'.
- Collect three similar metal containers for each team, such as food tins with lids removed or aluminium drink cans with ring pulls removed (mini drink cans are inexpensive and readily available in supermarkets). The containers need to be the same to make this a fair test (only the insulators change). Metal containers give the best results because they are poor insulators, and therefore the difference in temperature between the different insulators will be more evident.

  SAFETY

  If you use tin cans, make sure the edges are safe for students to handle.
- Collect three material samples of similar thickness for each team to wrap around their containers, such as wool or polar fleece, cotton and plastic from a raincoat. Cut into sheets large enough for teams to wrap around the containers.
- Obtain a thermometer for each team, such as from school supplies or school catalogues. Digital thermometers are preferred. If, however, the thermometers are not digital, consider how to introduce the students to reading temperatures (see the Primary**Connections** website for suggestions).

  SAFETY

  Do not use mercury thermometers because breakages will expose students to harmful mercury vapour.

ELABORATE

- Set up a safety zone where you can prepare the hot water. Decide on a class safety procedure for students to collect the hot water, for example, students collect water that the teacher prepares and pours.

SAFETY

Keep water temperature below 50°C.

- Trial the experiment to be sure of the best intervals of time for the experiment. For example, in a hot environment, the heat loss will occur more slowly than in a cool environment.

Set up of investigation of 'Which material keeps things the warmest?

Lesson steps

1 Review the class materials snapshot and discuss which properties of materials would be useful for clothes, such as the ability to keep the wearer warm or cool, to be waterproof, or to allow movement.

2 Ask students to suggest examples of natural and processed materials that might be good at keeping us warm. Discuss ways to test which material is the best at keeping things warm.

3 Explain that students will be working in collaborative learning teams to investigate the question 'Which material keeps things the warmest?' and display the question in the class science journal.

4 Explain that students will be wrapping different materials around metal containers in which they will put warm water. They will then measure the temperature of the water at regular intervals, for example, every five minutes. Ask questions, such as:

- Does it matter when I measure the temperature of each container? (Yes, since in order to compare the materials it is best to compare them after the same amount of time.)
- Why might it be interesting to measure regularly, for example, every five minutes, instead of once in an hour? (Because the water in all the containers may have already cooled to room temperature by that time.)
- How long do you think we will need to keep measuring? Why? (At least half an hour is necessary to allow the differences of cooling to be apparent.)

5 Ask students what variables might affect the temperature of the water and the rate at which the temperature goes down. Suggestions might include the type of container, the amount of water, the initial temperature of the water, the temperature of the surrounding air, where the container is placed and what is wrapped around the container.

6 Review the fair testing that students have completed during the unit and explain that students will need to make this a fair test.

7 Introduce the enlarged copy of 'Keeping it warm investigation planner' (Resource sheet 8). Discuss and model how students will complete their investigation planner and discuss what they will:

- **change:** the type of material wrapped around the container
- **measure:** the temperature of the water in the container
- keep the **same:** the type of container, the amount of water, the initial temperature of the water, where the containers are placed.

8 Model how to set up the investigation, for example, using the funnel to pour the hot water into the containers and how to secure the material to the container using elastic bands. Discuss how to use the thermometers (see 'Preparation').

Focus students' attention on the safety issues for this activity. Explain the class safety procedure for using hot water (see 'Preparation').

9 Form teams and allocate roles. Provide teams with time to complete the first page of the investigation planner.

10 Ask Managers to collect team equipment. Ask teams to set up their investigations and identify which team member will be responsible for collecting the data for each container.

11 Allow time for teams to conduct their investigations and record their findings in the table.

12 Model how to construct a graph to visually represent the information recorded during the investigation, for example, by representing the temperature of the water in their container after half an hour. Discuss the purpose and features of a graph.

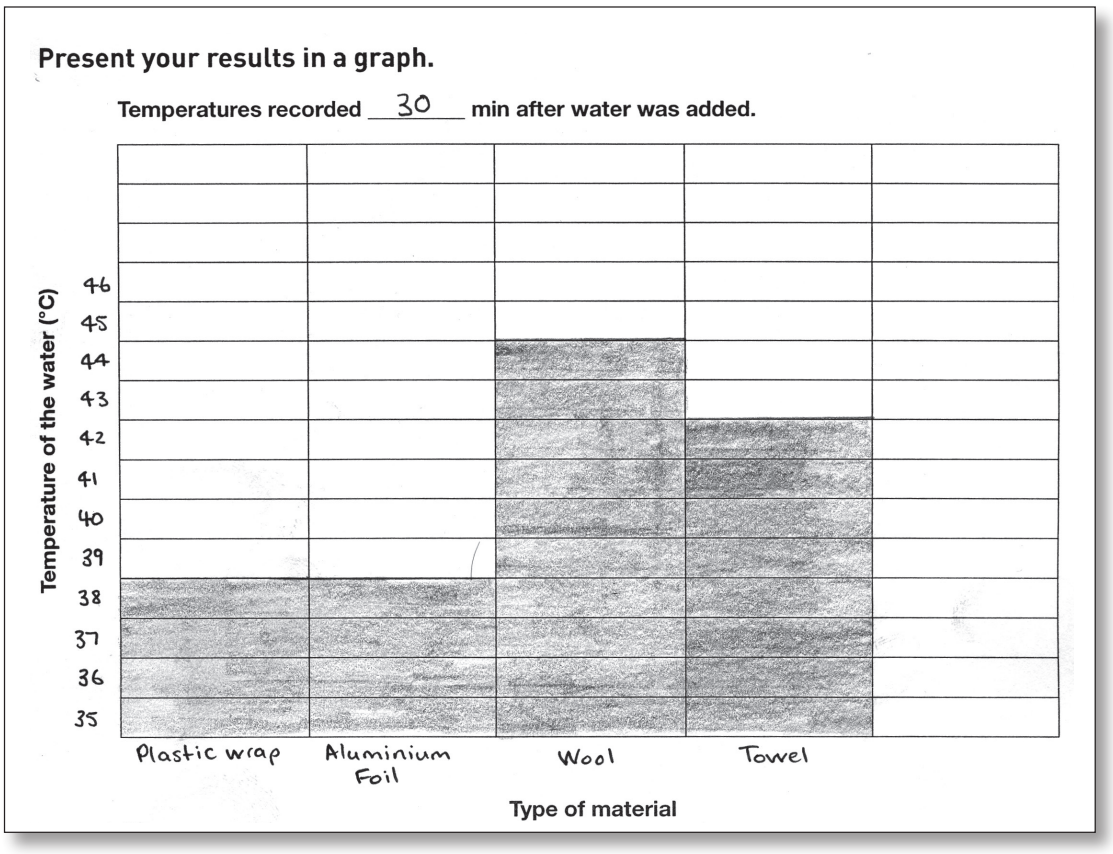
Literacy focus

Why do we use a graph?

We use a **graph** to organise information so we can look for patterns. We use different types of graphs, such as picture, column, or line graphs, for different purposes.

What does a graph include?

A **graph** includes a title, axes with labels on them and the units of measurement.



Student work sample of a bar graph

Discuss with students the conventions of constructing a scientific graph. The vertical axis (Y axis) usually represents the thing (variable) we measure and the horizontal axis (X axis) the thing (variable) we change.

Note: For these findings, scientists would create a line graph showing the change of temperature (Y axis) over time (X axis) with several plotted lines which represent the different insulating layers on the containers. However, the suggested column graph is more appropriate for Year 4 students.

ELABORATE

13 Discuss what scale to use on the Y axis, for example, one box is 1°C (in order to identify small differences). Explain that the scale should start at a temperature that is lower than the lowest reading, for example, 35°C if the lowest reading is 38°C (in order to avoid colouring 35 boxes unnecessarily).

14 Explain to students that scientists gather evidence, look for patterns in the results and then formulate explanations. Ask teams to work like scientists and analyse and compare their graphs to look for patterns and relationships, asking questions, such as:

- What is the story of your graph?
- Which material kept the water warmest?
- Does the data in the graphs reveal any patterns?

15 Ask teams to discuss and record answers to the questions and summarise their findings in the 'Explaining the results' section of their investigation planner.

16 Discuss the properties of the materials tested in the investigation, and therefore the clothes they might be used to make. For example, the wool kept the water warmest so it could be used for slippers that keep my feet warm.

17 Provide students with time to reflect on the investigation and respond to the questions in the 'Evaluating the investigation' section of their investigation planner. The completed investigation planner provides a work sample for summative assessment of the investigation outcomes.

18 Introduce the term 'insulation' and ask students to describe what they think it might mean. Add the term 'thermal' and discuss how it relates to insulation. Add the term 'thermal insulation' to the word wall and add a description to the glossary.

19 Update word wall and glossary with words and images.

Curriculum links

Science

- Test the same type of material three times, firstly using one layer, then two layers and finally three layers of the material.

Mathematics

- Explore reading scales on conventional thermometers.

Studies of Society and Environment

- Explore the clothes made in the distant past, for example, during the Ice Ages.
- Investigate the properties of modern sports clothing.

Information and Communication Technology (ICT)

- Explore different graphs that can be constructed using the data (see 'Appendix 6').

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).

Keeping it warm investigation planner

Name: _____ **Date:** _____

Other members of your team: _____

Question for investigation.	What do you think will happen? Why?

Things (variables) you are going to:

Change?	Measure/Observe?	Keep the same?

How will you make this a fair test?	Draw the equipment you will use and show how it will be set up.

Write and draw your observations in your science journal.

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Recording and presenting results

Record your team's results in a table.

The temperature of the water over time			
Time since the water was added (mins)	**Temperature of water in container 1 (°C)**	**Temperature of water in container 2 (°C)**	**Temperature of water in container 3 (°C)**

Present your results in a graph.

Temperatures recorded _____ mins after water was added.

Temperature of the water (°C)

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Explaining results

Name: _____ **Date:** _____

When you changed the material what happened to the temperature of the water?
Which material kept the water warmest?
Which material let the water cool down the most?

Evaluating the investigation

What challenges did you experience doing this investigation?
How did you, or could you, overcome them?
How could you improve this investigation (fairness, accuracy)?

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Lesson 7 Material matters

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, how these properties can influence their use, and to reflect on their learning during the unit.

Students:

- review the unit using the science journal, word wall and other resources developed during the unit
- represent their understanding of the properties of materials by creating a page for a class design catalogue
- reflect on their learning during the unit.

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:

- natural and processed materials, for example, fabrics, have properties that make them useful for different purposes; knowledge of the properties of materials helps people to understand how to use them effectively.

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:

- describe the properties and uses of everyday materials
- explain why the properties of a material make it suitable for a particular use.

Literacy

Students will be able to:

- contribute to discussions about materials, their properties and uses
- use scientific vocabulary appropriately
- create an annotated drawing to represent what they know about the properties of materials and how they relate to use
- reflect on their learning in a science journal entry.

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

Equipment

FOR THE CLASS

- class science journal
- word wall
- 1 enlarged copy of 'Material matters' (Resource sheet 9)

FOR EACH STUDENT

- each team member's science journal
- 1 copy of 'Material matters' (Resource sheet 9)
- magazines that can be cut up

Preparation

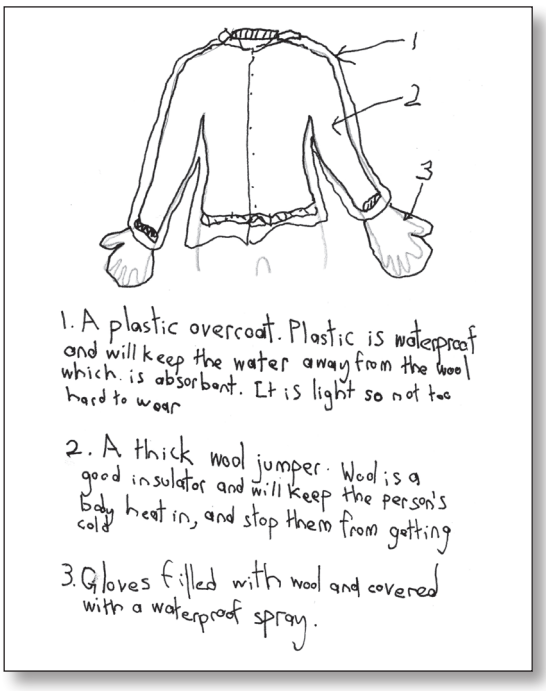
- Decide whether the whole class will design clothes for the same scenario, or whether each student will respond to an individual scenario, for example, on a strip of paper. Some possible scenarios are listed below. Decide if students will choose the scenario or if they will be allocated a scenario.

Possible scenarios

Going into dark, damp caves	Going walking in the snow
Exploring underwater/scuba diving	Going into space
Going into the desert	Going for a walk in the wet, tangled jungle
Going for a walk in the scrub	Going for a hike up a mountain
Going shopping	Weeding the garden
Weeding the prickly garden	Running in a competition
Going surfing	Building a snowman
Going to the markets	Mountain bike riding
Washing a car	Going out in windy weather
Going dancing	Going to school
Playing soccer	Working in a rubbish tip
Doing the washing up	Bee keeping
Fencing with practice swords	Boxing
Travelling on a plane	Going to bed in winter
Going to bed in summer	Making mud sculptures

Lesson steps

1. Review the unit using the class science journal, the word wall and the glossary. Focus students' attention on how the properties of materials make them suitable for different uses.
2. Explain that the class will create a class book in the form of a catalogue to display suitable materials to use for clothes in given situations.
3. Give students the scenarios that they are to design clothes for a scenario (see 'Preparation'). Remind students to think about the different properties of materials and whether they might be useful in the scenario.
4. Introduce the enlarged copy of 'Material matters' (Resource sheet 9) and explain that students will create a drawing (or collage) of the outfit they would recommend for their scenario. Remind students to annotate the materials chosen for their outfit and to provide reasons for the choice of these materials based on the properties that make them suitable for the task.
5. *Optional:* Students annotate by indicating materials with an arrow and writing a number next to it. The corresponding number and description is written underneath the drawing or on another page.
6. Explain that the design of the clothes is less important than the choice of the materials (explained by the annotations). Explain that students can draw the outfit on the outline, or cut and paste images from a magazine.



Student work sample of 'Material matters' (Resource sheet 9)

7 Provide students with time to complete their copy of 'Material matters' (Resource sheet 9) and to share their designs and reasons for material selections. Compile the sheets to make a class catalogue. Read the catalogue as a class and add it to the class reading area.

8 Ask students to review their science journal and reflect on their learning during the unit. Ask students to record in their science journals, four (or more) things they learned. Provide questions to guide their reflections, such as:

- What new things did you learn during this unit?
- What activity did you enjoy most of all? Why?
- Which activity did you find most challenging? Why?
- What did you find interesting? Why?
- What are you still wondering about?
- What skills did you improve while working in a team?

9 Invite students to share what they have learned by taking turns to read out one thing they have written without repeating what other students have reported.

EVALUATE

Curriculum links

Studies of Society and Environment

- Explore traditional clothes from around the world.

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).

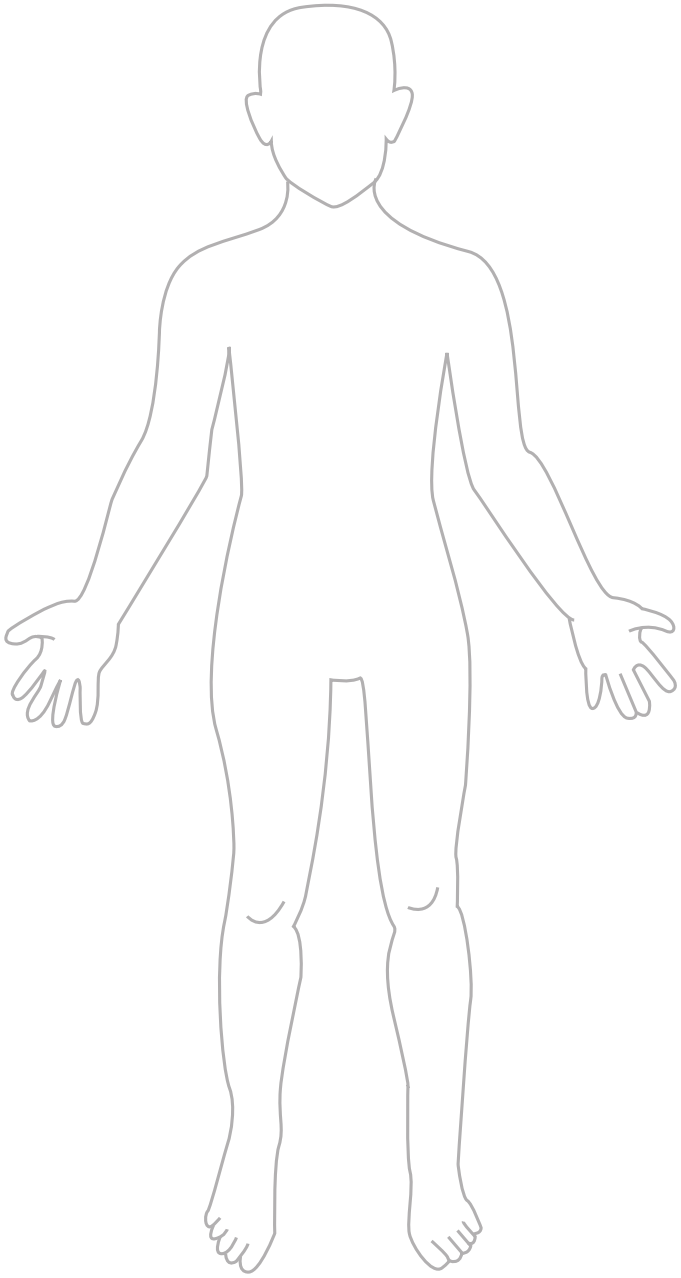
Material matters

Name: _____ **Date:** _____

Clothes for:

_____

My suggestion:



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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, for example, a wristband, badge, or coloured clothes 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 science journal

Introduction

A science journal is a record of observations, experiences and reflections. It contains a series of dated, chronological entries. It can include written text, drawings, labelled diagrams, photographs, tables and graphs.

Using a science journal provides an opportunity for students to be engaged in a real science situation as they keep a record of their observations, ideas and thoughts about science activities. Students can use their science journals as a useful self-assessment tool as they reflect on their learning and how their ideas have changed and developed during a unit.

Monitoring students' journals allows you to identify students' alternative conceptions, find evidence of students' learning and plan future learning activities in science and literacy.

Maintaining a science journal aligns to descriptions in the Australian Curriculum: Science and English. See pages 2 and 7.

Using a science journal

1. At the start of the year, or before starting a science unit, provide each student with a notebook or exercise book for their science journal or use an electronic format. Tailor the type of journal to fit the needs of your classroom. Explain to students that they will use their journals to keep a record of their observations, ideas and thoughts about science activities. Emphasise the importance of including pictorial representations as well as written entries.
2. Use a large project book or A3 paper to make a class science journal. This can be used at all year levels to model journal entries. With younger students, the class science journal can be used more frequently than individual journals and can take the place of individual journals.
3. Make time to use the science journal. Provide opportunities for students to plan procedures and record predictions, and their reasons for predictions, before an activity. Use the journal to record observations during an activity and reflect afterwards, including comparing ideas and findings with initial predictions and reasons. It is important to encourage students to provide evidence that supports their ideas, reasons and reflections.
4. Provide guidelines in the form of questions and headings and facilitate discussion about recording strategies, such as note-making, lists, tables and concept maps. Use the class science journal to show students how they can modify and improve their recording strategies.
5. Science journal entries can include narrative, poetry and prose as students represent their ideas in a range of styles and forms.
6. In science journal work, you can refer students to display charts, pictures, diagrams, word walls and phrases about the topic displayed around the classroom. Revisit and

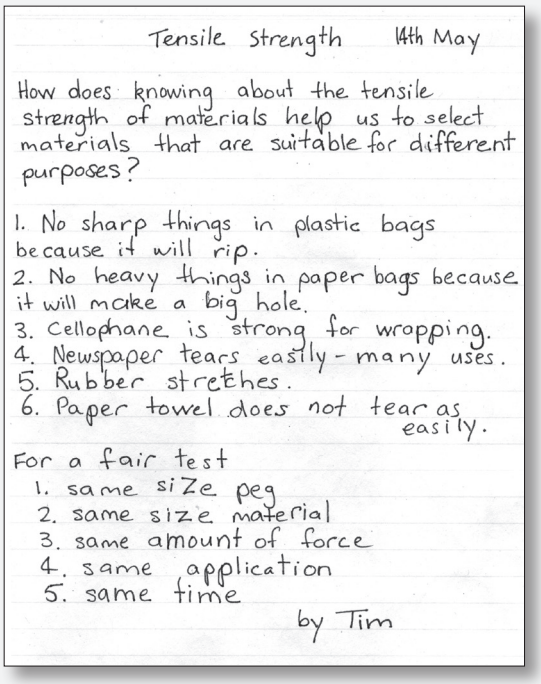
revise this material during the unit. Explore the vocabulary, visual texts and ideas that have developed from the science unit, and encourage students to use them in their science journals.

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

8 Use the science journal to assess student learning in both science and literacy. For example, during the *Engage* phase, use journal entries for diagnostic assessment as you determine students' prior knowledge.

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

Material world science journal



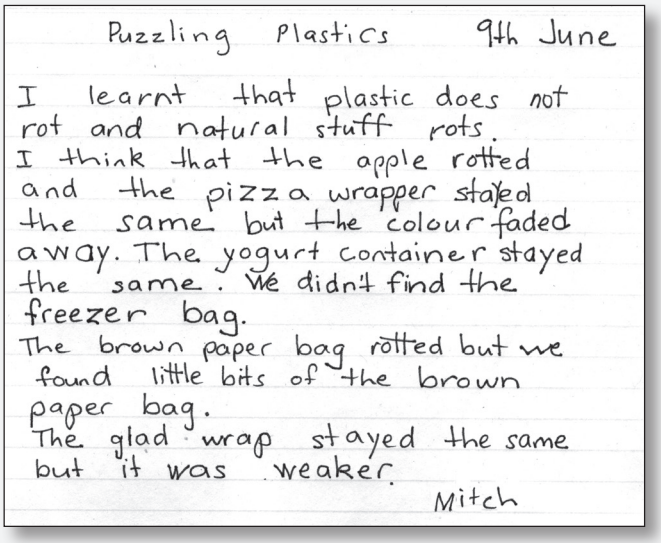
Tensile Strength 14th May

How does knowing about the tensile strength of materials help us to select materials that are suitable for different purposes?

1. No sharp things in plastic bags because it will rip.
2. No heavy things in paper bags because it will make a big hole.
3. Cellophane is strong for wrapping.
4. Newspaper tears easily - many uses.
5. Rubber stretches.
6. Paper towel does not tear as easily.

For a fair test
1. same size peg
2. same size material
3. same amount of force
4. same application
5. same time

by Tim



Puzzling Plastics 9th June

I learnt that plastic does not rot and natural stuff rots.
I think that the apple rotted and the pizza wrapper stayed the same but the colour faded away. The yogurt container stayed the same. We didn't find the freezer bag.
The brown paper bag rotted but we found little bits of the brown paper bag.
The glad wrap stayed the same but it was weaker.

Mitch

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.

Creating a class word wall, including words from different dialects and languages, aligns to descriptions in the Australian Curriculum: English. See page 7.

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.

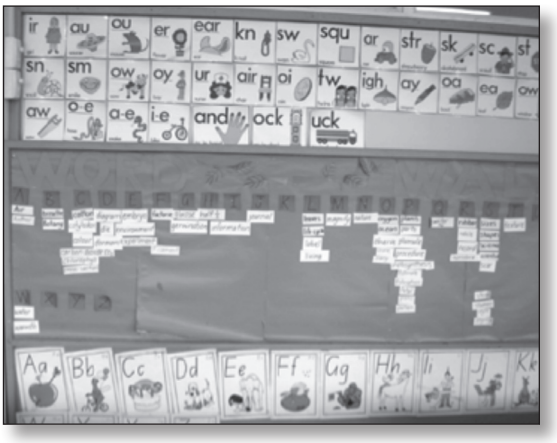
Choose robust material for the word cards. Write or type words on cardboard and perhaps laminate them. Consider covering the wall with felt-type material and backing each word card with a self-adhesive dot to make it easy for students to remove and replace word cards.

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.

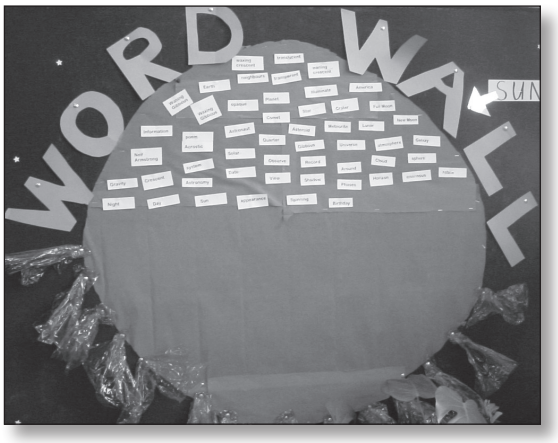
The purpose is for students to be exposed to a print-rich environment that supports their science and literacy experiences.

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 *Material world* unit might be organised using headings, such as ‘Materials’, ‘Properties’ and ‘Investigation words’.

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



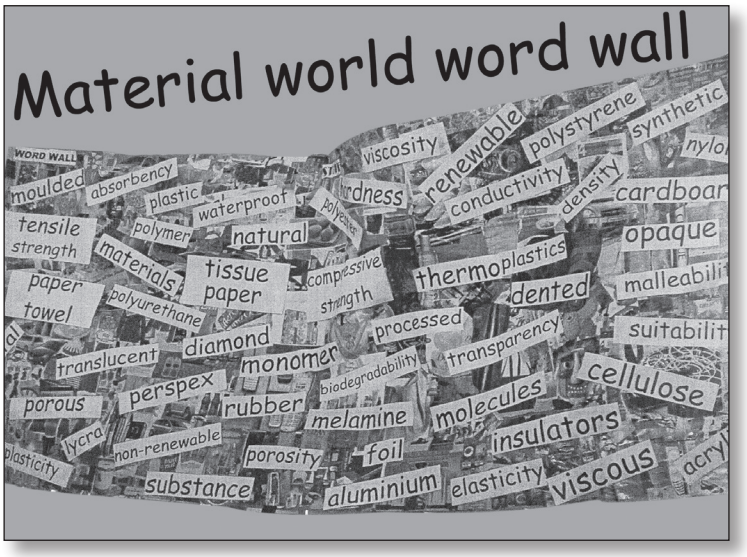
***Plants in action* word wall**



***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.



***Material world* word wall**

Appendix 4
How to use a glossary

Introduction

A glossary is a list of technical terms that relate to a particular subject matter or topic, generally accompanying a document. Each term is accompanied by a description or explanation of the term within the context of the subject. A glossary entry is generally more descriptive than a dictionary definition.

Creating a class glossary can be used to:

- elicit students' prior understanding of subject-specific terms
- develop a growing bank of descriptions to help students understand and use new words in written and oral tasks
- support students' understanding of scientific descriptions and explanations
- develop the strategy of using word sources as a real-life, valuable investigative research strategy.

Using a class glossary

1. Introduce a term and discuss what it might mean within the context of the unit. Possible strategies include: students connecting the word to a feature or aspect of the topic, and students using the word in a spoken sentence to explain topic, concept or context.
2. Create a shared understanding of the term and record it in the science journal or as part of the word wall.
3. Introduce the conventional technical meaning of the term where appropriate.
4. Encourage students to practice using the terms in the glossary to become familiar with them. Students may wish to amend a description of a word after becoming more familiar with how it is used in a particular context. This may occur when writing, talking or making annotations to diagrams.
5. Integrate the glossary across all curriculum areas where appropriate. For example, in a literacy lesson discuss various meanings for the term.
6. The glossary could be a part of the science journal or the word wall for a particular unit.

   Note: It is important to ask students for 'descriptions' of the terms, rather than 'definitions'. 'Definitions' are often viewed as fixed and unchangeable, whereas 'descriptions' support students to see that ideas can change as their understanding develops.

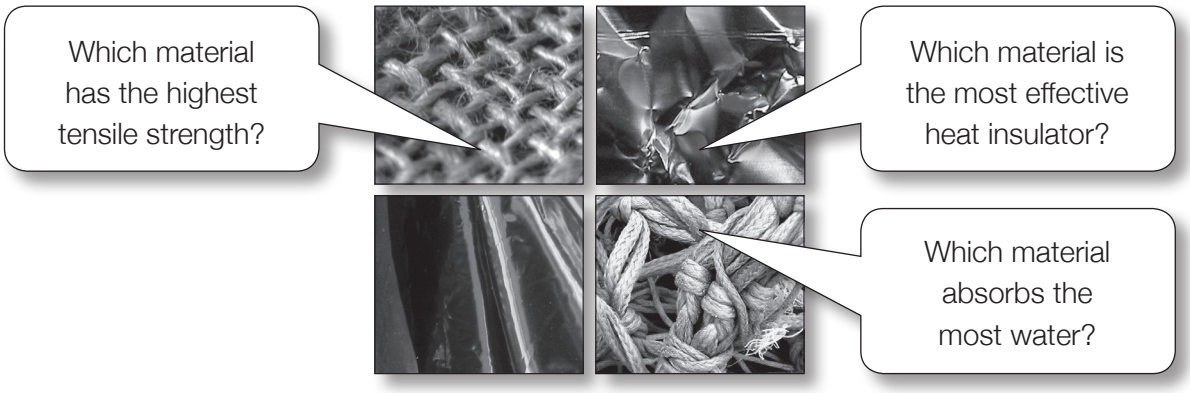
Appendix 5
How to conduct a fair test

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 *Material world*, students investigate the properties of different materials.



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) and

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

To investigate whether the insulating material has an effect on the temperature of the water in the container, students could:

CHANGE	the type of material	Independent variable
MEASURE/OBSERVE	the temperature of water in the container	Dependent variable
KEEP THE **SAME**	the type of container; the amount of water; the initial amount of water; the initial temperature of water; where the containers are placed	Controlled variable

Appendix 6
How to construct and use a graph (Year 4)

Introduction

A graph organises, represents and summarises information so that patterns and relationships can be identified. Understanding the conventions of constructing and using graphs is an important aspect of scientific literacy.

During a scientific investigation, observations and measurements are made and measurements are usually recorded in a table. Graphs can be used to organise the data to identify patterns, which help answer the research question and communicate findings from the investigation.

Once you have decided to construct a graph, two decisions need to be made:

- What type of graph? and
- Which variable goes on each axis of the graph?

What type of graph?

The Australian Curriculum: Mathematics describes data representation and interpretation for Year 4 as follows:

> 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.

Picture graph

Picture graphs support students in the transition from using physical representations to representing information using symbols or pictures in columns. The symbols or pictures must be the same size.

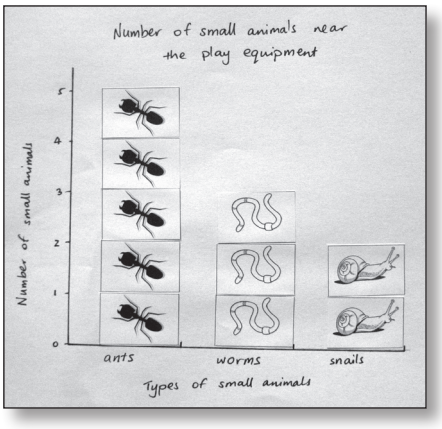
Table A shows the results recorded for an investigation of the types of small animals found in different environments. This information is represented in Graph A by using one small picture for each animal in Table A.

Table A: Number of small animals near the play equipment

Types of small animals	Number of small animals
ant	5
worm	3
snail	2

In the graph to the right, each picture might also represent a number of animals, for example, 1 picture = 5 animals found

Graph A: Number of small animals near the play equipment



Column graph

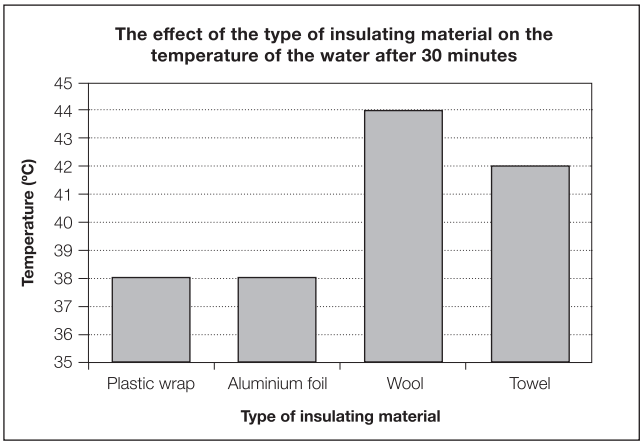
Where data for one of the variables are in **categories** (that is, we use **words** to describe it, for example, earthquake location) a **column graph** is used.

Graph B below shows how the results of an investigation of the effect of material type on the amount of light that passes through it **(data in categories)** have been constructed as a **column graph**.

Table A: The effect of type of insulating material on the temperature of the water in a can after 30 minutes.

Material	Temperature (ºC)
Plastic wrap	38
Aluminium foil	38
Wool	44
Towel	42

Graph A: The effect of type of insulating material on the temperature of the water in a can after 30 minutes.



Which variable goes on each axis?

It is conventional in science to plot the variable that has been changed on the horizontal axis (X axis) and the variable that has been measured/observed on the vertical axis (Y axis) of the graph.

Graph titles and labels

Graphs have titles and each variable is labelled on the graph axes, including the units of measurement. The title of the graph is usually in the form of 'The effect of one variable on the other variable'. For example, 'The effect of material on the amount of light that passes through.'

Steps in analysing and interpreting data

Step 1 — Organise the data (for example, construct a graph) so you can see the pattern in data or the relationship between data for the variables (things that we change, measure/observe, or keep the same).

Step 2 — Identify and describe the pattern or relationship in the data.

Step 3 — Explain the pattern or relationship using science concepts.

Questioning for analysis

Teachers use effective questioning to assist students to develop skills in interrogating and analysing data represented in graphs. For example:

- What is the story of your graph?
- Do the data in your graph reveal any patterns?
- Is this what you expected? Why?
- Can you explain the pattern? Why did this happen?
- What do you think the pattern would be if you continued the line of the graph?
- How certain are you of your results?

Analysis

Analysis of Graph A shows that different numbers of small animals were found near the play equipment. Students could compare graphs of different environments to determine which environments suit which animals. For example, if lots of ants were found in the garden, near the play equipment and in the lunch area, students might conclude that ants can live in lots of places in the schoolyard. If ants were only found in the garden, students might conclude that the ants prefer a garden habitat because they aren't found in other places.

Analysis of Graph B shows that the amount of light that passes through materials changes according to the type of material. This is because the more transparent or translucent a material is the more light that can pass through it.

Appendix 7
Material world equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	2	3	4	5	5	6	7
		SESSION	1	2	1	2			1	2		
Equipment and materials												
apple core	1 per team					●						
bags, different (eg, calico, thick plastic, paper, thick fabric, thin plastic)	5 per class								●			
box, large	1 per class			●								
cardboard, large	1–2 sheets per class		●									
clothes pegs, large	several per team							●				
clothing	1 piece per class		●									
clothes (eg, jumpers, gloves, hats, scarves, dresses, aprons, shirts)	1 collection per class				●							
containers	1 collection per team											
– clear plastic, at least 10 cm deep (eg, takeaway food container)	1 per class					●						
– clear plastic, at least 10 cm deep (eg, takeaway food container)	1 per team					●						
– metal, identical (eg, tins or cans to hold 200 mL warm water)	3 per team										●	
– transparent (eg, clear plastic cup)	1 per class						●					
– transparent (eg, clear plastic cup)	1 per team						●					
elastic bands (include 1 for modelling)	1 per team						●				●	
eye-dropper	1 per class						●					
eye-dropper	1 per team						●					
food colouring (to colour 1 cup of water for each team)	1 per class						●					
funnel	1 per team										●	
gloves, different (eg, woollen, ski, gardening, evening, rubber [dishwashing], latex)	1 collection per class			●								
magazines that can be cut up	1 collection per class											●
magnifying glass	1 per team							●				

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	2	3	4	5	5	6	7
		SESSION	1	2	1	2			1	2		
Equipment and materials (Continued)												
markers for a relay (eg, witches hats, cones)	3 per class				●							
materials												
– material sample (eg, newspaper), 3 cm x 3 cm	1 per class					●						
– material samples (eg, paper, plastic and fabric bags), 3 cm x 3 cm	3 or more different types per team					●						
– material samples of similar thickness (eg, paper, plastic and fabric bags), 15 cm x 15 cm	4 or more different types per team						●					
– material samples of similar thickness (eg, paper, plastic and fabric bags), 1 cm x 15 cm	4 or more different types per team							●				
– material samples buried in Lesson 2	several per team									●		
– material to wrap around each metal container, different types of similar thickness (eg, wool, cotton and plastic)	3 different types per team										●	
class materials snapshot from Lesson 1, Session 1	1 per class			●			●	●				
measuring cup, 200 mL	1 per team										●	
paper												
– graph paper *optional*	1 per student										●	
– newspaper strip, 1 cm x 15 cm	1 per class							●				
– tissue paper square, 15 cm x 15 cm	1 per class						●					
marking pen	1 per class					●						
marking pen	1 per team					●						
self-adhesive notes	several per student		●									
soil, enough to fill a plastic container 10 cm deep	1 quantity per team					●						
thermometer	1 per team										●	
timing device (eg, a stopwatch or a watch with a second hand)	1 per team										●	
tray to hold samples	1 per team									●		
water												
– coloured (include 1 extra cup for modelling)	1 cup per team						●					
– hot (<50°C)	200 mL per class										●	
– hot (<50°C)	600 mL per team										●	
waterproofing spray (eg, shoe or lounge spray) optional	1 can per class						●					

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	2	3	4	5	5	6	7
		SESSION	1	2	1	2			1	2		
Resource sheets												
– 'Glove guide' (RS1)	1 per class			●								
– 'Glove guide' (RS1), enlarged	1 per student			●								
– 'Information note for families' (RS2) *optional*	1 per student			●								
– 'Information note for families' (RS2), enlarged *optional*	1 per class			●								
– 'Bags at home' (RS3) *optional*	1 per student			●								
– 'Bags at home' (RS3), enlarged *optional*	1 per class			●								
– 'Leak, soak or repel?' (RS4)	1 per student						●					
– 'Leak, soak or repel?' (RS4), enlarged	1 per class						●					
– 'Snap, tear or stretch?' (RS5)	1 per student							●				
– 'Snap, tear or stretch?' (RS5), enlarged	1 per class							●				
– 'Carrying dilemma' (RS6)	1 per student								●			
– 'Carrying dilemma' (RS6), enlarged	1 per class								●			
– 'Puzzling over plastics' (RS7)	1 per student									●		
– 'Puzzling over plastics' (RS7), enlarged	1 per class									●		
– 'Keeping it warm investigation planner' (RS8)	1 per student										●	
– 'Keeping it warm investigation planner' (RS8), enlarged	1 per class										●	
– 'Material matters' (RS9)	1 per student											●
– 'Material matters' (RS9), enlarged	1 per class											●

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	2	3	4	5	5	6	7
		SESSION	1	2	1	2			1	2		
Teaching tools												
class science journal	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 science journal	1 per student			●	●	●	●	●	●	●	●	●
word wall	1 per class		●	●	●	●	●	●	●	●	●	●
Multimedia												
digital camera *optional*	1 per class					●						
Texts												
narrative												
– Animals Should Definitely Not Wear Clothing or Mr Tuggle's Trouble	1 per class		●									
factual												
– texts about plastics	1 collection per class									●		

Appendix 8
Material world unit overview

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to represent their current understanding as they:	Students will be able to:	Students:	
ENGAGE	**Lesson 1** Curious clothes ***Session 1*** Fanciful fiction ***Session 2*** Gripping gloves	• discuss the properties of materials • explore how the properties of materials relate to their use.	• contribute to discussions about properties and uses of materials • understand the purpose and features of an annotated drawing • develop scientific vocabulary about materials and properties • record ideas about materials and properties in a science journal.	***Session 1*** Fanciful fiction • use a narrative and discussion to explore the relationship between properties of materials and their uses • construct a snapshot of what they know about the properties of materials and their uses. ***Session 2*** Gripping gloves • identify the uses of different gloves • explore the materials used to make different types of gloves.	**Diagnostic assessment** • Through discussion, share ideas and questions about properties and uses of materials • Science journal entries • 'Glove guide' (Resource sheet 1)

* 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 2** What a rotter ***Session 1*** That's not fair! ***Session 2*** Rot or remain?	• identify the features of a fair test • identify variables to investigate • make predictions about the decomposition of materials and give reasons for their predictions • test materials for decomposition.	• contribute to discussions about fair testing and the decomposition of materials • develop scientific vocabulary about decomposition • describe the purpose and features of a table • record ideas in a science journal.	***Session 1*** That's not fair! • consider the 'fairness' of a dress-up relay • record their ideas about fair testing in their science journals. ***Session 2*** Rot or remain? • make predictions about decomposition of materials • investigate the decomposition of materials showing an awareness of the need for fair testing.	**Formative assessment** • Science journal entries • Student participation in and discussion about the dress-up relay

* 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** Leak, soak or repel?	• describe the elements of a fair test • make predictions about the absorbency of materials • plan and conduct a test of the absorbency of materials • interpret results by identifying uses for materials.	• use oral, written and visual language to report observations on the absorbency of materials • develop scientific vocabulary about the absorbency of materials • use a table to record predictions and observations.	• explore the absorbency of materials • conduct a fair test about absorbency.	**Formative assessment** • Verbal descriptions and reasoning • Science journal entries • 'Leak, soak or repel?' (Resource sheet 4)
EXPLORE	**Lesson 4** Snap, tear or stretch?	• make predictions about the tensile strength of materials • plan and conduct a test of the tensile strength of materials • record results in a table and interpret findings.	• contribute to discussions about tensile strength of materials • use a table to record predictions and observations • develop scientific vocabulary about tensile strength.	• explore the tensile strength of materials • plan and conduct a fair test of tensile strength of materials • record results in a table and interpret findings.	**Formative assessment** • 'Snap, tear or stretch?' (Resource sheet 5) • Science journal 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 5** Choosey consumers ***Session 1*** Bags of fun ***Session 2*** Puzzling plastics	• describe and compare the properties of materials • explain how the properties of materials make them suitable for different uses • describe the positives and negatives of using certain types of materials for certain uses.	• use oral and written language to represent their understanding of how the properties of materials relate to use • record observations and explanations about the decomposition of materials • read a factual text about the properties of plastics • understand the features and purpose of role-plays and factual texts • use scientific vocabulary appropriately in their writing and talking.	***Session 1*** Bags of fun • select suitable bags based on the properties of their materials to transport particular objects • identify properties of materials and how they relate to use. ***Session 2*** Puzzling plastics • explore the results of the decomposition investigation • read a factual text about the properties of plastics • explain their understanding of the properties and uses of plastic materials through role-play.	**Formative assessment** • Carrying dilemma' (Resource sheet 6) • Participation in role-play • Science journal entries • 'Puzzling plastics' (Resource sheet 7)

* 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 6** Investigating insulation	• plan an investigation into the thermal insulation capacity of materials, showing an awareness of the need for fair testing • describe the features of fair testing • record findings in a table and interpret results as a graph • identify which materials are the best thermal insulators • generate explanations about the thermal insulation capacity of materials.	• use language and visual representations to design and record an investigation into the thermal insulation capacity of materials • use a table and a graph to record and represent findings • identify the features and purpose of a graph • participate in discussions about the thermal insulation capacity of materials.	• measure water temperature to investigate the thermal insulation capacity of materials • observe, record and interpret results.	**Summative assessment** of Science Inquiry Skills • 'Keeping it warm investigation planner' (Resource sheet 8) • Science journal 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:	
EVALUATE	**Lesson 7** Material matters	• describe the properties and uses of everyday materials • explain why the properties of a material make it suitable for a particular use.	• contribute to discussions about materials, their properties and uses • use scientific vocabulary appropriately • create an annotated drawing to represent what they know about the properties of materials and how they relate to use • reflect on their learning in a science journal entry.	• review the unit using the science journal, word wall and other resources developed during the unit • represent their understanding of the properties of materials by creating a page for a class design catalogue • reflect on their learning during the unit.	**Summative assessment** of Science Understanding • 'Material matters' (Resource sheet 9) • Science journal 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.

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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*
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