PrimaryConnections®

Australian Academy of Science

Fully aligned with the Australian Curriculum

Among the gum trees

Year 4

Biological sciences

About this unit Among the gum trees

Eucalypts are an important feature of Australian life, with over 900 species found in almost every corner of the nation. Eucalypts have adapted to survive both drought and bushfire—some rely on extreme heat or smoke to release and germinate seeds. Eucalypts provide shelter and food to many native animals, and some species are the sole food source for koalas.

The *Among the gum trees* unit is an ideal way to link science with literacy in the classroom. Through hands-on investigations, students explore the fruit and flowers of eucalypts, identify how different living things interact with the trees, and plan and conduct an investigation of whether Eucalyptus oil inhibits the germination of plants beneath its canopy or the growth of microorganisms.

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Contents

Foreword

Never has there been a more important time for science in Australia. More than ever, we need a scientifically-literate community to engage in debates about issues that affect us all. We also need imaginative thinkers to discover the opportunities in our exponentially expanding knowledge base. Teachers play a vital role in nurturing the minds of our future citizens and scientists.

The Australian Academy of Science has a long, proud history of supporting science education. Our primary education program, Primary**Connections**: linking science with literacy, now has over 15 years' experience in supporting teachers to facilitate quality learning experiences in their classrooms. Regular evaluations demonstrate the significant impact the program can have on both teacher confidence and student outcomes.

Primary**Connections** has been developed with the financial support of the Australian Government and endorsed by education authorities across the country. It has been guided by its Steering Committee, with members from the Australian Government and the Australian Academy of Science, and benefitted from input by its Reference Group, with representatives from all states and territories.

Key achievements of the program include engaging over 24,000 Australian teachers in professional learning workshops, producing multi award-winning curriculum resources, and developing an Indigenous perspective framework that acknowledges the diversity of perspectives in Australian classrooms.

The Primary**Connections** teaching and learning approach combines guided inquiry, using the 5Es model, with hands-on investigations. It encourages students to explore and test their own, and others', ideas and to use evidence to support their claims. It focuses on developing the literacies of science and fosters lasting conceptual change by encouraging students to represent and re-represent their developing understandings. Students are not only engaged in science, they feel that they can do science.

This is one of 40 curriculum units developed to provide practical advice on implementing the teaching and learning approach while meeting the requirements of the Australian Curriculum: Science. Trialled in classrooms across the country and revised based on teacher feedback, and with the accuracy of the teacher background information verified by Fellows of the Academy, the experience of many brings this unit to you today.

I commend Primary**Connections** to you and wish you well in your teaching.

Professor John Shine, AC Pres AA
President (2018–2022)
Australian Academy of Science

The Primary**Connections teaching and learning approach**

Primary**Connections** units embed inquiry-based learning into a modified 5Es instructional model. 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

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

Developing students' scientific literacy

The Primary**Connections** program supports teachers in 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.

Reference: 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.

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

Science 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.

Rubrics to help you make judgments against the relevant achievement standards of the Australian Curriculum are available on our website:
www.primaryconnections.org.au

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 smell, taste or eat anything unless they are given permission.
- Discuss and display a list of safe practices for science activities.

Teaching to 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 2020).

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, including how current knowledge has developed over time through the actions of many people
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 about 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 this 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

Above material is sourced from the Australian Curriculum: Australian Curriculum Assessment and Reporting Authority (ACARA). (2020). *Australian Curriculum: Science*. www.australiancurriculum.edu.au

Primary**Connections** has units to support teachers to teach each Science Understanding detailed in the Australian Curriculum: Science from Foundation to Year 6. Units also develop students' skills and knowledge of the Science as a Human Endeavour and Science Inquiry Skills sub-strands, as well as specific sub-strands within the Australian Curriculum: English and Mathematics. Detailed information about its alignment with the Australian Curriculum is provided in each unit.

Unit at a glance

Among the gum trees

Phase	Lesson	At a glance
ENGAGE	**Lesson 1** Which tree?	To capture students' interest and find out what they think they know about how living things have life cycles and depend on each other and the environment to survive. To elicit students' questions about eucalypts.
EXPLORE	**Lesson 2** Fruits and seeds ***Session 1*** Fruit or vegetable? ***Session 2*** Setting it up	To provide students with hands-on, shared experiences of the conditions that affect the germination of eucalypt seeds.
	Lesson 3 Bustling bees ***Session 1*** Flower parts ***Session 2*** Sweet as honey	To provide students with hands-on, shared experiences of the life cycles of eucalypts and European honey bees and the relationship between them.
	Lesson 4 At home on the tree	To provide students with hands-on, shared experiences of how some animals depend on eucalypts, and the different impacts that their activities have.
EXPLAIN	**Lesson 5** The story of its life ***Session 1*** Germinated or not? ***Session 2*** Cycle of life	To support students to represent and explain their understanding of how living things have life cycles that can depend on other living things. To introduce current scientific views on how events, for example, bushfires, can provide favourable environmental conditions for eucalypt growth.
ELABORATE	**Lesson 6** Why oils? ***Session 1*** An oily investigation ***Session 2*** Oily results	To support students to plan and conduct an investigation of whether *Eucalyptus* oil might help the plant defend itself against other living things.
EVALUATE	**Lesson 7** For the future	To provide opportunities for students to represent what they know about how living things have life cycles and depend on each other and the environment to survive, and to reflect on their learning during the unit.

A unit overview can be found in Appendix 9, page 78.

Among the gum trees—Alignment with the Australian Curriculum

Among the gum trees is written to align to the Year 4 level of the Australian Curriculum: Science. The Science Understanding, Science Inquiry Skills, and Science as a Human Endeavour strands are interrelated and embedded throughout the unit (see page xi for further details). This unit focuses on the Biological sciences sub-strand.

Year 4 Science Understanding for the Biological Sciences:	Living things have life cycles (ACSSU072) Living things depend on each other and the environment to survive (ACSSU073)
Incorporation in *Among the gum trees*:	Students explore the life cycles and beneficial interactions between eucalypts and bees. They explore other beneficial as well as harmful interactions between animals and eucalypts. Students conduct a fair test on seed germination of eucalypt seeds and test theories on why oil is present in eucalypt leaves.

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

Year 4 Achievement Standard

The Australian Curriculum: Science Year 4 achievement standard indicates the quality of learning that students should demonstrate by the end of Year 4.

By the end of Year 4, students apply the observable properties of materials to explain how objects and materials can be used. They describe how contact and non-contact forces affect interactions between objects. They discuss how natural processes and human activity cause changes to the Earth's surface. **They describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. They identify when science is used to understand the effect of their actions.**

Students follow instructions to identify investigable questions about familiar contexts and make predictions based on prior knowledge. They describe ways to conduct investigations and safely use equipment to make and record observations with accuracy. They use provided tables and column graphs to organise data and identify patterns. Students suggest explanations for observations and compare their findings with their predictions. They suggest reasons why a test was fair or not. They use formal and informal ways to communicate their observations and findings.

The sections relevant to *Among the gum trees* are bolded above. By the end of the unit, teachers will be able to make evidence-based judgements on whether the students are achieving below, at or above the achievement standard for the sections bolded above.

Among the gum trees—Australian Curriculum Key ideas

In the Australian Curriculum: Science, there are six key ideas that represent key aspects of a scientific view of the world and bridge knowledge and understanding across the disciplines of science. The below table explains how these are represented in *Among the gum trees*.

Overarching idea	Incorporation in *Among the gum trees*
Patterns, order and organisation	Students describe the life cycle of eucalypts and bees. They investigate patterns in the mutualistic relationships that exist between eucalypts and bees and other pollinating animals.
Form and function	Students observe and investigate parts of flowers and bees that play important roles in pollination as part of the plant life cycle. Students explore the role that seed capsules play in protecting seeds from the heat of bushfires.
Stability and change	Students observe the predictable stages of growth of living things as they change through their life cycle. They explore the pattern of bushfires and the regeneration of eucalypts.
Scale and measurement	Students discuss the time scale involved in the growing and changing of living things.
Matter and energy	Students explore the theories of the presence of oil in eucalypts and how it might contribute to the survival of the trees.
Systems	Students identify and describe the relationships that exist between the components of ecosystems, including the interdependency of living things and their environments.

Among the gum trees—Australian Curriculum: Science

Among the gum trees embeds all three strands of the Australian Curriculum: Science. For ease of reference, the table below outlines the sub-strands covered in *Among the gum trees*, the content descriptions for Year 4 and their aligned lessons.

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Science Understanding	**Biological Sciences**	ACSSU072	Living things have life cycles	1–7
		ACSSU073	Living things depend on each other and the environment to survive	1–7
Science as a Human Endeavour	**Nature and development of science**	ACSHE061	Science involves making predictions and describing patterns and relationships	2–6
	Use and influence of science	ACSHE062	Science knowledge helps people to understand the effect of their actions	5
Science Inquiry Skills	**Questioning and predicting**	ACSIS064	With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge	2, 6
	Planning and conducting	ACSIS065	With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment	2, 6
		ACSIS066	Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately	2, 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, 6
		ACSIS216	Compare results with predictions, suggesting possible reasons for findings	2, 6
	Evaluating	ACSIS069	Reflect on investigations; including whether a test was fair or not	2, 6
	Communicating	ACSIS071	Represent and communicate observations, ideas and findings using formal and informal representations	1–7

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

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 further information see: www.australiancurriculum.edu.au

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

Among the gum trees—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	*Among the gum trees* examples
Literacy	Literacy knowledge specific to the study of science develops along with scientific understanding and skills. PrimaryConnections 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 *Among the gum trees* the literacy focuses are: • TLWH charts • science journals • word walls • factual texts • labelled diagrams • posters • annotated diagrams • flow charts.
Numeracy	Elements of numeracy are particularly evident in Science Inquiry Skills. These include practical measurement and the collection, representation and interpretation of data.	Students: • measure plant growth • collect and represent data in tables • represent and identify patterns and trends in simple column graphs.
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 digital cameras to record observations in investigations • integrate digital images into science journal entries • use interactive resource technology to view video resources on pollination and bushfires.
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: • use evidence to discuss and support claims • make predictions • summarise information from investigations • reflect on learning.
Ethical behaviour	Students develop ethical behaviour as they explore principles and guidelines in gathering evidence and consider the implications of their investigations on others and the environment.	Students: • ask questions of others, respecting each other's point of view.
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 • listen to and follow instructions to safely complete investigations.
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. • Important contributions made to science by people from a range of cultures are highlighted.

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

Among the gum trees—Australian Curriculum: English

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
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	1–7
		ACELA1489	Understand differences between the language of opinion and feeling and the language of factual reporting or recording	2, 3, 5
	Text structure and organisation	ACELA1490	Understand how texts vary in complexity and technicality depending on the approach to the topic, the purpose and the intended audience	1–7
	Expressing and developing ideas	ACELA1498	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	2–7
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	1–7
		ACELY1689	Plan, rehearse and deliver presentations incorporating learned content and taking into account the particular purposes and audiences	7
	Interpreting, analysing, evaluating	ACELY1692	Use comprehension strategies to build literal and inferred meaning to expand content knowledge, integrating and linking ideas and analysing and evaluating texts	4
	Creating texts	ACELY1694	Plan, draft and publish imaginative, informative and persuasive texts containing key information and supporting details for a widening range of audiences, demonstrating increasing control over text structures and language features	7
		ACELY1697	Use a range of software including word processing programs to construct, edit and publish written text, and select, edit and place visual, print and audio elements	2, 6, 7

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

Among the gum trees—Australian Curriculum: Mathematics

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Measurement and Geometry	**Using units of measurement**	ACMMG084	Use scaled instruments to measure and compare lengths, masses, capacities and temperatures	2
		ACMMG290	Compare objects using familiar metric units of area and volume	6
Statistics and Probability	**Chance**	ACMSP093	Identify everyday events where one cannot happen if the other happens	4
	Data representation and interpretation	ACMSP095	Select and trial methods for data collection, including survey questions and recording sheets	2, 6
		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.

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.

Two of these are embedded within *Among the gum trees*, as described below.

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

Among the gum trees focuses on the Western science method of making evidence-based claims about life cycles and interactions between living things. Aboriginal and Torres Strait Islander Peoples might have other explanations for why living things interact with each other.

The ubiquitousness of eucalypts has meant that the trees have been an important resource for Aboriginal and Torres Strait Islander Peoples for thousands of years. Their knowledge includes how to use parts of the trees for ailments including diarrhoea, fever and headache, and the food sources that might lie within the tree, such as sugarbag and witchetty grubs.

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 *Among the gum trees* unit provides opportunities for students to develop an understanding of how the growth of some living things can be impacted by environmental conditions, including changes due to human impact such as bushfires. 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.

Teacher background information

This information is intended as teacher information only. It provides teachers with information relevant to the science concept so they can feel more confident and competent to teach each lesson. The content and vocabulary of this information is at a more detailed and advanced level than what is required for students.

Introduction to eucalypts

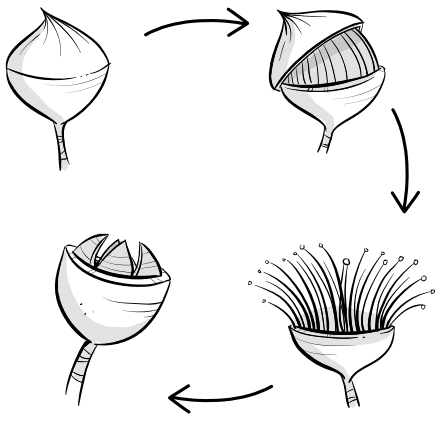
The term 'eucalypt' encompasses approximately 900 species in the three genera *Eucalyptus*, *Corymbia* and *Angophora*, with almost all of these species native to Australia. Eucalypts are often referred to as 'gum trees' because of the characteristic of some species to exude a sticky, gum-like substance (kino) from the trunk.

Eucalypts are a type of flowering plant (*Angiosperm*), which means that they reproduce by producing flowers and fruit. Many common plants are flowering plants, including many trees, grasses and cacti. In order for a flower to become a fruit it needs to be fertilised through pollination. Plants that require animals, such as insects, birds or small mammals, for pollination often have brightly coloured flowers. Plants with flowers that use other mechanisms, for example, the wind, generally have smaller, discrete flowers.

Every flowering plant starts life as a seed. In the right conditions, a seed starts to germinate by sending roots down into the soil and a shoot up towards the sunlight. If the plant receives enough light, air, water and nutrients it grows to become a seedling, and eventually an adult plant. When it is time for the plant to reproduce it produces flowers. After pollination and fertilisation have occurred the flower develops into a fruit containing seeds. The fruit often helps seeds to disperse, by having structures to float on the water, to be carried by the wind or to encourage animals to ingest the seeds. If the seeds experience suitable conditions for germination the life cycle starts over again.

The name *Eucalyptus* comes from two Greek words, *eu*, which means 'well' and *kalyptus* which means 'covered'. This refers to the unusual flower buds, which are covered with a little cap (or operculum). When the cap comes off the stamens of the flower unfurl around the central pistil.

After fertilisation, the cup-like base of the flower dries, enlarges and becomes a woody fruit with seeds inside. The fruit is technically termed a 'capsule' but commonly called a 'gumnut'. The appearance of the fruit helps distinguish between species.



Sequence of development of the fruit of a eucalypt

Interactions with other living things

Eucalypts are iconic Australian trees. Eucalypt forests are Australia's most common forest type, accounting for roughly seventy per cent of Australian forest and occurring in all but the driest regions. A wide variety of Australian flora and fauna interact with the trees:

- Eucalypts provide nectar to encourage insects, birds and small mammals to visit their flowers, which are then pollinated through such visits. A relationship where both living things derive benefit from the interaction is known as mutualistic or cooperative.
- Eucalypts provide shade and shelter as well as nesting sites. This benefits other living things but not necessarily the tree itself, so many of those interactions would be identified as commensalistic.
- Eucalypts need resources, such as water, nutrients and sunlight, as do other plants. Where supply is limited and plants growing close together do not receive enough, this relationship is known as competitive. However, when the relationship is very uneven, for example, the presence of the grass has little effect on a eucalypt but the eucalypt has a very negative effect on the grass, then the relationship is known as amensalistic.
- Eucalypts provide a source of food for animals that can ingest their oil-rich leaves, for example, koalas. Other animals also eat the flowers and seeds. This relationship is antagonistic as the animal gains benefit at expense of the tree.

These classifications help ecologists to model ecosystems. However, life is rarely simple. For example, some insects have larvae that feed on *Eucalyptus* leaves but as adults, they pollinate the flowers. Birds might destroy some flowers and seeds but also eat insects that attack the leaves and trunk.

Students' conceptions

Taking account of students' existing ideas is important in planning effective teaching approaches that 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 believe that trees, grass, vegetables and weeds are not plants. Plants have many different characteristics. There are many different types of plants throughout the world. Not all plants have the same structures, such as stems, leaves, flowers and roots.

Some students might think that plants grow flowers purely to serve animals, for example, to look pretty for human eyes or to provide nectar and pollen for bees. Flowering plants produce flowers as part of their reproductive cycle. Flowers that rely on animals for pollination are attractively coloured and provide nectar to encourage visits from pollinators to ensure they can have fertilised seeds.

Some students might think of fruit as something sweet produced by plants. In science, fruit develops from a flower and contains seeds. It generally aids in the dispersal of seeds. Fleshy fruits, such as berries, plums, apples and oranges, are intended for animal consumption. Their seeds travel inside the animal and are expelled into a pile of fertiliser. Other fruits may aid with wind or water dispersal, for example, the outer shell of a coconut floats the coconut seed on water.

To access more in-depth science information in the form of text, diagrams and animations, refer to the Primary**Connections** Science Background Resource available on the Primary**Connections** website:
www.primaryconnections.org.au

Lesson 1 Which tree?

AT A GLANCE

To capture students' interest and find out what they think they know about how living things have life cycles and depend on each other and the environment to survive.

To elicit students' questions about eucalypts.

Students:

- use given features to identify eucalypts in the school grounds
- represent the life cycle of a eucalypt using words and images
- begin a weekly report of animals found on a eucalypt.

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:

- living things have cycles
- living things depend on each other and the environment to survive.

Key lesson outcomes

Science

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

- identify trees that might be eucalypts
- explain their ideas about the life cycle of a eucalypt
- list animals that might be found on a eucalypt and discuss why
- discuss what they think a eucalypt needs to survive.

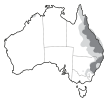
Literacy

Students will be able to:

- contribute to discussions about eucalypts
- represent the life cycle of a eucalypt using words and images.

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

Teacher background information

Scientific name and common name	Description	Flowering	Distribution
Eucalyptus camaldulensis • **River red gum**	River red gum is one of the best known of all eucalypts. Common along watercourses.	The white flowers are seen mainly in late spring and summer.	
Eucalyptus obliqua • **Messmate**	The bark is rough, fibrous and stringy, grey to red-brown in colour. Fruits are barrel-shaped.	Flowers are white and appear most of the year.	
Eucalyptus macrorhyncha • **Red stringybark**	A small- to medium-sized tree with rough, thick fibrous and stringy, dark-brown bark.	White flowers appear in mid-summer to mid-autumn.	
Eucalyptus leucoxylon • **Yellow gum**	Has rough bark on the lower 1–2 m of the trunk. Above this, the bark becomes smooth, with a white, yellow or bluish-grey surface.	White, pink or red flowers appear during winter.	
Eucalyptus miniata • **Darwin woollybutt**	Has a particularly spongy and fibrous bark that grows a quarter to half-way up the trunk. Above this, the bark is smooth and white.	Flowering occurs from May to September with orange or scarlet flowers.	
Eucalyptus tetrodonta • **Darwin stringybark**	Fruits are bell-shaped to cylindrical, with prominent triangular teeth.	Flowers in winter (dry season) and rarely in summer. Flowers are white or cream.	
Eucalyptus crebra • **Narrow-leaved ironbark**	Bark is retained on the tree and is hard and deeply furrowed.	Small white flowers appear from late autumn to spring.	
Eucalyptus sideroxylon • **Red ironbark** • **Mugga**	Has unusually black bark, often holding copious quantities of kino (gum).	Flowers are white, pink, red or pale yellow from early autumn until mid-spring.	
Eucalyptus marginata • **Jarrah**	The name 'marginata' comes from a vein that runs roughly parallel to the edge of a mature leaf, creating the appearance of a margin.	Flowers are white and bloom in spring and early summer.	
Eucalyptus caesia • **Silver princess** • **Gungurra**	White powder covers the branches, flower buds and fruit. Branches tend to flail or weep on the ground.	Flowers are large and normally pink to red. Flowering occurs in winter and spring.	

Scientific name and common name	Description	Flowering	Distribution
Eucalyptus lehmannii • **Bushy yate**	A small mallee with smooth bark, often with accumulated older bark at base of trunk. Fruit stays on the tree.	Flowers are green-yellow and appear during summer and spring.	
Eucalyptus todtiana • **Coastal blackbutt** • **Pricklybark**	Usually holds its fruits. Not too tall.	Produces cream and white flowers from January to April.	
* *Corymbia calophylla* • **Marri**	Very large buds and fruit. A bloodwood, with red gum effusions often found on the trunk. Is 40-60 m high, with rough bark.	Produces white and pink flowers through summer to autumn.	
Eucalyptus dives • **Broad-leaved peppermint**	Medium, low-branching tree with fibrous bark. The oil in the leaves has a peppermint-like aroma.	Flowers are white, appearing from September to December.	
Eucalyptus viminalis • **Ribbon gum or Manna gum**	A straight erect tree. Bark is deciduous and is shed in long strips, which often hang from the branches.	Creamy white flowers during summer to autumn.	
Eucalyptus sclerophylla, rossii, racemosa, signata • **Scribbly gum**	Bark is deciduous and the smooth trunk is marked with 'scribbles' caused by an insect larva.	White flowers from spring to summer.	
* *Corymbia maculata* • **Spotted gum**	Has a distinctive trunk that is blotched with patches of old bark contrasting with the smooth, cream bark beneath.	Small, white flowers occur from winter to spring.	
* *Corymbia citriodora* • **Lemon-scented gum**	Bark is smooth for the entire height of the tree. Smells strongly of lemons.	White flowers during June to November.	
Eucalyptus globulus • **Blue gum**	Bark is usually smooth, white to cream, yellow or grey. Shed bark accumulates at the base of the trunk.	The white flowers occur from winter to early summer.	

**Corymbia* is a new genus (1995) that contains 113 species, 80 of which were formerly within *Eucalyptus*.

Primary**Connections** is developing additional classroom resources to help with the identification of eucalypts, with the Bjarne K Dahl Trust's support. Please visit the website to see if they are available, www.primaryconnections.org.au

The following website also contains additional information to help with identification:

- 'Meet 12 Species of Gum Trees', http://treesandshrubs.about.com/od/selection/ss/Meet-12-Species-of-Gum-Trees.htm#showall

For detailed information about how botanists classify eucalypts, see: https://www.anbg.gov.au/cpbr/cd-keys/euclid3/euclidsample/html/learn.htm. This information assists you to use the identification tables published by local governments:

- NSW: http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=gn&name=Eucalyptus
- SA: http://www.flora.sa.gov.au
- WA: https://florabase.dpaw.wa.gov.au/search/quick?q=eucalyptus

ENGAGE

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'Is it a eucalypt?' (Resource sheet 1)
- *Eucalyptus*-scented items (see 'Preparation')
- *optional:* lyrics/tunes to 'gum tree' songs
- *optional:* digital camera

FOR EACH STUDENT

- science journal
- 1 copy of 'Is it a eucalypt?' (Resource sheet 1)
- clipboard
- small paper bag

Preparation

- Read 'How to use a science journal' (Appendix 2).
- Read 'How to use a word wall' (Appendix 3).
- Read 'How to use a TWLH chart' (Appendix 5). Prepare a four column chart for the class with the following headings:

***Among the gum trees* TWLH chart**

What we **T**hink we know	What we **W**ant to learn	What we **L**earned	**H**ow we know

- Select four different trees in the school grounds that the class will visit. Ensure that one or two are eucalypts (see Teacher Background Information).
- Collect *Eucalyptus*-scented items, such as tissues, sweets or cotton balls soaked in diluted *Eucalyptus* oil.
- Prepare an enlarged copy of 'Is it a eucalypt?' (Resource sheet 1).
- Prepare a page in the class science journal as follows:

Animals we observed on the eucalypt

Week	**Animal**

- Source packets of eucalypt seeds in preparation for Lesson 2 in case fertile seeds are not present in collected capsules. Trial teachers sourced seeds online or from their local nurseries. You can also find distributors through the following websites:

  – http://anpsa.org.au/seedsupp.html
  – **https://www.greeningaustralia.org.au/services-native-seed/**
- *Optional:* Display the TWLH chart, 'Is it a eucalypt?' (Resource sheet 1) and 'Animals we observed on the eucalypt' table in a digital format.

Lesson steps

1 Discuss the well-known Australian songs 'Kookaburra sits in the old gum tree' and 'Give me a home among the gum trees'.

Optional: Play the tunes and/or display the lyrics to the songs.

2 Explain that students will be going out into the school grounds to find trees that are gum trees. Explain that scientists call gum trees 'eucalypts', and that *Eucalyptus* trees are a type of eucalypt. Introduce the TWLH chart. Discuss its purpose and features.

Literacy focus

Why do we use a TWLH chart?

We use a **TWLH chart** to show our thoughts and ideas about a topic before, during and after an investigation or activity.

What does a TWLH chart include?

A **TWLH chart** includes four sections with the headings: What we **T**hink we know, What we **W**ant to learn, What we **L**earned, and **H**ow we know. Words or pictures can be used to show our thoughts and ideas.

3 Ask students:

- How will we know a tree is a eucalypt?
- What animals might be on or in the tree? Why do you think they are there?
- What do you think the tree needs to survive?

Record students' ideas in the 'What we think we know' column of the TWLH chart.

4 Introduce the enlarged copy of 'Is it a eucalypt?' (Resource sheet 1) and read through with students. Discuss how it shows different things or 'features' that scientists use to identify a eucalypt.

5 Introduce the *Eucalyptus*-scented items (see 'Preparation'). Explain that the smell is because of oil that comes from the leaves of a eucalypt. Allow students to smell the items so that they can recognise similar smells coming from a crushed leaf.

6 Explain that students will visit four different trees and use the sheet to identify which of those trees are eucalypts. Ask students to put a tick next to a feature if the tree has it, and a cross if not.

7 At a tree that has been identified as a eucalypt ask students to carefully collect items from the tree, such as a leaf, a flower, a bud or a gumnut.

Note: The presence of buds, flowers and gumnuts will depend on the season and the species of eucalypt.

8 Ask students to record on the back of their sheet any living things they observe on the tree, such as birds, ants or other plants. Encourage students to also record 'clues' that living things may have visited, such as nests, droppings or bite marks on leaves. Explain that each week students will record the different living things that live on, or visit, the tree.

Optional: Take a photo of the tree and the animals on, or in, it.

9 Back in the classroom, ask students to write their name on a paper bag, put the collected items inside and place the bag in a warm place, for example, on a window sill.

10 Record animals that students saw in, and on, the tree in the prepared page in the class science journal.

11 Ask students to think about how the tree grew and what the life cycle of a eucalypt might be. Ask students to draw the life cycle of a eucalypt in their science journal and add any information to each of the life cycle stages that they can think of.
Discuss the purpose and features of a science journal.

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.

Allow time for students to complete their life cycle drawing.

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

12 Ask students what questions they might have about eucalypts. Record students' ideas in the 'W' column of the TWLH chart.

13 Introduce the class word wall. 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 which we have seen or heard about the topic.

14 Ask students what words from today's lesson they would like to add to the word wall.

Curriculum links

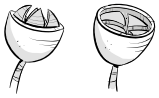
Science

- Draw a map of the school grounds and mark where each eucalypt is growing.

Is it a eucalypt?

Name: _____ **Date:** _____

Look for the features described below and mark with a ✓ or ✘ for each feature that you find on each tree. The more ✓ each tree has the more likely it is to be a 'gum tree' (eucalypt).

Feature	Tree 1	Tree 2	Tree 3	Tree 4
1. Are the mature leaves shaped like this and hanging downwards?* 				
2. Hold a leaf up to the light. Can you see the oil glands (small yellow spots)?				
3. Crush a leaf and smell it. Does it have a '*Eucalyptus* oil' smell ?				
4. If there are flowers, are the flower buds covered by a 'cap'? 				
5. Are there 'gumnuts' in or under the tree? 				

*Most adult eucalypts have leaves of that shape, but their leaves can also be rounded (especially for young trees). That is why we look for several different clues to identify the tree.

From your collected evidence, which of the four trees do you claim might be eucalypts?

Lesson 2 Fruits and seeds

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of the conditions that affect the germination of eucalypt seeds.

Session 1 Fruit or vegetable?

Students:

- view a video about what a 'fruit' is
- work in teams to plan an investigation of the germination of eucalypt seeds.

Session 2 Setting it up

Students:

- work in teams to set up an investigation of the germination of eucalypt seeds.

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:

- living things have cycles
- living things depend on each other and the environment to survive.

You will also monitor their developing science inquiry skills (see page xi).

Key lesson outcomes

Science

Students will be able to:

- identify that fruits are intended to contain seeds
- recognise the fruit of a eucalypt
- with support, develop a question to investigate conditions that affect germination
- with support, plan a fair test investigation.

Literacy

Students will be able to:

- contribute to discussions about seed germination
- incorporate new vocabulary into writing.

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

Teacher background information

Every flowering plant starts life as a seed. Seeds generally germinate under the right conditions of light, warmth, oxygen and moisture. Some seeds require extra conditions, for example, orchid seeds may require a particular type of fungus to be present in the soil.

Seeds can be dormant: they will not be ready to germinate even if the conditions are right. Dormancy ensures that seeds are more likely to germinate at a time when the young plant has the most chances for survival. For example, seeds from the snow gum germinate better after they have experienced a period of cold (such as winter conditions).

When a seed germinates it sends roots down into the soil and a shoot up towards the sunlight. If the plant receives enough light it grows to become a seedling, and eventually an adult plant. When it is time to reproduce it produces flowers. After pollination and fertilisation have occurred, the flower develops into a fruit containing seeds. If the seeds experience suitable conditions for germination the life cycle starts again.

What is a fruit?

Botanically speaking, a fruit is a seed-bearing structure that develops from the ovary of a flowering plant. Therefore, apples, oranges, lemons and tomatoes are all fruits, as are woody capsules produced by eucalypts (sometimes called gumnuts), burrs that attach to your clothing and other structures that enable some seeds to float on the wind. They all contain seeds.

Note: Strawberries are called multiple fruits. They consist of a fleshy stem, with the 'strawberry grains' each being a small fruit containing a seed. Bananas are a special type of fruit. Through selection, we have engineered plants that produce fruits without fertilisation, and the seeds do not develop although you can still see the small black ovules.

Scientists refer to all plant material as 'vegetative matter'. Traditionally, 'vegetable' referred to any member of the plant kingdom, hence the guessing game 'animal, vegetable or mineral'. More commonly, 'vegetable' is used to designate any part of a plant that is consumed

by people for, often savoury, food. The common use of the term 'vegetable' can refer to botanical fruits (capsicums, cucumbers), seeds (peas, corn), flowers (broccoli, cauliflower), roots (potatoes, turnips), buds (Brussels sprouts, cabbage), stems (celery), bulbs (onions) or leaves (spinach, kale).

Germinating eucalypt seeds

The best time to germinate eucalypt seeds is from September through to March. However, seeds can be germinated at any time throughout the year, although they might take longer to germinate outside those months.

As the fruits mature they change from green to brown and woody. Pick the brown woody fruits and place them in a paper bag in a warm position. The capsules release the seeds as they ripen. With a seed capsule is chaff (sterile seeds). Separate the seeds from the chaff by gently blowing it away. Eucalypt seeds generally take about two weeks to germinate.

Students' conceptions

Some students might think of fruit as something sweet produced by plants. In science, fruit develops from a flower and contains seeds. It generally aids in the dispersal of seeds. Fleshy fruits, such as berries, plums, apples and oranges, develop to encourage animals to eat them. The seeds travel within the animal while in the digestive system and are expelled into a pile of fertiliser.

EXPLORE

Session 1 Fruit or vegetable?

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- team skills chart
- team roles chart
- word wall
- 1 enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2)
- 1 eucalypt seed capsule
- packets of eucalypt seeds (in case seeds are not present in capsules)
- *optional:* heated eucalypt seeds (see 'Preparation')
- video(s) about why plants produce fruits (see 'Preparation')

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) per team member
- paper bag with seed capsules from Lesson 1

Preparation

- Read 'How to write questions for investigation' (Appendix 7).
- Read 'How conduct a fair test' (Appendix 4).
- Source a video discussing why plants produce fruits, for example:
  – 'Why do plants make fruit?' on ABC Education, see: https://education.abc.net.au/home#!/media/86130/fruit-why-plants-make-them
- Prepare the following page in the class science journal:

Eucalypt seeds germination variables grid planner

- Prepare an enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2).
- *Optional:* Prepare heated seeds by scattering them on a tray and heating in an oven at 100°C for approximately 30 minutes. If students conduct a fair test on the effect of heat they will have additional evidence to discuss about the effect of bushfires on different stages of the eucalypt life cycle.
- Source packets of eucalypt seeds in case fertile seeds are not present in capsules (see 'Preparation', Lesson 1).
- *Optional:* Display 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) in a digital format.

Lesson steps

1 Ask three students to observe and record animals in and on a eucalypt identified in Lesson 1 and report back to the class. Add observations to the page in the class science journal set up in Lesson 1.

2 Review the previous lesson using the class science journal, TWLH chart and the word wall. Discuss the parts of the eucalypt that students collected.

3 Ask students why they think plants produce fruit. Record students' ideas in the class science journal.

4 Watch the video 'Why do plants make fruit?' (see 'Preparation'). Ask students questions, such as:

- When do scientists consider a food to be a 'fruit'? (When it has seeds inside it.)
- Can you think of foods that you would call a vegetable that scientists consider to be a fruit?
- Why do plants produce fruit? (As a container for seeds.)

Record students' updated ideas in the class science journal.

5 Ask students if they can identify the fruits of the eucalypt among the parts of the tree that they collected. Model how to shake the seed capsule to dislodge the seeds. Discuss how scientists consider the capsules to be the woody 'fruit' of the eucalypt as they contain its seeds.

6 Explain that some of what comes out of the capsule are the seeds and some are called chaff (seeds that are sterile or will not grow). Tell students to gently blow away the chaff to collect the remaining seeds.

7 Ask students if they know what the word is for when a plant starts to grow from a seed (germination). Ask students if they think that all seeds would germinate and, if not, what might stop them from germinating.

8 Introduce the variables grid (see 'Preparation'). Brainstorm what things (variables) might affect the seeds germinating successfully in the bush once they have been released from a seed capsule from high in the tree onto the ground. Write students' ideas in each of the boxes of the grid.

Eucalypt seeds germination variables grid planner

under leaves	soil	bushfire
ash	water	temperature
animals	lots of seeds together	being eaten by animals

9 Explain that students will be working in collaborative learning teams to investigate one of the variables of what might affect seeds germinating in the bush.

10 Introduce students to the process of writing questions for investigation. Model how to develop a question, such as:

- What happens to the germination of eucalypt seeds when we change the amount of light they receive?
- What happens to the germination of eucalypt seeds when we change the type of soil?
- What happens to the germination of eucalypt seeds when we change whether they have been through a fire or not?

11 Introduce the enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2). Model how to complete the investigation planner. For example, students might plan to investigate, 'What happens to the germination of eucalypt seeds when we change the amount of light they receive?'.

12 Explain that students will be working in the collaborative learning teams to plan their investigation. Ask students:

- How could you test whether the germination of eucalypt seeds is affected by the amount of light they receive? (By comparing seeds growing without leaves covering them with seeds growing with a layer of leaves over them.)
- How could you test whether the germination of eucalypt seeds is affected by the type of soil? (By comparing seeds growing in soil with seeds growing in gravel.)
- How could you test whether the germination of eucalypt seeds is affected by being exposed to bushfire? (By comparing seeds that have not been exposed to high heat with those that have been exposed to high heat.)

13 For their investigation, ask students to determine what they will do to keep the investigation fair. For example, they could:

- Change: the amount of light
- Measure/Observe: the number of seeds germinated after a particular number of days
- Keep the same: the number of seeds, the type of soil, the amount of water, how the seeds are watered, when the seeds are watered, the temperature.

14 Explain that each team will need to set up two sets of labelled pots:

- A control pot that has the eucalypt seeds sprinkled onto the top of the potting mix and then covered very lightly with some more potting mix (about 2 mm).
- A test pot that is set up the same as the control pot except for the variable being tested, for example, the seeds are covered with eucalypt leaves to reduce the amount of light.

Discuss why a control pot is needed (to provide a fair comparison, so you can be sure of how the variable being tested affects the germination of the seeds).

15 Ask teams to make predictions of what they think will happen and why they think that.

16 Form teams and allocate roles. Ask Managers to collect their team's copies of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2).
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 badges to help them (and you) know which role each team member has.

17 Allow time for teams to plan their investigation. Explain that teams will set up their investigations in the next session.

18 Update the TWLH chart and the word wall with words and images.

EXPLORE

Session 2 Setting it up

Equipment

FOR THE CLASS

- class science journal
- TWLH chart
- team skills chart
- team roles chart
- word wall
- enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) from Session 1
- eucalypt seeds from Session 1

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) from Session 1 per team member
- 2 small pots containing nutrient-rich soil or potting mix
- 2 labels
- watering can or container

Preparation

SAFETY

- **Safety note:** It is possible to contract legionnaires disease from bacteria living in some potting mix. Take special precautions if you intend to use it:
  - store potting mix bags securely, away from students
  - do not handle potting mix in the classroom or near students
  - moisten the mix as you open to reduce airborne particles
  - wear a paper mask that fits over your nose and mouth
  - always wear gloves and rinse them afterwards
  - ask students to wash their hands carefully with soap after touching soil.

Lesson steps

1 Revise the previous session using the enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2). Explain that in this session teams will be setting up their investigations.

SAFETY

Safety note: Discuss safety procedures for dealing with potting mix (see 'Preparation').

2 Re-form teams and allocate roles. Ask Managers to collect team equipment. Allow time for teams to set up their investigations.

3 Organise regular watering of seeds to keep the soil damp making sure that watering is kept the same to keep the test fair.

4 Remind teams to make weekly observations of the number of seeds that germinate and record the number in the 'Recording results' section of the 'Germinating eucalypt seeds investigation planner'.

5 Update the TWLH chart and the word wall with words and images.

Eucalypt fruit and seeds

Curriculum links

Indigenous perspectives

- Explore how eucalypts and other plants are used in traditional aboriginal medicine. 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

Germinating eucalypt seeds investigation planner

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate?	What do you predict will happen? Why?
Can you write it as a question?	Give scientific explanations for your prediction

To make this a fair test what things (variables) are you going to:

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

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

Recording results

Number of seeds planted: _____

Number of seeds germinated

Amount of time	Control pot	Test pot
Week 1		
Week 2		
Week 3		

Explaining results

Question: What was your investigation question?

Claim: What claim can you make after completing the investigation?

Evidence: What data did you collect to support your claim?

The control seeds:

The test seeds:

Reasoning: Why do you think this happened? Give scientific explanations.

Lesson 3 Bustling bees

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of the life cycles of eucalypts and European honey bees and the relationship between them.

Session 1 Flower parts

Students:

- explore the internal parts of a flower
- read a factual text about the function of parts of a flower.

Session 2 Sweet as honey

Students:

- explore the life cycle of a European honey bee
- discuss why and how bees pollinate flowers.

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:

- living things have life cycles
- living things depend on each other and the environment to survive.

You will also monitor their developing science inquiry skills (see page xi).

Key lesson outcomes

Science

Students will be able to:

- identify the parts of a flower involved in reproduction
- locate and label the reproductive parts of a eucalypt flower
- explore the role of bees in pollination
- sequence the life cycle of a European honey bee.

Literacy

Students will be able to:

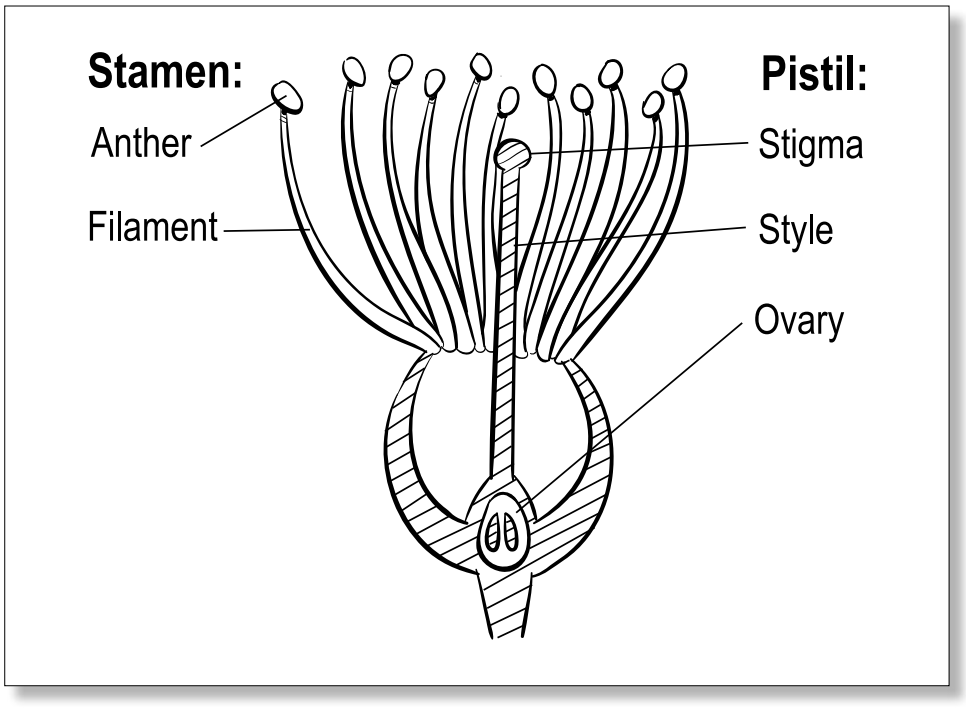
- create a labelled diagram of a eucalypt flower
- view and read a factual text
- represent the life cycle of a European honey bee.

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

Teacher background information

Pollination is the term used to describe the transfer of pollen from an anther to a stigma, and it occurs in a number of ways. Some plants self-pollinate and others rely on the wind. Many rely on animals, such as insects, birds and even mammals including bats and honey possums to collect pollen and transfer it from flower to flower. Those plants usually have a variety of ways to attract their pollinators, including attractive flowers, scents and providing nectar. Some flowers mimic female insects, even producing pheromone-like compounds.

Eucalypt flowers have an operculum, or cap, which protects the interior of the flower bud as the male and female parts develop. Eucalypt flowers do not have petals like other feathers, instead they have brightly coloured pistils and stamens. The parts which become petals in other plants contribute to the structure of the operculum, which falls off when the flowers open.



Cross-section of *Eucalyptus leucoxylon* flower

After flowering, the stamens detach. The fruit is the part of the flower that remains after fertilisation, which enlarges, dries and becomes woody. Valves in the fruit open, dispersing its seeds, which mostly fall onto the ground below the crown of the tree.

Note: Biologists describe a diagram of the internal parts of a flower cut longways as a 'longitudinal section'. In this unit, we have used the generic term 'cross-section', meaning 'to cut through'.

Bees and honey

Most honey produced in Australia is made from the nectar of eucalypt trees, such as Grey box, Yellow box, River red gum, Ironbark and Blue gum. Honey is usually classified by the specific flower source of the nectar from which it was made.

Commercial honey is commonly produced by European honey bees. These were introduced by early European settlers to ensure both a good supply of honey and that crops were fertilised. The bees live in highly organised hives, in which a queen lays all the eggs and controls the hive using pheromones. The majority of the hive is made of (usually sterile) female worker bees that carry out maintenance of the hive, care of the brood and collect nectar and pollen for food. They also produce honey and various secretions, for example, royal jelly. Some male bees (drones) are also produced to fertilise future queens of colonies.

Australia has over 1,600 native species of bees. Most are solitary, producing very small quantities of honey and pollen for a small brood of young. They can be almost any colour. There are some bees, called stingless bees, which live in large colonies. They produce a distinctive honey called sugarbag. Smaller than European honey bees, they are generally black and do not sting but can bite. Like European honey bees they have special areas on their legs to carry pollen. They behave very differently from European honey bees. For example, worker bees do not tend the larvae, instead each egg is laid into a cell that is already full of all the honey and pollen that the future bee needs in order to become an adult.

Students' conceptions

Some students might think that bees collect honey from flowers. Bees collect nectar from flowers, which they convert into honey in the hive and place in storage cells as a food supply.

Some students might think that plants grow flowers because bees need the pollen or nectar, the flowers make the plant look nice or to grow seeds or fruit. Flowering plants produce flowers and fruit as part of their reproductive life cycle. The flowers of a plant provide visual clues as well as scent to attract pollinators, such as bees, towards them.

Session 1 Flower parts

Equipment

FOR THE CLASS

- class science journal
- team skills chart
- team roles chart
- TWLH chart
- word wall
- 1 enlarged copy of 'Flower parts' (Resource sheet 3)
- video of eucalypt flowers opening (see 'Preparation')
- *optional:* images of eucalypt flowers
- *optional*: images of, or a variety of cut flowers

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'Flower parts' (Resource sheet 3) per team member
- eucalypt flowers (see 'Preparation')
- 1 magnifying glass

Preparation

- Prepare an enlarged copy of 'Flower parts' (Resource sheet 3).
- Collect eucalypt flowers for each team. If flowers are not available show images instead.
- Source a video showing a eucalypt flower bursting open, for example:
  - 'Cluster of red eucalypt flowers burst open'
    See: www.gettyimages.com.au/detail/video/cluster-of-red-eucalyptus-flowers-burst-open-stock-video-footage/1B06650_0001 and
  - 'Pink eucalypt flower bursts open, Victoria'
    See: www.gettyimages.com.au/detail/video/pink-eucalyptus-flower-bursts-open-victoria-stock-video-footage/1B06648_0005
- *Optional:* Display 'Flower parts' (Resource sheet 3) in a digital format.

Lesson steps

1 Ask three students to observe and record animals in and on a eucalypt identified in Lesson 1 and report back to class. Add observations to the page in the class science journal set up in Lesson 1.

2 Review the previous lesson and the conditions needed for the germination of seeds. Allow time for teams to make recordings of germinated seeds.

3 Ask students what they know about the parts of a flower. Ask questions, such as:

- What parts of a flower can you identify?
- Why are flowers important to plants?
- Why do plants produce flowers?

Record students' ideas in the class science journal.

4 Introduce an enlarged copy of 'Flower parts' (Resource sheet 3). 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.

5 Read through and discuss how the text is about a generic flower with all the different parts clearly shown. Explain that students will complete the labels on their copy of 'Flower parts' (Resource sheet 3) and then use this information to help them identify similar parts in their eucalypt flowers. Highlight new vocabulary and add words to the word wall.

6 Ask students to complete their copy of 'Flower parts' (Resource sheet 3).

Optional: Provide opportunities for students to identify and labels the features of a variety of different flowers, by providing images or cut flowers.

7 Show students the prepared video 'Cluster of red eucalypt flowers burst open' (see 'Preparation'). Highlight that the flower buds are covered with a little cap that comes off, allowing the stamens to unfurl around the central pistil. Explain that the cap is unique to eucalypts.

8 Explain that students will work in collaborative learning teams using a magnifying glass to explore the parts of a eucalypt flower and draw a labelled diagram. Remind students to use their completed copies of 'Flower parts' (Resource sheet 3) to help identify the different parts of the eucalypt flower. Discuss the purpose and features of a labelled diagram.

Literacy focus

Why do we use a labelled diagram?

We use a **labelled** diagram to show the shape, size and features of an object.

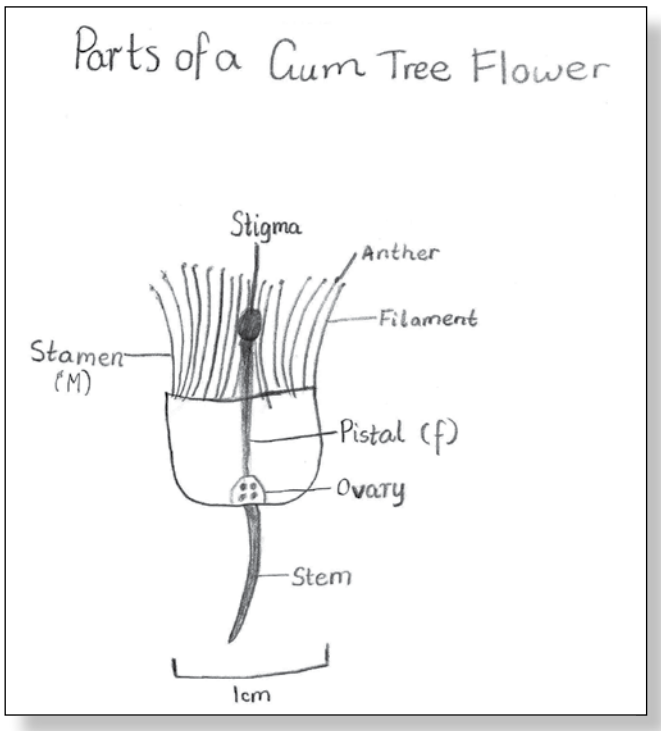
What does a labelled diagram include?

A **labelled diagram** might include a title, an accurate drawing, a scale to show the object's size and labels showing the main features. A line or arrow connects the label to the feature.

Re-form teams and allocate roles. Ask Managers to collect team equipment.

Allow time for teams to complete their labelled diagrams.

9 Ask some Speakers to present their labelled diagrams and point out the parts of the eucalypt flower and their scientific names.



Work sample of a labelled diagram of a eucalypt flower

10 Review the enlarged copy of 'Flower parts' (Resource sheet 3). Ask students if they have heard of the term 'pollination' and what they think it means. Record students' responses in the class science journal.

11 Explain that pollination is when pollen is transferred from the male parts of the flower, the anther, to the female parts of the flower, the stigma. Ask students to locate the anther and the stigma on the resource sheet. Discuss how once this happens fertilisation occurs and a seed will grow.

12 Review the TWLH chart and add what students have learned to the chart.

13 Update the word wall with words and images.

Curriculum links

Science

- View *The private life of plants*, Episode 3: Flowering, David Attenborough (2003), BBC Worldwide Ltd.
- Read 'Top Draw – Drawing Aussie Flora'. See: http://www.parksaustralia.gov.au/botanic-gardens/pub/topdraw.pdf

Indigenous perspectives

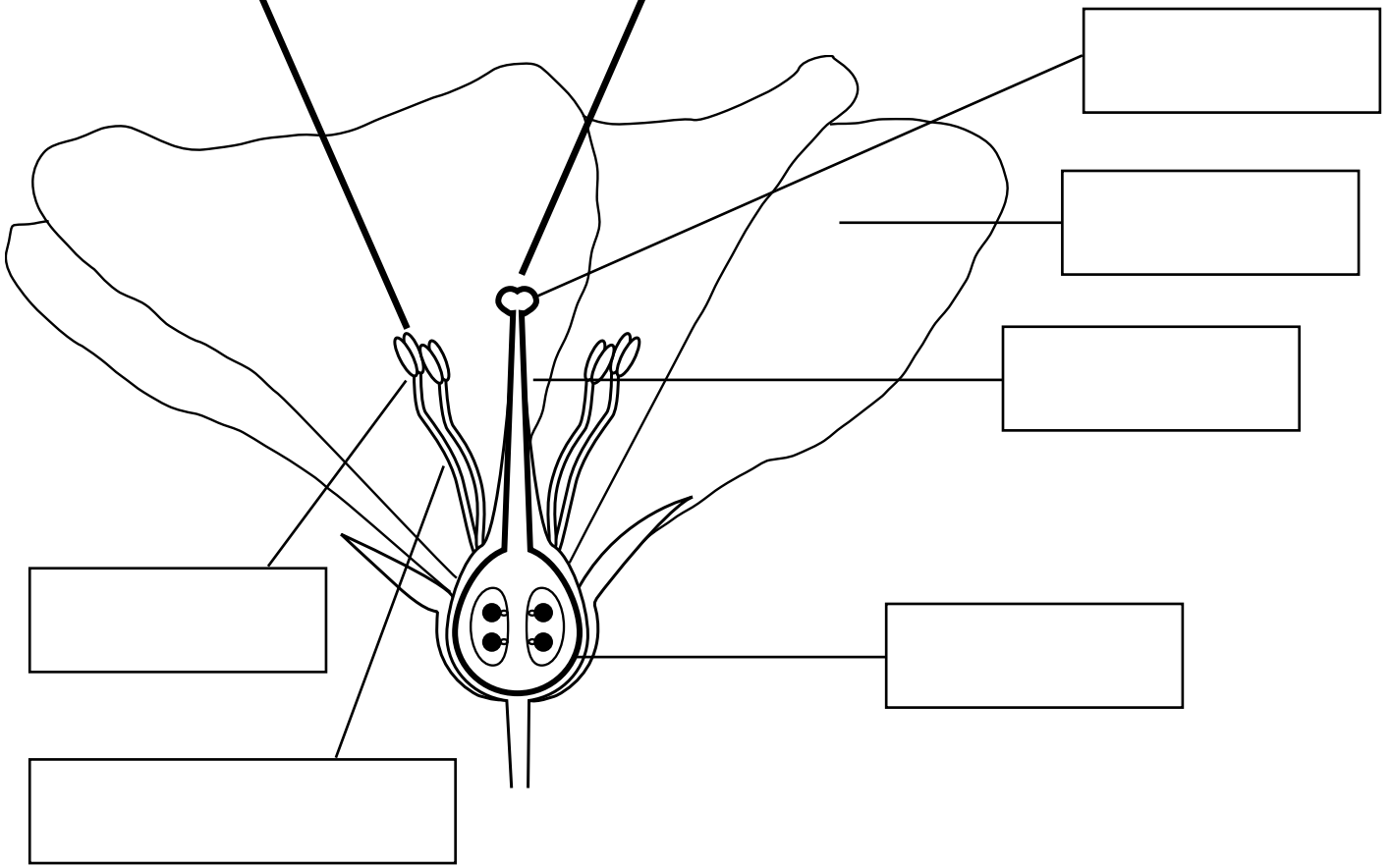
- Read 'Aboriginal Trail – information on plants used by Australian Aboriginals'. See: http://www.anbg.gov.au/gardens/visiting/exploring/aboriginal-trail/
- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. 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).

Flower parts

Flowers are the parts of a plant that help it reproduce.

Stamens: These are the **male parts** of the flower. It is made up of the anther at the top and the filament. The stamens produce pollen.

Pistil: This is the **female part** of the flower. It is made up of the stigma, style, and ovary. It is the part of the plant that receives the pollen.



Anther: This is the part of the stamen that contains the pollen. It is usually on top of a long stalk that looks like a fine hair.

Stigma: This is the sticky bulb that you see in the centre of the flower that 'catches' the pollen grains.

Filament: This is the fine hair-like stalk that the anther sits on top of.

Style: This is the tube that the stigma sits on top of and the pollen travels down.

Ovary: The part of the plant that has the seeds inside and turns into the fruit.

Petal: The part of the flower that can help to attract insects and birds due to their shape and colour (not all flowers have visible petals).

One of these parts seems to be missing from a eucalyptus flower. Which one is it?

Session 2 Sweet as honey

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- team skills chart
- team roles chart
- 1 enlarged copy of 'The honey bee life' (Resource sheet 4)
- video(s) about European honey bees (see 'Preparation')
- *optional:* jars of different-flavoured honey (see 'Preparation')

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'The honey bee life' (Resource sheet 4) per team member
- poster-sized paper

Preparation

- Source a video about European honey bees, for example:
  - How bees make honey. See: 'Backyard bees' http://www.abc.net.au/btn/story/s2968817.htm
  - Isn't it funny how bees make honey!' **https://education.abc.net.au/home?sf85977974=1#!/media/86020/where-does-honey-come-from-**
  - The extraordinary behaviour of some of our native bees. See: 'Bee scene' http://australianmuseum.net.au/bee-scene1
- Prepare an enlarged copy of 'The honey bee life' (Resource sheet 4).
- *Optional:* Purchase jars of different-flavoured honey collected from different eucalypts, such as Red gum, Ironbark and Yellow box.
- *Optional:* Display 'The honey bee life' (Resource sheet 4) in a digital format.

Lesson steps

1 Review the previous lesson, focusing on the male and female parts of the flower. Ask students questions, such as:

- Which parts of the flower are involved in pollination?
- Eucalypts can't transfer pollen to the stigma themselves. Which insects or animals do you think help pollinate the flowers?

2 Show students a video on honey bees collecting nectar and making honey (see 'Preparation'). Review students' ideas on why bees visit flowers.

3 Explain to students that most eucalypt flowers in Australian are pollinated by bees. Discuss how Australia has Australian native bees as well as European honey bees that were brought to Australia by settlers nearly 200 years ago.
Optional: Invite students to view and or taste the jars of different-flavoured honey.

4 Ask students questions, such as:

- Why do plants need to be pollinated?
- What does pollinate mean? (Mixing the male and female parts of the flower so the flower can reproduce.)
- Why do bees pollinate flowers?
- What parts of the bee are involved in pollination?
- When does the nectar change into honey?

Record students responses in the class science journal.

Optional: Show the second video of a native bee pollinating a flower (see 'Preparation').

5 Introduce the enlarged copy of 'The honey bee life' (Resource sheet 4). Read through and discuss. Review the purpose and features of a factual text.

6 Explain that students will work in their collaborative learning teams to make poster of the life cycle of the honey bee and include words and phrases to annotate the cycle. Discuss the purpose and features of a poster.

Literacy focus

What is a poster?

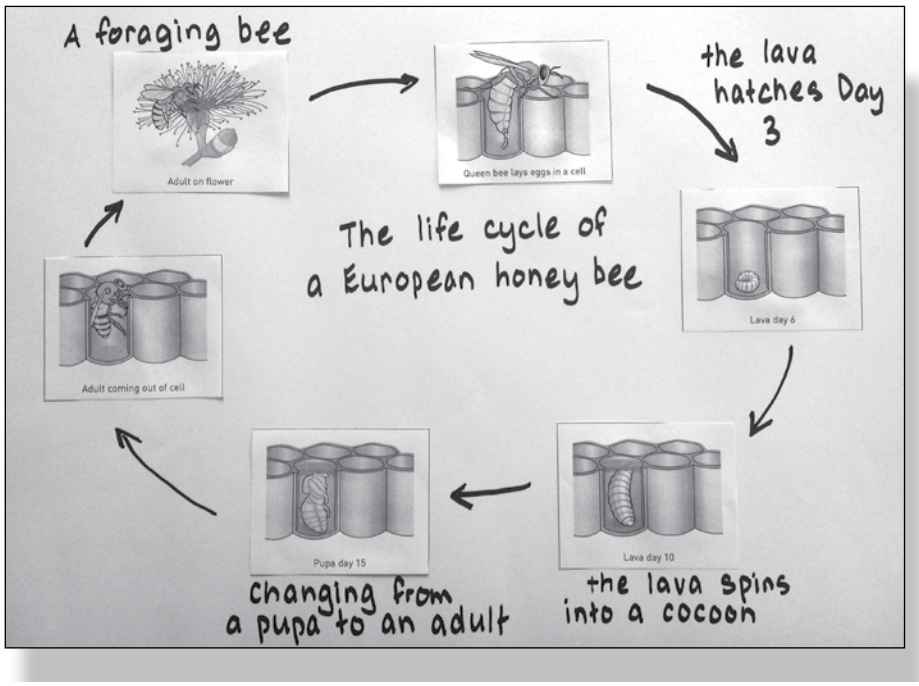
We use a **poster** to display ideas and information. We can view a **poster** to collect information about a topic.

What does a poster include?

A **poster** includes a title, words and pictures. It might include graphs, photos and tables as well as borders, arrows and labels.

7 Ask teams to include information about how the pollination process interacts with the bee's life cycle.

8 Re-form teams. Allow time for teams to create their poster of the life cycle of a bee.



Work sample of the life cycle of a bee

9 Ask Speakers to present their posters. Ask questions, such as:
- How do bees and flowers depend on each other for survival?

10 Update the TWLH chart and the word wall with words and images.

Curriculum links

Indigenous perspectives

- Watch George King take the Yarralin School students to collect sugarbag. See: 'Sugarbag' https://vimeo.com/113253327
- For Yolngu living on country, in the homeland communities of Northeast Arnhem Land, the relationship with local, endemic stingless bees is quite different from the 'domestication' of the honey bee for consumption on an industrialised scale. A highly anticipated activity is sugarbag season, where men, women and children undertake excursions into the bush in search of these tiny bees to extract honey from their hives. See 'Sugarbag Dreaming' https://vimeo.com/88737231
- 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

Science

- Observe bees in the garden. Take photos of each of the flower types that the bees visit. Count the number of times a bee visits flowers on one plant before it flies away.

The honey bee life

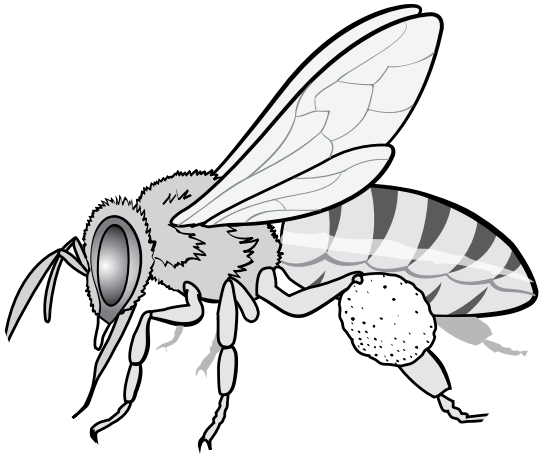
Types of European honey bees

There are three types of bees: the Queen bee, the drones and the worker bees.

The **Queen** is the largest bee. Her body is specially formed for egg-laying into the cells of the honeycomb. The Queen can live up to five years.

The **drones** are stingless male bees who wait in the hive until they can mate with a Queen bee. They can wait months or just a few weeks. They die after mating.

Worker bees are female bees who do not lay eggs. They have lots to do! They find pollen and nectar to feed everyone in the hive, make honey from nectar, build honeycomb, look after the larvae and the Queen, clean the hive and defend against predators. Worker bees only live for about six weeks in spring or summer but can live for months over winter since they are a lot less busy with no larvae to care for, and less flowers to visit.



The worker bees that look for food for the colony are called 'foraging bees'. When they visit a flower they get pollen all over their body. They gather and collect the pollen into pouches on their legs but some remains. This remaining pollen can be transferred to the pistil of another flower.

Life cycle of a European honey bee

Day 1: The Queen lays eggs in cells specially prepared by worker bees. The Queen lays all the eggs for the beehive, sometimes over 1,000 per day.

Day 3: The larvae hatch from the eggs. At first, all the larvae are fed by worker bees on a special food called 'royal jelly'. This food is a white liquid made by a gland in the head of the worker bees.

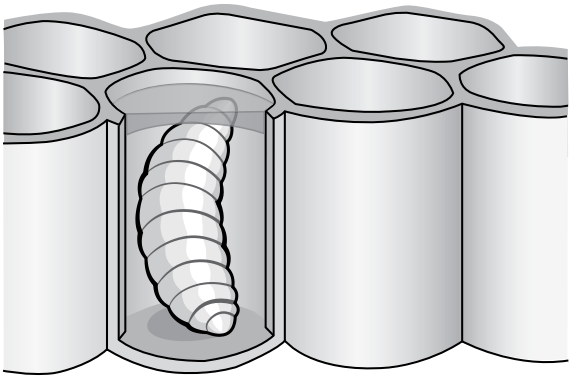
Day 6-9: The larvae that will become worker bees and drones are fed on pollen and nectar. The larvae that will become Queen bees are fed on more royal jelly.

Day 10: The larva spins itself a cocoon where it begins to change from a pupa to an adult. The worker bees place a cap of wax over the top of each cell to protect the pupa.

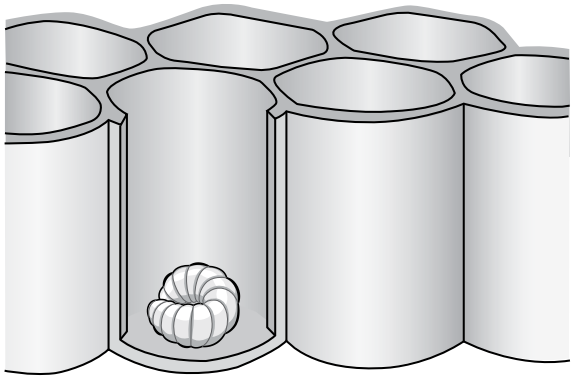
Days 16-24: The adult gnaws its way out of its cocoon and emerges as an adult bee. The amount of time it spends as a pupa depends on what type of bee it is. Queen bees take the least amount of time as a pupa and drones take the most.

The honey bee life

Read the text. Cut out the images below and arrange them to show the life cycle of a bee.
Add arrows, words and pictures to the life cycle.



Lava day 10

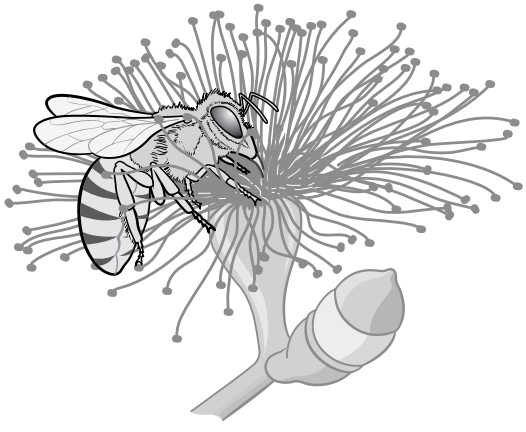


Lava day 6

Adult coming out of cell

Pupa day 15

Queen bee lays eggs in a cell



Adult on flower

Lesson 4 At home on the tree

EXPLORE

AT A GLANCE

To provide students with hands-on, shared experiences of how some animals depend on eucalypts, and the different impacts that their activities have.

Students:

- create a chart showing how different animals use eucalypts
- work in teams to identify the impact(s) a given animal might have on a eucalyptus tree
- discuss the impact that the disappearance of eucalypts would have on animals and vice versa.

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:

- living things depend on each other and the environment to survive.

You will also monitor their developing science inquiry skills (see page xi).

Key lesson outcomes

Science

Students will be able to:

- identify the ways in which animals rely on eucalypts for survival
- classify the impacts of animals on the eucalypt as positive, negative or neutral.

Literacy

Students will be able to:

- discuss ideas and use interaction skills, for example, acknowledging another's point of view.

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

Teacher background information

Effects of different species on eucalypts

The survival and reproduction of living things depends not only on the physical characteristics of their environment, but also on the other living things around them. In this lesson students will be looking at how different living things can affect eucalypt plants.

Negative impacts include:

- Animals that destroy the leaves, in particular many insects and koalas.
- Neighbouring plants that take the eucalypt's resources of water, light and/or nutrients.
- Animals that stop reproduction, by destroying flowers and/or seeds, for example, sulphur-crested cockatoos.

Positive impacts include:

- Animals that help reproduction, by pollinating the flowers and/or distributing seeds, for example, native bees.
- Preventing other animals from destroying the leaves, for example, by eating insects like spiders.

Animals may also use the eucalypt for shelter. This has a neutral impact on the eucalypt itself. However, species with negative impacts might occupy the shelters, which inhibits species with positive impacts from settling near the tree.

A single animal may have both positive and negative impacts:

- at different stages of its life cycle, for example, juvenile jewel beetles can have a negative impact on growth by boring into sapwood but adult jewel beetles can pollinate the flowers.
- on different areas of the tree, for example, gang-gang cockatoos have positive effects on the leaves by eating insects but negative effects on the seeds by eating them as well.

Different types of relationships between living things

Scientists can classify relationships between living things by the effect that the relationship has on both parties:

- **Competition:** two living things have negative effects on each other, generally by both requiring the same resources that are in short supply. Many trees are in competition with others for access to light, water and nutrients in the soil. European honey bees *(Apis mellifera)* are in competition with native bees for nectar sources.
- **Antagonism:** one living thing negatively affects another and receives a benefit, for example, by eating them (predation and herbivory) or by living in/on them and relying on them for energy and nutrients (parasitism). Spitfire sawflies receive a double benefit from eucalypts as the leaves supply them with not only nutrition but also a measure of protection.
- **Amensalism:** one living thing negatively affects another without being affected. For example, an animal trampling grass receives little or no benefit from doing so, but the grass is harmed.
- **Commensalism:** one living thing benefits from another, which is not affected, such as birds nesting in the branches of a tree or animals feeding on the discarded food of others, for example, remoras (suckerfish) that swim with sharks.
- **Mutualism or cooperation:** two living things benefit from each other. For example, a pollinator receiving food (nectar) from a food while transferring pollen, which ensures the plant can produce fertile seeds. Common pollinators of eucalypts include insects, birds and small mammals. The closest form of mutualism is symbiosis.

EXPLORE

If the living things live in the same area and do not interact in any way then their relationship would be neutral, but true neutralism is almost non-existent in nature due to indirect relationships between living things.

All relationships are specific to the species of living things involved. For example, while European honey bees generally pollinate the flowers from which they collect nectar, they do not always do so. Some plants require a special type of pollination—buzz pollination—where the bee vibrates the flower to dislodge the pollen. Some native bees do this, however European honey bees rarely do. When European honey bees visit those flowers they may collect nectar without pollinating the flower, which is an antagonistic relationship.

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- team skills chart
- team roles chart
- 1 enlarged copy of 'Friends and foes' (Resource sheet 5)
- large image of a eucalypt (see 'Preparation')
- large individual images of each animal on 'Friends and foes' (Resource sheet 5)

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'Friends and foes' (Resource sheet 5) per team member

Preparation

- Prepare a large image of a eucalypt.
- Prepare an enlarged copy of 'Friends and foes' (Resource sheet 5).
- *Optional:* Display 'Friends and foes' (Resource sheet 5) in a digital format.

Lesson steps

1 Review the previous lesson, focusing on the beneficial (mutualistic) relationship between eucalypts and bees.

2 Introduce the large image of a eucalypt (see 'Preparation').

3 List the animals that have been observed on or in a eucalypt around the large image of a tree using the 'Animals we observed on the eucalypt' page in the class science journal. Explain that you are going to draw arrows showing what the class thinks the impact(s) of the animal on the tree might be:

- a green arrow where the impact is positive, for example, it brings a benefit by removing plant eaters (herbivores) or pollinating flowers
- a yellow arrow where the impact is neutral, for example, nesting in the tree
- a red arrow where the impact is negative, for example, eating leaves or destroying seed or flowers.

Create a key to remind students of the meaning of each colour of arrow.

4 Choose one animal and discuss what impact that animal might have on the eucalypt. Explain that several arrows can be drawn from the same animal for different activities. For example, a cockatoo eats seeds, so a red arrow labelled 'eats seeds' can be drawn, and cockatoos also nest in the tree branches, so a yellow arrow labelled 'nests' can also be drawn. Use the key to discuss and draw arrows for each animal students observed on the eucalypt.

5 Introduce the enlarged copy of 'Friends or foes' (Resource sheet 5). Read through and discuss.

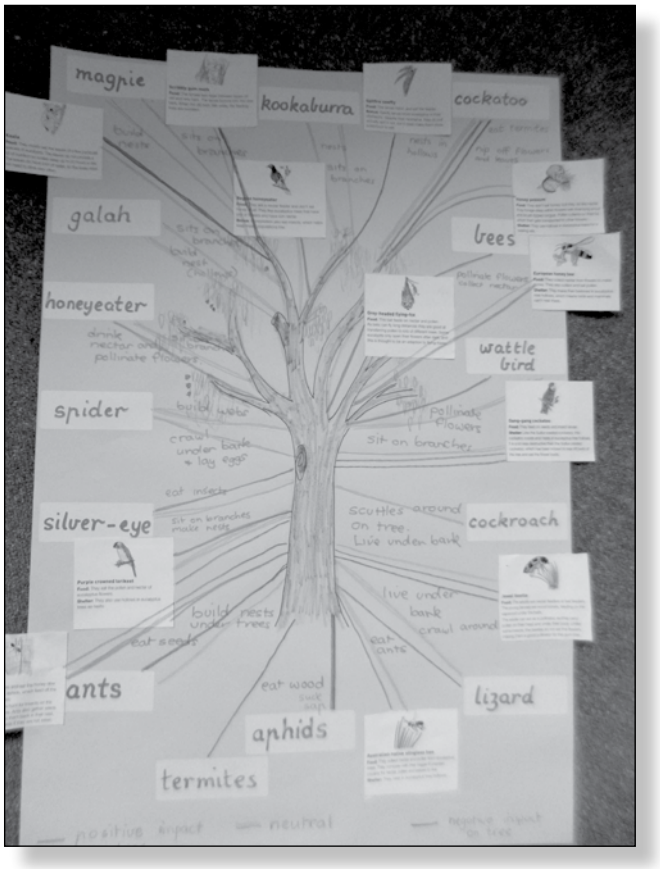
6 Explain that students will be working in collaborative learning teams to read about and discuss each animal to decide what impact(s) it has on eucalypts. Ask teams to paste each animal in their science journals and draw underneath the labelled arrows they suggest to represent its impact(s) on a eucalypt.

7 Form teams. Ask Managers to collect equipment. Allow time for teams to complete the activity.

8 Place the enlarged images of each of the animals around the enlarged image of the eucalypt. Ask teams what arrows they suggest for each and why. Draw coloured arrows for each of the animals based on an agreed class decision. For example:

- For the European honey bee and the Australian native stingless bee: a green arrow (pollinates), a red arrow (eats pollen) and a yellow arrow (nests).
- For the honey possum: a green arrow (pollinates) and a yellow arrow (nests).
- For the jewel beetle: a red arrow (larvae burrow into trunk), a red arrow (adults eat leaves) and a green arrow (adults pollinate).

- For the gang-gang cockatoo: a green arrow (eats insects), a red arrow (eats seeds) and a yellow arrow (nests).
- For the spitfire sawfly: a red arrow (eats leaves).
- For the koala: a red arrow (eats leaves).
- For the purple meat ant: a red arrow (farms insects that eat sap), a green arrow (kills insects that eat leaves), a green arrow (distributes seeds) and a red arrow (eats seeds).



Work sample of a eucalypt showing impacts of animals

9 Discuss how there are animals from around Australia that depend on eucalypts in different ways. Discuss what impact not having eucalypts might make on each of the animals and what impact not having different animals might make on the tree.

Record students' answers in the class science journal.

10 Update the TWLH chart and the word wall with words and images.

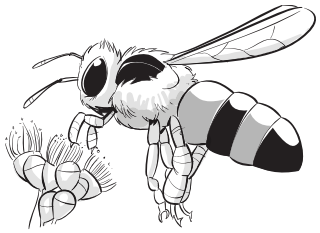
Curriculum links

Information and Communication Technology (ICT)

- Use interactive technology to represent data.

Friends and foes

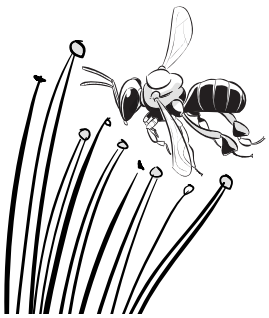
How do each of these animals interact with eucalypts?



European honey bee

Food: They collect nectar from flowers to make honey. They also collect and eat pollen, and by doing so can contribute to pollination.

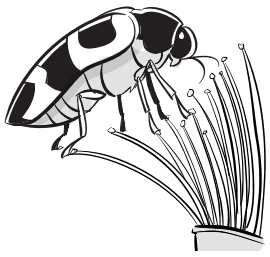
Shelter: They make their beehives in eucalypt hollows, which means birds and mammals cannot nest there.



Australian native stingless bee

Food: They collect nectar and pollen from eucalypts and contribute to pollinating many species. They compete with the European bees for nectar, pollen and places to live.

Shelter: They nest in eucalypt hollows.



Jewel beetle

Food: The adults are nectar feeders or leaf feeders. The young (larvae) are wood borers, feeding on the sapwood under the bark.

The adults can act as a pollinator, as they carry pollen on their head and under their body. Unlike some insects, the beetles do not eat the flowers, making them a good pollinator for the eucalypt.

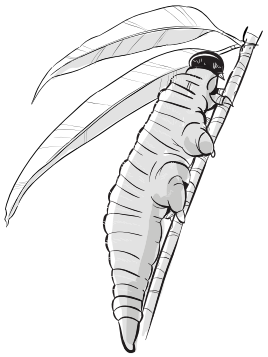
Honey possum

Food: They do not eat honey, but they do like nectar. They forage deep within flowers with their long snout and brush-tipped tongue. Pollen collects on their fur, which then gets transported to other flowers.

Shelter: They use hollows in eucalypts for a nesting site.

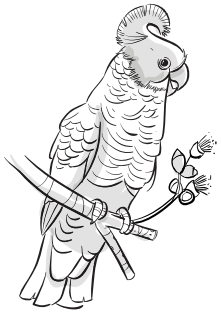
Friends and foes

How do each of these animals interact with eucalypts?



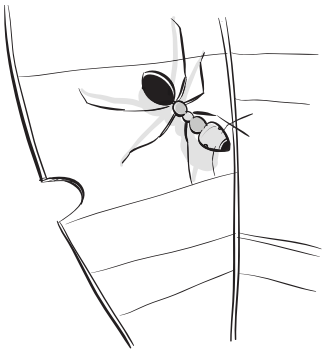
Spitfire sawfly

Food: The larvae hatch and eat the leaves.
Bonus: Sawfly larvae store *Eucalyptus* oil in their stomachs. Despite their nickname, they do not actually spit it out, but it does make them more poisonous to eat.



Gang-gang cockatoo

Food: They feed on seeds and insect larvae.
Shelter: Like the sulfur-crested cockatoo, this cockatoo roosts and nests in eucalypt hollows. It is a lot less destructive than the sulfur-crested cockatoo, which has been known to tear off parts of the tree and eat the flower buds.



Purple meat ant

Food: They collect, store and eat the honey dew of insects, for example, aphids, which feed off the leaves of eucalypts.
Bonus: Ants sometimes hunt for insects on the leaves of eucalypts. Ants also gather seeds from eucalypts and store them back in their nest, helping distribute the seeds if they are not eaten.

Koala

Food: They mostly eat the leaves of a few particular species of eucalypts. The leaves do not provide a lot of nutrition so koalas sleep up to 20 hours a day. The leaves do have a lot of water, so the koala does not need to drink very often.

Lesson 5 The story of its life

AT A GLANCE

To support students to represent and explain their understanding of how living things have life cycles that can depend on other living things.

To introduce current scientific views on how bushfires can provide favourable environmental conditions for eucalypt growth.

Session 1 Germinated or not?

Students:

- discuss the results of a germination investigation.

Session 2 Cycle of life

Students:

- sequence images of the life cycle of a eucalypt
- watch a video on the effect of bushfires on eucalypts.

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:

- living things have life cycles
- living things depend on each other and the environment to survive.

You will also monitor their developing science inquiry skills (see page xi).

You are also able to look for evidence of students' use of appropriate ways to represent what they know and understand about how living things have life cycles and depend on each other and the environment to survive, and give them feedback on how they can improve their representations.

Key lesson outcomes

Science

Students will be able to:

- identify what conditions might affect the germination of eucalypt seeds
- order the key stages in the life cycle of a eucalypt
- explain how animals and eucalypts depend on each other for survival
- discuss the effects of fire on a eucalypt depending on its life stage.

Literacy

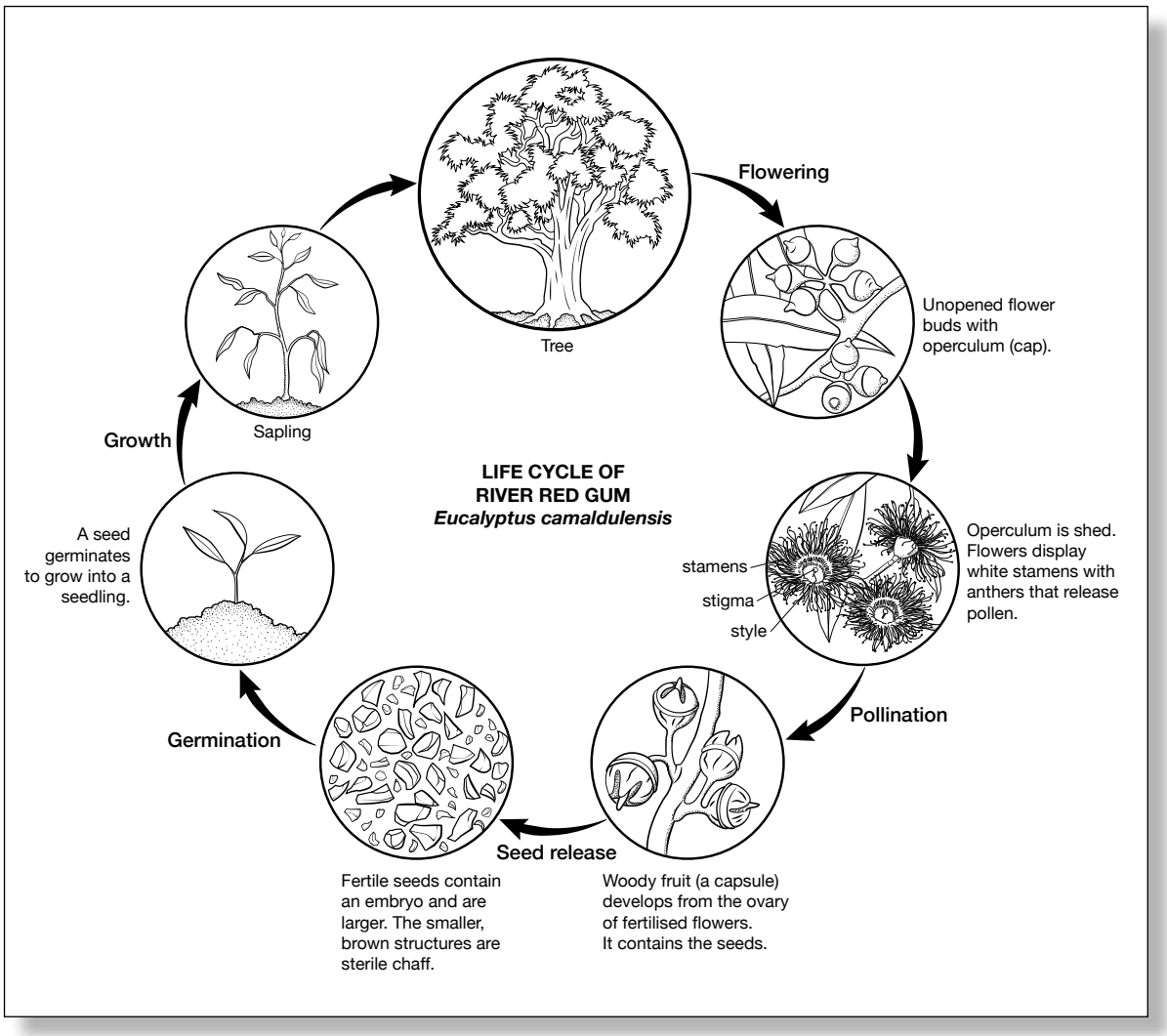
Students will be able to:

- orally present investigation results to the class using diagrams, tables and text
- represent their ideas as a flow chart
- discuss and explain how their ideas have changed.

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

Teacher background information

Life cycle of a eucalypt



Eucalypts and fire

Eucalypts evolved from rainforest ancestors, adapting to an environment in which drought, nutrient-poor soils and fire were increasingly common. Eucalypt species have oil-rich foliage that burns readily, and they display a range of strategies to survive and recover from fire. For example, the Browntop stringybark has thick fibrous bark that allows it to resist moderate fires. Some species have (epicormic) buds on their branches and trunk that are protected by bark. These can quickly start to sprout if the canopy is damaged. Some eucalypts create roots with extra stores of energy (lignotubers), for a tree to re-sprout from after a fire.

Eucalypt species have also evolved to require fire in their life cycle. Some species need the heat of a fire to open the woody capsules. The seeds drop to soil that is clear of undergrowth, covered in nutrient-rich ash, and is temporarily free of herbivores. These all assist the young eucalypt seedlings to better survive until they have time to establish themselves.

Session 1 Germinated or not?

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- team skills chart
- team roles chart
- 1 enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2)
- *optional:* digital camera

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) from Lesson 2 per team member

EXPLAIN

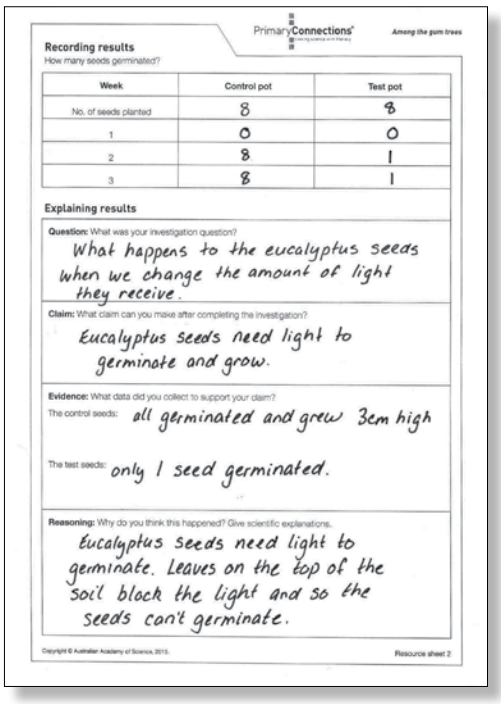
Preparation

- Read 'How to facilitate evidence-based discussions' (Appendix 6).
- Prepare an enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2).
- *Optional:* Display the enlarged copy of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) in a digital format.

Lesson steps

1 Review the 'Germinating eucalypt seeds investigation planner' (Resource sheet 2). Review the observations that teams have been making over the past few weeks.

2 Explain that teams will review their observations and complete the QCER (Question, Claim, Evidence, Reasoning) section of the investigation planner. Model how teams might complete the QCER section, focusing on the Reasoning section.



PrimaryConnections — Among the gum trees

Recording results

How many seeds germinated?

Week	Control pot	Test pot
No. of seeds planted	8	8
1	0	0
2	8	1
3	8	1

Explaining results

Question: What was your investigation question?
What happens to the eucalyptus seeds when we change the amount of light they receive.

Claim: What claim can you make after completing the investigation?
Eucalyptus seeds need light to germinate and grow.

Evidence: What data did you collect to support your claim?
The control seeds: all germinated and grew 3cm high
The test seeds: only 1 seed germinated.

Reasoning: Why do you think this happened? Give scientific explanations.
Eucalyptus seeds need light to germinate. Leaves on the top of the soil block the light and so the seeds can't germinate.

Resource sheet 2

Work sample of 'Germinating eucalypt seeds investigation planner' (Resource sheet 2)

3 Ask teams to draw an annotated diagram to show the final results of the two pots. Discuss the purpose and features of an annotated diagram.

Literacy focus

Why do we use an annotated diagram?

We use an **annotated diagram** to show the parts of an object and what they do.

What does an annotated diagram include?

An **annotated diagram** might include an accurate drawing, a title, a date and a few words about each of the parts. A line or arrow joins the words to the part.

Optional: Take photos of teams' results.

4 Re-form teams. Allow teams time to complete the activity.

5 Ask teams to present their investigation findings to the class. Encourage students to ask questions using the 'Science question starters' in Appendix 6. Ask questions, such as:

- How did your results compare with your prediction?
- Why do you think that you got those results?
- Do you think that your investigation was a fair test? Why or why not?

6 As a class, evaluate the investigation by asking questions, such as:
   - What difficulties did you have with conducting the investigation?
   - What would you do differently if you did the investigation again?
   - What do our results from the investigations tell us about the conditions that eucalypt seeds need to germinate?

7 Record teams' results in the 'L' (What we learned) and 'H' (How we know) columns of the TWLH chart.

8 Update the word wall with words and images.

Curriculum links

Information and Communication Technology (ICT)

- Use interactive technology to represent data.

Session 2 Cycle of life

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'What's its story?' (Resource sheet 6)
- video on the regeneration of eucalypts after a fire (see 'Preparation')

FOR EACH STUDENT

- science journal
- 1 copy of 'What's its story?' (Resource sheet 6)

Preparation

- Prepare an enlarged copy of 'What's its story?' (Resource sheet 6).
- Source a video on the regeneration of eucalypts after a fire. For example, see 'After the fires' http://www.abc.net.au/gardening/stories/s4005912.htm
- *Optional:* Display 'What's its story?' (Resource sheet 6) in a digital format

EXPLAIN

Lesson steps

1. Review the previous lessons using the TWLH chart and class science journal.
2. Introduce the enlarged copy of 'What's its story?' (Resource sheet 6). Explain that students will create a flow chart to show the life cycle of a eucalypt using the images from the resource sheet.
3. Ask students to include words and phrases to describe what helps it grow and what does not. Discuss the purpose and features of a flow chart.

Literacy focus

Why do we use a flow chart?

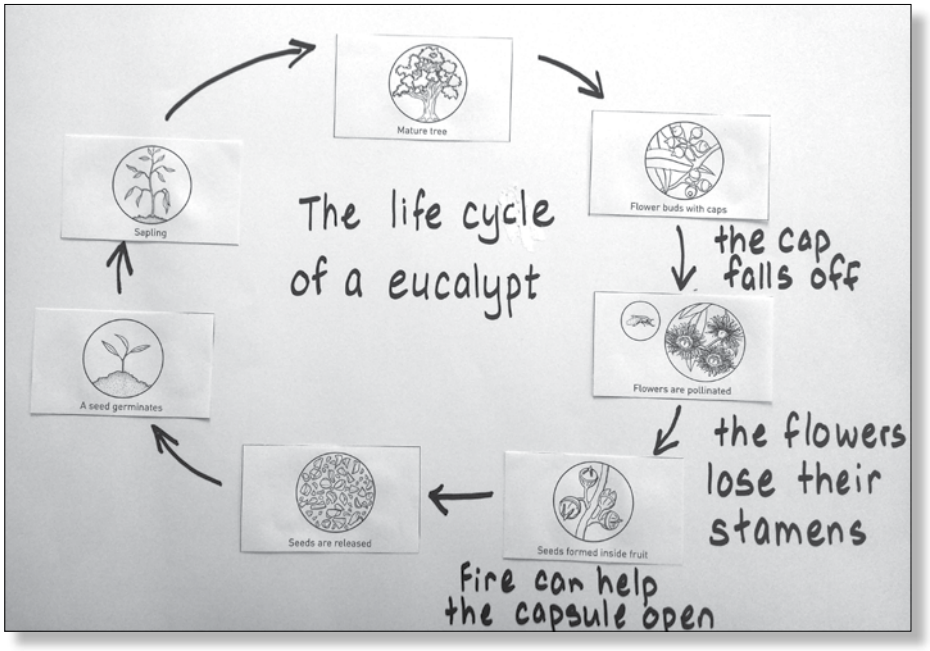
We use a **flow chart** to show a sequence of events or the stages in a process.

What does a flow chart include?

A linear **flow chart** organises events or stages in a line. Arrows are used to indicate the sequence in which they occur.

4. Encourage students to use the class word wall, their science journals and TWLH chart to help them to create their flow chart.
5. Allow time for students to complete the activity.

6 Ask students to compare their flow chart with their initial ideas from Lesson 1 and share their flow chart with a partner about how their ideas have changed.



Work sample of the life cycle of a eucalypt

7 Ask students to predict what the effect of a bushfire might have on each stage of the tree, and give reasons for their prediction. Record students' predictions in the class science journal.

8 Introduce the video on bushfires and their effect on eucalypts (see 'Preparation'). Ask students to look for examples about how the eucalypts regenerate after a bushfire.

9 Ask students what they have learned from today's lesson that can be added to the TWLH chart.

10 Update the TWLH chart and word wall with words and images.

EXPLAIN

Curriculum links

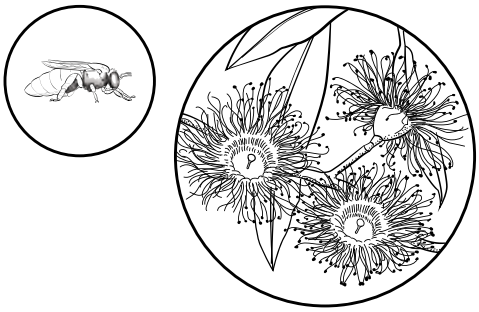
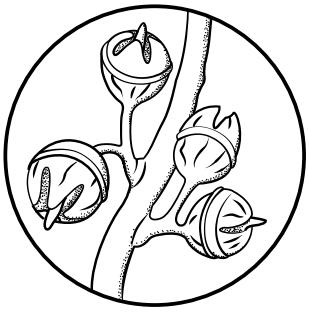
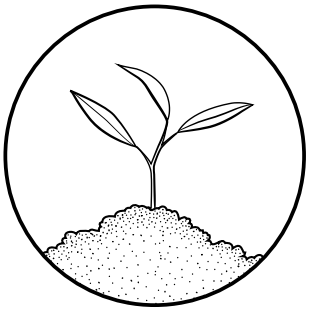
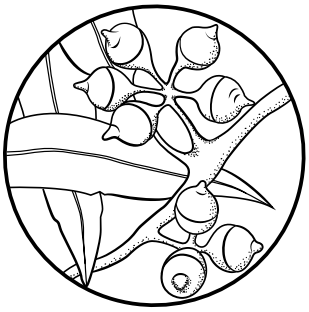
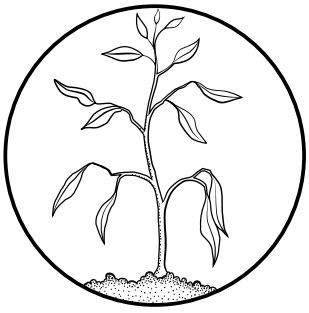
English

- Read 'Fire' by Jackie French.

What's its story?

Name: _____ **Date:** _____

Put these pictures of the life cycle of a eucalypt in order. Add words and pictures to show what helps the eucalypt to grow and what does not.

 Flowers are pollinated	 Mature tree
 Seeds formed inside fruit	 Seeds are released
 A seed germinates	 Flower buds with caps
 Sapling	

Lesson 6 Why oils?

AT A GLANCE

To support students to plan and conduct an investigation of whether *Eucalyptus* oil might help the plant defend itself against other living things.

Session 1 An oily investigation

Students:

- discuss ideas about why eucalypts produce oil
- plan and conduct an investigation.

Session 2 Oily results

Students:

- present the results of the investigation
- reflect on the investigation and ideas about life cycles and survival.

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 v).

Key lesson outcomes

Science

Students will be able to:

- brainstorm ideas on *Eucalyptus* oil and its role in the tree's life cycle
- with support, develop a question to investigate
- make a prediction about the effect of *Eucalyptus* oil on mould growth
- with support, plan an investigation that incorporates a control and fair testing
- describe and reflect on the results of the investigation.

Literacy

Students will be able to:

- contribute to discussions
- orally present investigation results to the class using diagrams, tables and text.

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

Teacher background information

Eucalyptus oil

Synthesising the complex oils that go into '*Eucalyptus* oils' takes a lot of energy. Scientists therefore think that the oils helped the trees to survive and/or reproduce during a significant period of their evolutionary history. There are a number of ways in which the oils could be beneficial:

- They could help the tree survive or propagate after fires: if fire is required for seed germination, then helping to ensure the right conditions is beneficial to the species. Alternatively, having a highly flammable canopy can encourage fire to burn through quickly, leaving the inside of stumps relatively unaffected and ready for regrowth.
- They could help to protect the plant from herbivores: by repelling them, by being difficult/poisonous to ingest and/or by attracting the predators of the herbivores. Over time, some herbivores evolved to tolerate the oils and even use them in turn to defend against predators.
- They could help prevent competition for resources: by inhibiting germination of other plants or by changing the conditions of the soil so they are unfavourable to the growth of other plants.
- They could help prevent the plants from being attacked by microbial agents such as fungi and bacteria.

We can never be entirely sure why certain traits evolved. Scientists develop their claims about the evolution of *Eucalyptus* oils by looking at their properties today. Tests that use extracted oils are a useful starting point for investigating potential reasons. However, they do not necessarily reflect biological realities. For example, while an oil may have anti-bacterial properties, if it is only located in specific glands it may not actually provide much protection against bacteria for the plant.

Mould

The term 'mould' is used to refer to several kinds of fungi that grow on various surfaces. Moulds reproduce by producing spores. Mould spores are commonly found in the air and soil, and will grow into mould only when they land somewhere with the right conditions for growth.

Moulds grow best away from direct sunlight, in moist, cool-to-warm conditions where there is plenty of organic matter for them to use as an energy source. Direct ultraviolet light (including sunlight) tends to kill moulds and they do not grow well in dry environments, or in very cold or hot conditions.

Mould should begin to grow on bread in about four to seven days, depending on the location and the temperature.

Session 1 An oily investigation

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- team skills chart
- team roles chart
- 1 enlarged copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7)
- 2 plastic spray-gun bottles with 100 mL markers on the side
- *Eucalyptus* oil
- cooking oil (eg, canola or sunflower)
- dishwashing detergent

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7) per team member
- 2 slices of bread
- 4 clear resealable plastic bags
- self-adhesive tape
- *optional:* extra resealable bags and bread

ELABORATE

Preparation

- Prepare an enlarged copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7).
- Lay out the slices of bread and leave them in the open air overnight to ensure mould spores can land on the bread.
- Put 10 mL of *Eucalyptus* oil in 200 mL of water in one spray-gun bottle, and 10 mL of cooking oil, such as canola or sunflower, in 200 mL of water in the other. Add a small quantity of dishwashing detergent to each bottle to help suspend the oils and shake well. Clearly label each bottle.
- *Optional:* Have extra water available to weaken the dilutions.
- Practise setting up the investigation (see Lesson step 10), including how many sprays are necessary to moisten the pieces of bread.

- *Optional:* Write a short procedural text in the class science journal for students to use as a reference.

- **Safety note:** Moulds produce spores that are released into the air. Some students are allergic to these spores. It is important to ensure that moulds are grown in double bags and that students do not open the bags.
- *Optional:* Display '*Eucalyptus* oil investigation planner' (Resource sheet 7) in a digital format.

Lesson steps

1 Remind students of how they identified eucalypts in Lesson 1 by looking for oil glands and smelling the leaves. Discuss how no-one can really be certain why eucalypts evolved to produce oil. Explain that scientists think that it is likely that producing the oils benefits the plants, for example, by helping them to survive fires.

2 Brainstorm other ways producing oil might help a plant survive or reproduce, such as:

- *Eucalyptus* oil in the soil (from dropped leaves or released by the leaves) stops other seeds from growing near the tree, reducing its competition for resources.
- *Eucalyptus* oil stops some insects and animals from eating the leaves.
- *Eucalyptus* oil in the leaves protects them from mould and bacteria.
- *Eucalyptus* oil in the soil stops harmful fungi and parasites from attacking the roots.

3 Explain that students will work in collaborative learning teams to test the claim that the *Eucalyptus* oil protects leaves from mould by investigating whether *Eucalyptus* oil stops mould from developing on bread. Discuss how to do this, for example, by looking comparing the growth of mould on bread sprayed with water and oil.

Encourage students to think of what *Eucalyptus* oil is used for in the home as a source of ideas.

Safety note: Explain that pure *Eucalyptus* oil is very concentrated and should never be ingested. Discuss how the oil will be diluted in water not only for safety but also because it is less concentrated in the leaves.

Optional: Encourage students to gather evidence about the other claims by designing their own investigations or consulting other sources.

4 Introduce the term 'variables' as things that can be changed, measured or kept the same in an investigation. Brainstorm variables that could affect the amount of mould that grows, such as the amount of liquid sprayed, the composition of the liquid, the temperature, the amount of light, the type of bread, the size and shape of the bread.

5 Introduce the enlarged copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7). Model how to develop a question for investigation, for example, 'What happens to the amount of mould that grows on bread when we change the liquid that it is soaked in?'.

6 Discuss with students why it is important to keep some things the same when you are measuring changes (to make the test fair and so we know what caused the observed changes).

7 Explain that students will compare water with cooking oil and water with *Eucalyptus* oil to be sure that it is not the introduction of an oil that changes the growth of mould. Ask questions, such as:

- Would it be fair to compare the two pieces of bread that have been soaked with different oils by putting one in the sunlight and one in the dark? Why do you think that?
- Would it be fair to put the pieces of bread with *Eucalyptus* oil in the fridge and put the pieces of bread with other oil near the heater? Why do you think that?
- Would it be fair to put the pieces of bread with *Eucalyptus* oil in paper bags and the pieces of bread with other oil in plastic bags? Why do you think that?

8 Ask teams to record what they will:

- **Change:** the liquid that the bread is soaked in
- **Measure/Observe:** the amount of mould that grows on the bread
- **Keep the same:** the type of bread, the amount of liquid sprayed, the temperature, the amount of light.

9 Introduce the equipment table and the materials that teams will be using.

10 Model how to set up the investigation, for example:

1. Spray one slice of bread twelve times from 10 cm away with the water and cooking oil spray.
2. Place the bread into one of the resealable bags and seal it, leaving some air in the bag.
3. Place the sealed bag into a labelled resealable bag and seal the outside bag.
4. Seal the outside bag further with tape.

11 Discuss why some air must be left in the bag (moulds are living things are need oxygen from air to live and grow) and why 'double bagging' is being used (moulds produce spores that some students might be allergic to).

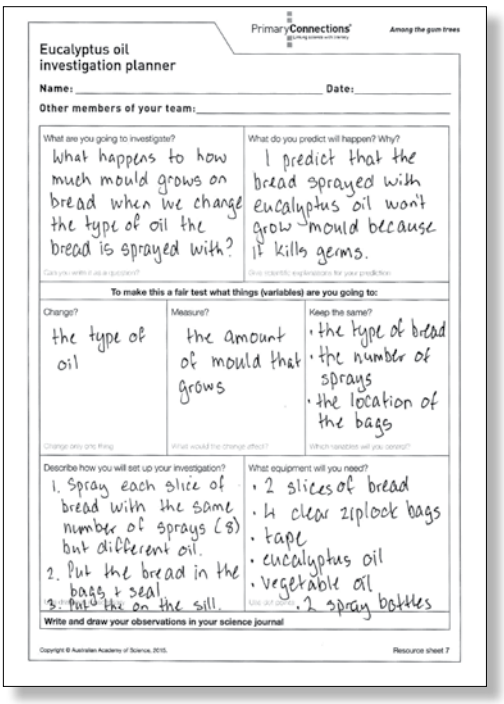
Optional: Allow students to investigate different dilutions of *Eucalyptus* oil by progressively diluting the liquids in the spray-gun bottles, for example, by adding 200 mL more water each time.

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

Allow time for teams to plan and set up their investigation.

Setting up the investigation

ELABORATE



PrimaryConnections — Among the gum trees

Eucalyptus oil investigation planner

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate?	What do you predict will happen? Why?
What happens to how much mould grows on bread when we change the type of oil the bread is sprayed with?	I predict that the bread sprayed with eucalyptus oil won't grow mould because it kills germs.

To make this a fair test what things (variables) are you going to:

Change?	Measure?	Keep the same?
the type of oil	the amount of mould that grows	• the type of bread • the number of sprays • the location of the bags

Describe how you will set up your investigation?	What equipment will you need?
1. Spray each slice of bread with the same number of sprays (8) but different oil. 2. Put the bread in the bags + seal 3. Put the on the sill.	• 2 slices of bread • 4 clear ziplock bags • tape • eucalyptus oil • vegetable oil • 2 spray bottles

Write and draw your observations in your science journal

Resource sheet 7

Work sample of 'Eucalyptus oil investigation planner' (Resource sheet 7)

13 Update the TWLH chart and the word wall with words and images.

Eucalyptus oil investigation planner

Name: _____ **Date:** _____

Other members of your team: _____

What are you going to investigate? Can you write it as a question?	What do you predict will happen? Why? Give scientific explanations for your prediction

To make this a fair test what things (variables) are you going to:

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

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

Write and draw your observations in your science journal

Session 2 Oily results

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- team skills chart
- team roles chart
- enlarged copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7) from Session 1
- 1 enlarged copy of '*Eucalyptus* oil results' (Resource sheet 8)
- *optional:* digital camera

FOR EACH TEAM

- each team member's science journal
- role wristbands or badges for Director, Manager and Speaker
- 1 copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7) from Session 1 per team member
- 1 copy of '*Eucalyptus* oil results' (Resource sheet 8) per team member
- *optional:* 1 sheet of clear grid paper, 1 cm by 1 cm

Preparation

- Prepare an enlarged copy of '*Eucalyptus* oil results' (Resource sheet 8).
- *Optional:* Display '*Eucalyptus* oil results' (Resource sheet 8) in a digital format.

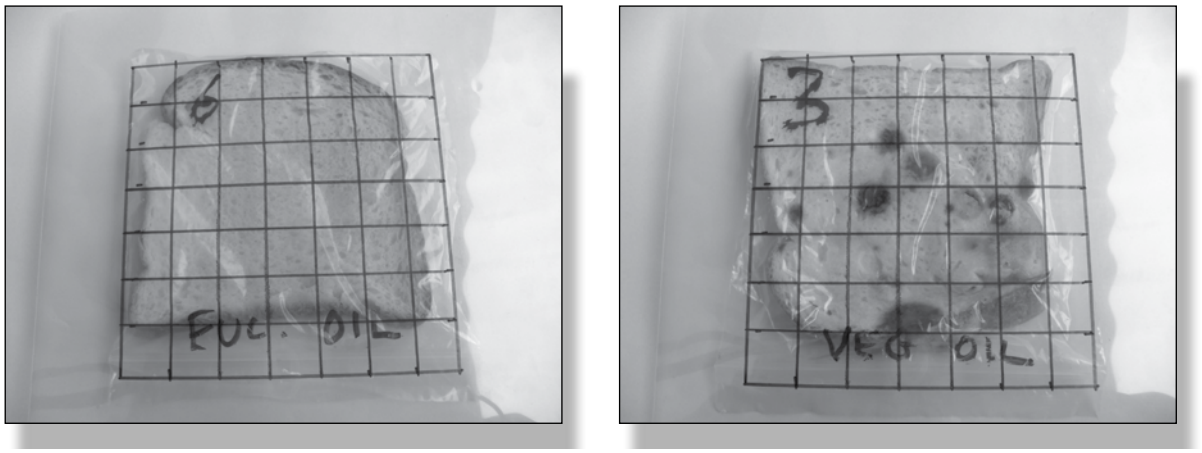
Lesson steps

ELABORATE

1 Remind students of their investigation set-up using the enlarged copy of '*Eucalyptus* oil investigation planner' (Resource sheet 7).

2 Explain that teams will record their observations and investigation results in their science journals. Discuss ways to make and record observations. For example, overlay a clear grid and count the number of squares that have mould and record results in a table.

Optional: Take photos of the investigation results.



Work samples of observing mould development

3 Introduce '*Eucalyptus* oil results' (Resource sheet 8). Ask teams to complete their copies of the resource sheet once they have made and recorded their observations.

4 Re-form teams. Allow time for teams to complete their observations and record their explanations.

5 Ask teams to present their investigation findings to the class. Encourage students to ask questions using the 'Science question starters' in Appendix 6.

6 Discuss the results of the investigations asking questions, such as:

- Did all the teams have the same results? Why do you think they were different?
- What went well in the investigation?
- What would you change if you did that investigation again?

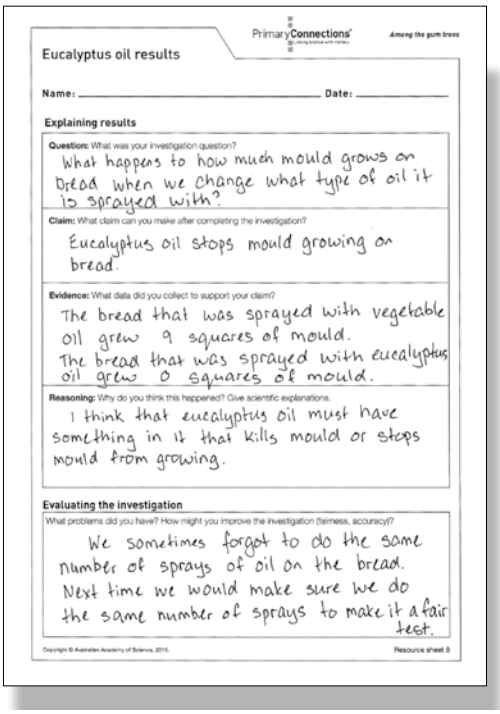
7 Remind students that the original investigation was conducted to gather evidence about possible benefits to the eucalypt by producing oil. Discuss how using bread allows us to create a fair test but that it may not reflect conditions in real life.

8 Review students' initial thoughts about other potential benefits (Session 1, Lesson step 2). Discuss how the evidence they have collected is just part of the puzzle about why eucalypts produce oil.

9 Record teams' findings in the 'L' (What we learned) and 'H' (How we know) columns of the TWLH chart. For example:

- What claim can we make from our investigations?
- Claim: '*Eucalyptus* oil stops mould from growing on bread'.
- Evidence: 'The bread that was sprayed with water and *Eucalyptus* oil = 0 squares of mould. The bread that was sprayed with water and cooking oil = 5 squares of mould.'

10 Update the word wall with words and images.



PrimaryConnections — Among the gum trees

Eucalyptus oil results

Name: _____ Date: _____

Explaining results

Question: What was your investigation question?
What happens to how much mould grows on bread when we change what type of oil it is sprayed with?

Claim: What claim can you make after completing the investigation?
Eucalyptus oil stops mould growing on bread.

Evidence: What data did you collect to support your claim?
The bread that was sprayed with vegetable oil grew 9 squares of mould.
The bread that was sprayed with eucalyptus oil grew 0 squares of mould.

Reasoning: Why do you think this happened? Give scientific explanations.
I think that eucalyptus oil must have something in it that kills mould or stops mould from growing.

Evaluating the investigation

What problems did you have? How might you improve the investigation (fairness, accuracy)?
We sometimes forgot to do the same number of sprays of oil on the bread. Next time we would make sure we do the same number of sprays to make it a fair test.

Resource sheet 8

'Work sample of '*Eucalyptus* oil results' (Resource sheet 8)'

ELABORATE

Curriculum links

Information and Communication Technology (ICT)

- Use interactive technology to represent data.

Eucalyptus oil results

Name: _____ **Date:** _____

Explaining results

Question: What was your investigation question?

Claim: Which claim can you make after completing the investigation? Choose one or write your own.

1. *Eucalyptus* oil makes mould grow on bread.
2. *Eucalyptus* oil stops mould from growing on bread
3. Cooking oil stops mould from growing on bread.

Evidence: What were your results?

Reasoning: Why do you think this happened?

Evaluating the investigation

What problems did you have? How might you improve the investigation (fairness, accuracy)?

Lesson 7 For the future

AT A GLANCE

To provide opportunities for students to represent what they know about how living things have life cycles and depend on each other and the environment to survive, and to reflect on their learning during the unit.

Students:

- write a letter or create a digital product for future students about their eucalypt seedling
- 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:

- living things have cycles
- living things depend on each other and the environment to survive.

Key lesson outcomes

Science

Students will be able to:

- identify the stages in the life cycle of a eucalypt
- describe interactions between eucalypts and other living things, including bees.

Literacy

Students will be able to:

- plan and publish an informative and persuasive letter or digital product containing key information
- reflect on their learning.

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

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- eucalypt seedling (see 'Preparation')
- *optional:* resources to create digital products (see 'Preparation').

FOR EACH STUDENT

- science journal

Preparation

- Select a eucalypt seedling that has grown well from Lesson 2 investigations to be planted in the school grounds.
- *Optional:* Collect resources to enable students to create digital products (see Lesson step 3), for example, digital cameras with video capability and computers.

Lesson steps

1 Review the science journal, TWLH chart and word wall. Show students the selected eucalypt seedling (see 'Preparation'). Explain that it will be planted in the school grounds.

Optional: Organise for students to plant the seedling.

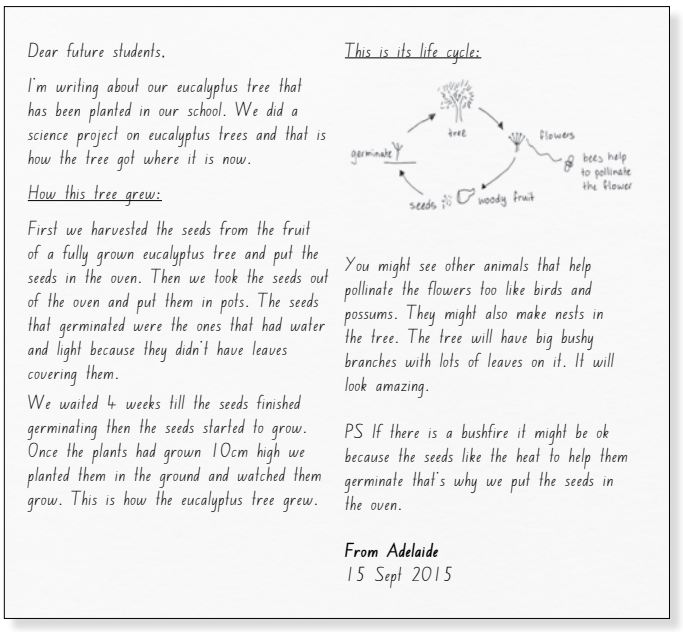
2 Explain that the eucalypt seedling might grow well and live for many years, and that some types of eucalypts live for up to 250 years in the wild.

3 Ask students to prepare a letter to future students at the school about the eucalypt seedling and how to look after it. Ask students to include:

- how the seedling was grown
- what they can expect from it as it grows, for example, its life cycle
- what animals it needs to help it grow
- what animals might hinder its growth.

Explain that students might use drawings and/or photos to illustrate their letter.

Optional: Ask students to think of how they might present their information digitally, such as by creating a video, a series of slides, an animation or a document written with a word processor.



Dear future students.

I'm writing about our eucalyptus tree that has been planted in our school. We did a science project on eucalyptus trees and that is how the tree got where it is now.

How this tree grew:

First we harvested the seeds from the fruit of a fully grown eucalyptus tree and put the seeds in the oven. Then we took the seeds out of the oven and put them in pots. The seeds that germinated were the ones that had water and light because they didn't have leaves covering them.

We waited 4 weeks till the seeds finished germinating then the seeds started to grow. Once the plants had grown 10cm high we planted them in the ground and watched them grow. This is how the eucalyptus tree grew.

This is its life cycle:

You might see other animals that help pollinate the flowers too like birds and possums. They might also make nests in the tree. The tree will have big bushy branches with lots of leaves on it. It will look amazing.

PS If there is a bushfire it might be ok because the seeds like the heat to help them germinate that's why we put the seeds in the oven.

From Adelaide
15 Sept 2015

Work sample of a letter to future students

4 Allow time for students to complete the activity.

5 Ask students to present their letter or digital product to a partner or the class.

6 Review the TWLH chart to identify what students have learned and how they learned those things. Review any unanswered questions.

7 Ask students to reflect on their learning during the unit. Ask questions, such as:

- How did your ideas change during the unit?
- What have you learned that you did not know before?
- What activity did you enjoy the most?
- What activity did you find the most challenging?
- What are you still wondering about?

EVALUATE

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 xiii.

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 experience working 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, teams consist of three students: Director, Manager and Speaker. (For F–Year 2, teams consist of two students: Manager and Speaker.) Each member of the team should wear something that identifies them as belonging to that role, such as a wristband, badge, or colour-coded peg. This makes it easier for you to identify which role each student is doing and it is easier for the students to remember what they and their team mates should be doing.

Manager

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

Speaker

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

Director (Year 3–Year 6)

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

Team skills

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

Students will practise the following team skills throughout the year:

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

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

Supporting equity

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

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

TEAM ROLES

Manager

Collects and returns all materials the team needs

Speaker

Asks the teacher and other team speakers for help

Director

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

TEAM SKILLS

1. Move into your teams quickly and quietly
2. Speak softly
3. Stay with your team
4. Take turns
5. Perform your role

Appendix 2
How to use a 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, measurements, 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.

Keeping a science journal aligns to descriptions in the Australian Curriculum: Science and English. See pages xi and xiii.

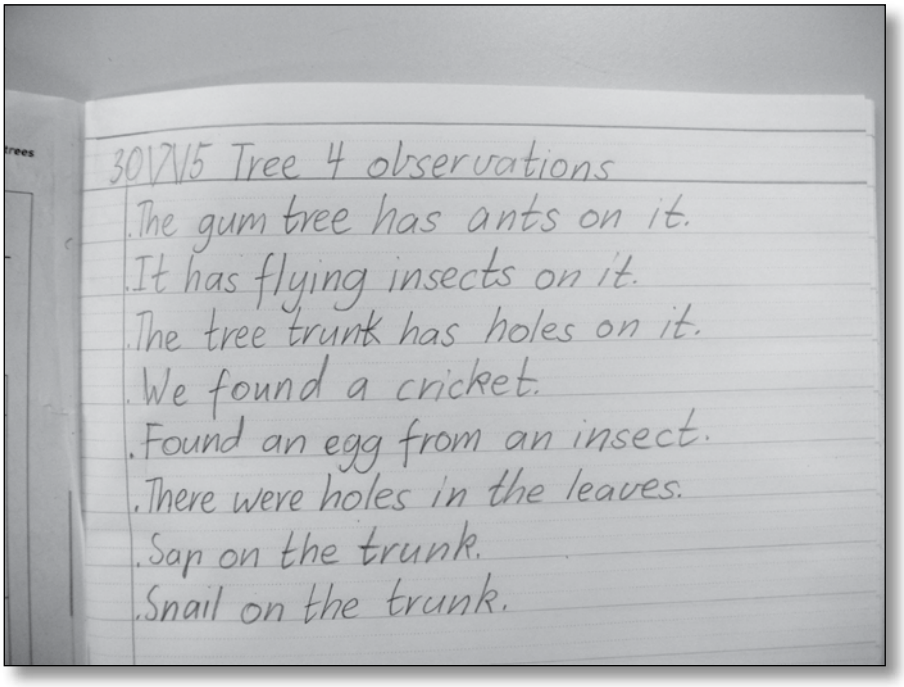
Using a science journal

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.



***Among the gum trees* science journal entry**

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 xiii.

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.

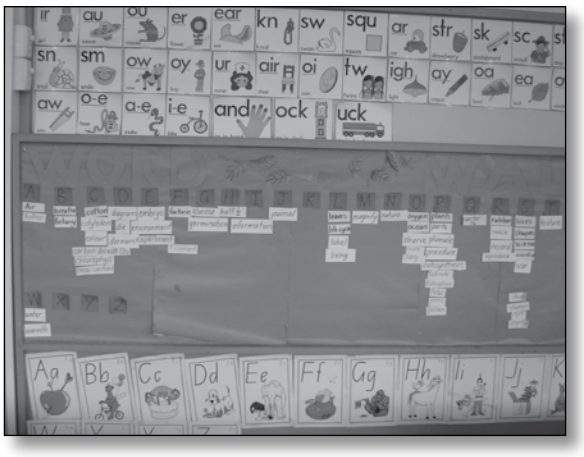
Choose robust material for the word cards. Write or type words on cardboard and perhaps laminate them. Consider covering the wall with felt-type material and backing each word card with a self-adhesive dot to make it easy for students to remove and replace word cards.

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.

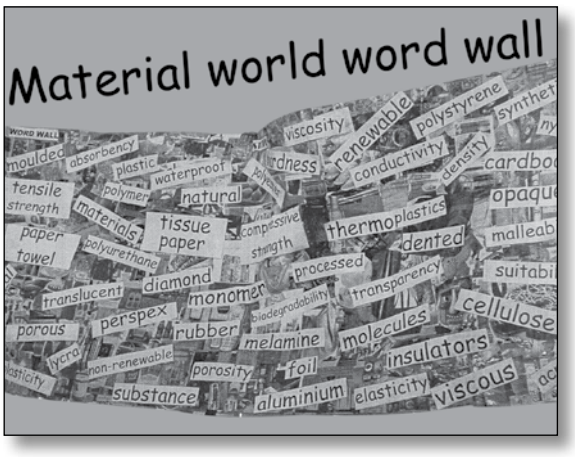
The purpose is for students to be exposed to a print-rich environment that supports their science and literacy experiences.

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 life cycles unit might be organised under headings, such as ‘Plant life cycle’ and ‘Animal life cycle’.

Invite students to contribute words from different languages to the word wall. Group words about the same thing, for example, different names of the same piece of clothing 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**



Material world **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.

Among the gum trees **word wall**

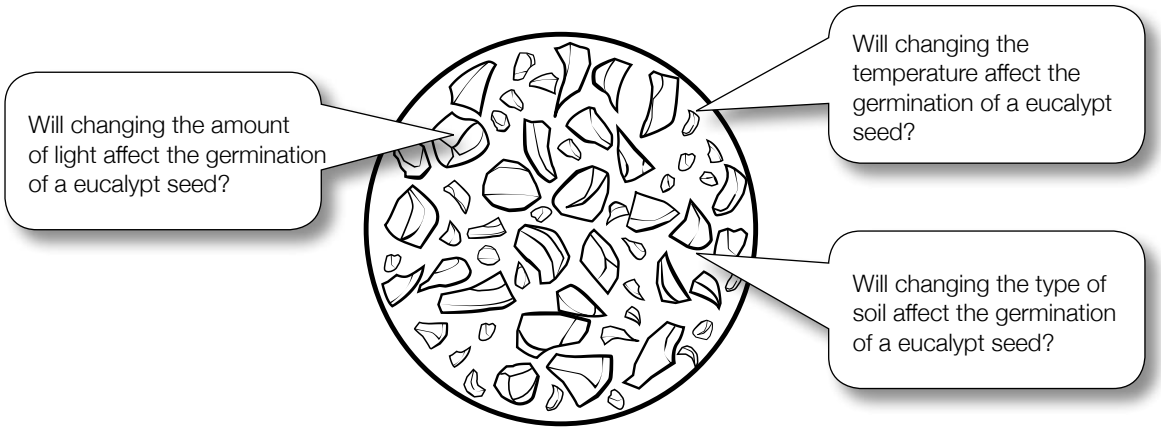
Appendix 4
How to conduct a fair test

Introduction

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

Planning a fair test

In *Among the gum trees*, students investigate things that affect the factors that determine the germination of a eucalypt seed.



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

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

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

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

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

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

To investigate whether the amount of light has an effect on the germination of a eucalypt seed, students could:

CHANGE	The amount of light	Independent variable
MEASURE/ OBSERVE	The number of germinated seeds	Dependent variable
KEEP THE **SAME**	The type of soil, the amount of water, how it is watered, when it is watered, the temperature	Controlled variables

Appendix 5
How to use a TWLH chart

Introduction

A learning tool commonly used in classrooms is the KWL chart. It is used to elicit students' prior **K**nowledge, determine questions students **W**ant to know answers to, and document what has been **L**earned.

Primary**Connections** has developed an adaptation called the **TWLH** chart.

T—'What we **think** we know' is used to elicit students' background knowledge and document existing understanding and beliefs. It acknowledges that what we 'know' might not be the currently accepted scientific understanding.

W—'What we **want** to learn' encourages students to list questions for investigation. Further questions can be added as students develop their understanding.

L—'What we **learned**' is introduced as students develop explanations for their observations. These become documented as 'claims'.

H—'**How** we know' or 'How we came to our conclusion' is used in conjunction with the third column and encourages students to record the evidence and reasoning that lead to their new claim, which is a key characteristic of science. This last question requires students to reflect on their investigations and learning, and to justify their claims.

As students reflect on their observations and understandings to complete the third and fourth columns, ideas recorded in the first column should be reconsidered and possibly confirmed, amended or discarded, depending on the investigation findings.

Among the gum trees TWLH chart

What we **think** we know	What we **want** to learn	What we **learned** (What are our claims?)	**How** we know (What is our evidence?)
Seeds need light to grow. →	Can eucalypt seeds grow if they are covered by leaves on the ground and don't get any light? →	The amount of light affects the germination of eucalypt seeds. →	No seeds germinated from the eucalypt seeds that were covered by leaves. Six seeds germinated from the eucalypt seeds that weren't covered by leaves.

Appendix 6

How to facilitate evidence-based discussions

Introduction

Argumentation is at the heart of what scientists do; they pose questions, make claims, collect evidence, debate with other scientists and compare their ideas with others in the field.

In the primary science classroom, argumentation is about students:

- articulating and communicating their thinking and understanding to others
- sharing information and insights
- presenting their ideas and evidence
- receiving feedback (and giving feedback to others)
- finding flaws in their own and others' reasoning
- reflecting on how their ideas have changed.

It is through articulating, communicating and debating their ideas and arguments that students are able to develop a deep understanding of science content.

Establish norms

Introduce norms before starting a science discussion activity. For example:

- Listen when others speak.
- Ask questions of each other.
- Criticise ideas not people.
- Listen to and discuss all ideas before selecting one.

Claim, Evidence and Reasoning

In science, arguments that make claims are supported by evidence. Sophisticated arguments follow the QCER process:

Q – What **question** are you trying to answer? For example, 'What happens to the germination of eucalypt seeds if we cover them with leaves?'

C – The **claim**. For example, 'The amount of light affects the germination of eucalypt seeds'.

E – The **evidence**. For example, 'No seeds germinated from the eucalypt seeds that were covered by leaves. Six seeds germinated from the eucalypt seeds that weren't covered by leaves'.

R – The **reasoning**. 'By covering the seeds with leaves the seeds didn't receive enough light and seeds need light to germinate.'

Students need to be encouraged to move from making claims only, to citing evidence to support their claims. Older students develop full conclusions that include a claim, evidence and reasoning. This is an important characteristic of the nature of science and an aspect of scientific literacy. Using science question starters (see next section) helps to promote evidence-based discussion in the classroom.

Science question starters

Science question starters can be used to model the way to discuss a claim and evidence for students. Teachers encourage team members to ask these questions of each other when preparing their claim and evidence. They might also be used by audience members when a team is presenting its results. (See Primary**Connections** 5Es video, *Elaborate*).

Science question starters

Question type	Question starter
Asking for evidence	I have a question about _____ . What is your evidence to support your claim?
Agreeing	I agree with _____ because _____ .
Disagreeing	I disagree with _____ because _____ . One difference between my idea and yours is _____ .
Questioning further	I wonder what would happen if _____? I have a question about _____ . I wonder why _____? What caused _____? How would it be different if _____?
Clarifying	I'm not sure what you meant there. Could you explain your thinking to me again?

DISCUSSION SKILLS

- Listen when others speak
- Ask questions of each other
- Criticise ideas not people
- Listen to and discuss all ideas before selecting one

Appendix 7
How to write questions for investigation

Introduction

Scientific inquiry and investigation are focused on and driven by questions. Some questions are open to scientific investigation, while others are not. Students often experience difficulty in developing their own questions for investigation.

This appendix explains the structure of questions and how they are related to variables in a scientific investigation. It describes an approach to developing questions for investigation and provides a guide for constructing investigable questions with your students. Developing their own questions for investigation helps students to have ownership of their investigation and is an important component of scientific literacy.

The structure of questions for investigation

The way that a question is posed in a scientific investigation affects the type of investigation that is carried out and the way information is collected. Examples of different types of questions for investigation include:

- How does/do …?
- What effect does …?
- Which type of …?
- What happens to …?

All science investigations involve variables. Variables are things that can be changed (independent), measured (dependent) or kept the same (controlled) in an investigation.

- The **independent variable** is the thing that is changed during the investigation.
- The **dependent variable** is the thing that is affected by the independent variable, and is measured or observed.
- **Controlled variables** are all the other things in an investigation that could change but are kept the same to make it a fair test.

An example of the way students can structure questions for investigation is:
What happens to_____ when we change_____?

dependent variable **independent variable**

The type of question for investigation in *Among the gum trees* refers to two things (variables) and the relationship between them, for example, an investigation of the things (variables) that affect the germination of a eucalypt seed might consider the effect of light or soil type. The question for investigation could be:

Q1: What happens to the germination of a eucalypt seed when we change the amount of light?

In this question, *the germination of a eucalypt seed* depends on *light.* Sunlight is the thing that is **changed** (independent variable) and the germination of a eucalypt seed is the thing that is **measured or observed** (dependent variable).

Q2: What happens to the germination of a eucalypt seed when we change the soil type?

In this question, *the germination of a eucalypt seed* depends on *soil type*. Soil type is the thing that is **changed** (independent variable) and plant growth is the thing that is **measured or observed** (dependent variable).

Developing questions for investigation

The process of developing questions for investigation is to:

- Provide a context and reason for investigating.
- Pose a general focus question in the form of:

  'What things might affect _____ (**dependent variable**)?'.

  For example, 'What things might affect the germination of a eucalypt seed?'
- Use questioning to elicit the things (**independent variables**) students think might affect the dependent variable, for example, the germination of a eucalypt seed.

  By using questions, elicit the things that students can investigate, such as the amount and type of soil, water and fertiliser, the temperature or amount of light. These are the things that could be changed (**independent variables**), which students predict will affect the thing that is measured or observed (**dependent variable**).
- Each of the independent variables can be developed into a question for investigation.
- Use the scaffold 'What happens to _____ when we change _____?' to help students develop specific questions for their investigation.

  For example, 'What happens to the germination of a eucalypt seed when we change the temperature?' or 'What happens to the germination of a eucalypt seed when we change the type of soil?'.
- Ask students to review their question for investigation after they have conducted their investigation and collected and analysed their information.
- Encouraging students to review their question will help them to understand the relationship between what was changed and what was measured in their investigation. It also helps students to see how the information they collected relates to their prediction.

Appendix 8 ***Among the gum trees*** **equipment list**

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	2	3	3	4	5	5	6	6	7
		SESSION		1	2	1	2		1	2	1	2	
Equipment and materials													
bread, slices	2 per team										●		
clear grid paper, 1 cm by 1 cm *optional*	1 sheet per team											●	
clipboard	1 per student		●										
cooking oil (eg, canola or sunflower)	per class										●		
dishwashing detergent	per class										●		
eucalypt flowers	per team					●							
Eucalyptus oil	1 bottle per class										●		
Eucalyptus-scented items	per class		●										
eucalypt seed capsule	1 per class			●									
eucalypt seeds, packets (in case seeds are not present in capsules)	per class			●									
eucalypt seeds, heated *optional*	per class			●									
eucalyptus seeds from Session 1	per class				●								
eucalypt seedling	per class												●
extra resealable bags and bread *optional*	per team										●		
images of, or a variety of cut flowers *optional*	per class					●							
jars of different-flavoured honey *optional*	per class						●						
labels	2 per team				●								
large image of a eucalypt	1 per class							●					
large individual images of each animal on ‘Friends and foes’ (RS5)	1 set per class							●					
lyrics/tunes to ‘gum tree’ songs *optional*	per class		●										
magnifying glass	1 per team					●							
paper, poster-sized	per team						●						
paper bag, small	1 per student		●										
paper bag with seed capsules from Lesson 1	per team			●									
plastic bags, clear resealable	4 per team										●		

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	2	3	3	4	5	5	6	6	7
		SESSION		1	2	1	2		1	2	1	2	
Equipment and materials													
plastic spray-gun bottles with 100 mL markers on the side	2 per class										●		
self-adhesive tape	per team										●		
small pots containing nutrient-rich soil or potting mix	2 per team				●								
watering can or container	1 per team				●								
Resource sheets													
'Is it a eucalypt?' (RS1)	1 per student		●										
'Is it a eucalypt?' (RS1), enlarged	1 per class		●										
'Germinating eucalypt seeds investigation planner' (RS2)	1 per team member			●	●				●				
'Germinating eucalypt seeds investigation planner' (RS2), enlarged	1 per class			●	●				●				
'Flower parts' (RS3)	1 per team member					●							
'Flower parts' (RS3), enlarged	1 per class					●							
'The honey bee life' (RS4)	1 per team member						●						
'The honey bee life' (RS4), enlarged	1 per class						●						
'Friends and foes' (RS5)	1 per team member							●					
'Friends and foes' (RS5), enlarged	1 per class							●					
'What's its story?' (RS6)	1 per student									●			
'What's its story?' (RS6), enlarged	1 per class									●			
'*Eucalyptus* oil investigation planner' (RS7)	1 per team member										●	●	
'*Eucalyptus* oil investigation planner' (RS7), enlarged	1 per class										●	●	
'*Eucalyptus* oil results' (RS8)	1 per team member											●	
'*Eucalyptus* oil results' (RS8), enlarged	1 per class											●	

EQUIPMENT ITEM	QUANTITIES	LESSON	1	2	2	3	3	4	5	5	6	6	7
		SESSION		1	2	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			●	●	●	●	●	●		●	●	
student science journal	1 per student		●	●	●	●	●	●	●	●	●	●	●
team roles chart	1 per class			●	●	●	●	●	●		●	●	
team skills chart	1 per class			●	●	●	●	●	●		●	●	
TWLH chart	1 per class		●	●	●	●	●	●	●	●	●	●	●
word wall	1 per class		●	●	●	●	●	●	●	●	●	●	●
Multimedia													
digital camera *optional*			●						●			●	
resources to create digital products *optional*													●
video(s) about why plants produce fruits				●									
video(s) about European honey bees							●						
video of eucalypt flowers opening						●							
video on the regeneration of eucalypts after a fire										●			

Appendix 9
Among the gum trees 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** Which tree?	• identify trees that might be eucalypts • explain their ideas about the life cycle of a eucalypt • list animals that might be found on a eucalypt and discuss why • discuss what they think a eucalypt needs to survive.	• contribute to discussions about eucalypts • represent the life cycle of a eucalypt using words and images.	• use given features to identify eucalypts in the school grounds • represent the life cycle of a eucalypt using words and images • begin a weekly report of animals found on a eucalypt.	**Diagnostic assessment** • Science journal entries • Class discussions • TWLH chart • 'Is it a eucalypt?' (Resource sheet 1) • Life cycle of a eucalypt drawing
EXPLORE	**Lesson 2** Fruits and seeds	• identify that fruits are intended to contain seeds • recognise the fruit of a eucalypt • with support, develop a question to investigate conditions that affect germination • with support, plan a fair test investigation.	• contribute to discussions about seed germination • incorporate new vocabulary into writing.	***Session 1*** Fruit or vegetable? • view a video about what a 'fruit' is • work in teams to plan an investigation of the germination of eucalypt seeds. ***Session 2*** Setting it up • work in teams to set up an investigation of the germination of eucalypt seeds.	**Formative assessment** • Science journal entries • Class discussions • TWLH chart • 'Germinating eucalypt seeds investigation planner' (Resource sheet 2)

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science, page xiii for English and page xiv for Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 3** Bustling bees	• identify the parts of a flower involved in reproduction • locate and label the reproductive parts of a eucalypt flower • explore the role of bees in pollination • sequence the life cycle of a European honey bee.	• create a labelled diagram of a eucalypt flower • view and read a factual text • represent the life cycle of a European honey bee.	***Session 1*** Flower parts • explore the internal parts of a flower • read a factual text about the function of parts of a flower. ***Session 2*** Sweet as honey • explore the life cycle of a European honey bee • discuss why and how bees pollinate flowers.	**Formative assessment** • Science journal entries • Class discussions • TWLH chart • 'Flower parts' (Resource sheet 3) • 'The honey bee life' (Resource sheet 4) • Labelled diagram
	Lesson 4 At home on the tree	• identify the ways in which animals rely on eucalypts for survival • classify the impacts of animals on the eucalypt as positive, negative or neutral.	• discuss ideas and use interaction skills, for example, acknowledging another's point of view.	• create a chart showing how different animals use eucalypts • work in teams to identify the impact(s) a given animal might have on a eucalypt • discuss the impact that the disappearance of eucalypts would have on animals and vice versa.	**Formative assessment** • Science journal entries • Class discussions • TWLH chart • 'Friends and foes' (Resource sheet 5)

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		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLAIN	**Lesson 5** The story of its life	• identify what conditions might affect the germination of eucalypt seeds • order the key stages in the life cycle of a eucalypt • explain how animals and eucalypts depend on each other for survival • discuss the effects of fire on a eucalypt depending on its life stage.	• orally present investigation results to the class using diagrams, tables and text • represent their ideas as a flow chart • discuss and explain how their ideas have changed.	***Session 1*** Germinated or not? • discuss the results of a germination investigation. ***Session 2*** Cycle of life • sequence images of the life cycle of a eucalypt • watch a video on the effect of bushfires on eucalypts.	**Formative assessment** • Science journal entries • Class discussions • TWLH chart • Annotated diagram • 'Germinating eucalypt seeds investigation planner' (Resource sheet 2) • 'What's its story?' (Resource sheet 6) • Flow chart

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		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
ELABORATE	**Lesson 6** Why oils?	• brainstorm ideas on *Eucalyptus* oil and its role in the tree's life cycle • with support, develop a question to investigate • make a prediction about the effect of *Eucalyptus* oil on mould growth • with support, plan an investigation that incorporates a control and fair testing • describe and reflect on the results of the investigation.	• contribute to discussions • orally present investigation results to the class using diagrams, tables and text.	***Session 1*** An oily investigation • discuss ideas about why eucalypts produce oil • plan and conduct an investigation. ***Session 2*** Oily results • present the results of the investigation • reflect on the investigation and ideas about life cycles and survival.	**Summative assessment** of Science Inquiry Skills • Science journal entries • Class discussions • TWLH chart • '*Eucalyptus* oil investigation planner' (Resource sheet 7) • '*Eucalyptus* oil results' (Resource sheet 8)

*For information on how the lessons align with the relevant descriptions of the Australian Curriculum, see page xi for Science, page xiii for English and page xiv for Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EVALUATE	**Lesson 7** For the future	• identify the stages in the life cycle of a eucalypt • describe interactions between eucalypts and other living things, including bees.	• plan and publish an informative and persuasive letter or digital product containing key information • reflect on their learning.	• write a letter or create a digital product for future students about their eucalypt seedling • reflect on their learning during the unit.	**Summative assessment** Science Understanding • Science journal entries • Class discussions • TWLH chart • Letter

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Among the gum trees was developed in collaboration with Eucalypt Australia.

In 1928, at the age of thirty, Klaus Bjarne Dahl ventured from Norway to Australia to take up the position of forest assessor with the Forests Commission of Victoria. In 1946, still with the Forest Commission of Victoria, Dahl was appointed Head of the Victorian Forest Assessment Branch. In 1948, Dahl became the Chief Land Purchasing Officer at Australian Paper Manufacturers, where he stayed until 1961. During this period he travelled extensively throughout Victoria, New South Wales and Queensland.

Throughout his life Dahl purchased land and managed forests as a private investment and, with other fortuitous investments, grew his private wealth. During his career Dahl developed a true affinity with the Australian bush and, in particular, a love of the silvertop ash (*Eucalyptus sieberi*)—so much so that he bequeathed all his property to the Forests Commission of Victoria (as of 2015, the Victorian Department of Environment, Land, Water and Planning) to be established as a Trust focused on eucalypts. Dahl recalled, 'I was once a Chief Forester, and I owe [the] Forests Commission of Victoria a great deal of gratitude for giving me in 1928 the opportunity to make good in my profession.'

Eucalypt Australia, formally the Bjarne K Dahl Trust, is a philanthropic fund established by a bequest from Bjarne K Dahl to focus on the iconic Australian trees 'the eucalypts'. The Trust was formally established in 2007 through an Order of the Supreme Court of Victoria as an independent Trust, separate from the Department of Environment, Land, Water and Planning of Victoria. In 2009 the Board of Managing Trustees was appointed and the Trust formally commenced operations in 2010.

We envisage a public inspired by and appreciative of eucalypts. We direct our resources, including small and multiyear grants, towards areas that have the greatest potential for impact, in order to promote, establish, cultivate and conserve eucalypts, and educate the public in these matters. We partnered with Primary**Connections** to develop a resource that would bring eucalypts to life in the classroom, using their 5Es teaching and learning approach to provide teachers with a learning sequence that develops not only the scientific knowledge of students but also their skills and attitudes towards science in line with the Australian Curriculum. We trust that it will serve as a valuable resource for years to come.

Please view our website for more information: www.eucalyptaustralia.org.au

PrimaryConnections®
Linking science with literacy

PrimaryConnections Units

Year	Biological sciences	Chemical sciences	Earth and space sciences	Physical sciences
F	*Staying alive*	*That's my hat!*	*Weather in my world*	*On the move*
	Growing well	*What's it made of?*		
1	*Schoolyard safari*	*Spot the difference*	*Changes all around*	*Look! Listen!*
	Dinosaurs and more	*Bend it! Stretch it!*	*Up, down and all around*	
2	*Watch it grow!*	*All mixed up*	*Water works*	*Machine makers*
				Push-pull
3	*Feathers, fur or leaves?*	*Melting moments*	*Night and day*	*Heating up*
4	*Plants in action*	*Material world*	*Beneath our feet*	*Magnetic moves*
	Friends or foes?			
	Among the gum trees	*Package it better*		*Smooth moves*
5	*Desert survivors*	*What's the matter?*	*Earth's place in space*	*Light shows*
6	*Marvellous micro-organisms*	*Change detectives*	*Creators and destroyers*	*Circuits and switches*
	Rising salt		*Earthquake explorers*	*Essential energy*