

Fully aligned
with the Australian
Curriculum

Plants in action

Year 4

Biological sciences



PrimaryConnections project

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Australian Government



Acknowledgments

PrimaryConnections is supported by the Australian Government.

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

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Cover images: Stock.xchng. www.sxc.hu

ISBN 978 0 85847 309 6

Published by the Australian Academy of Science.

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Foreword

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

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

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

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

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

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

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

Professor Suzanne Cory, AC PresAA FRS

President (2010–2013)

Australian Academy of Science

The PrimaryConnections program

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

The PrimaryConnections teaching and learning model

This unit is one of a series designed to exemplify the Primary**Connections** teaching and learning approach which embeds inquiry-based learning into a modified 5Es instructional model (Bybee, 1997), with the five phases: *Engage*, *Explore*, *Explain*, *Elaborate* and *Evaluate*. 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.science.org.au/primaryconnections

Developing students' scientific literacy

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

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

Linking science with literacy

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

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

Assessment

Assessment against the year level Achievement standards of the Australian Curriculum: Science (ACARA, 2012) is ongoing and embedded in PrimaryConnections units.

Assessment is linked to the development of literacy practices and products. Relevant understandings and skills for each lesson are highlighted at the beginning of each lesson.

Different types of assessment are emphasised in different phases:



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



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



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

Alignment with the Australian Curriculum: Science

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

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


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

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



Safety

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

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

References

Australian Curriculum Assessment and Reporting Authority (ACARA). (2010). *Australian Curriculum: Science*. www.australiancurriculum.edu.au

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

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

Unit at a glance

Plants in action

Phase	Lesson	At a glance
ENGAGE	Lesson 1 What goes where? Session 1 Plant life stages jumble Session 2 Garden Buddies (optional)	To capture students' interest and find out what they think they know about how living things, such as plants, have life cycles To elicit students' questions about plant parts, plant growth and the life cycle of flowering plants
	Lesson 2 What's inside a seed?	To provide students with hands-on, shared experiences of the outside and inside appearance of a seed when dry and when soaked
EXPLORE	Lesson 3 Bean seed germination	To provide students with hands-on, shared experiences of the changes that occur in a germinating seed
	Lesson 4 Flowers and pollination	To provide students with hands-on, shared experiences of the internal parts of a flower and their role in pollination
	Lesson 5 Flowers, fruits and seeds	To provide students with hands-on, shared experiences of the seeds inside fruits and read about the way fruits develop
EXPLAIN	Lesson 6 Patterns in plants	To support students to represent and explain their understanding and observations of seed germination and the growth of seedlings To introduce current scientific views about the life cycles of plants
ELABORATE	Lesson 7 Investigating conditions for plant growth	To support students to plan and conduct an investigation of the conditions that affect plant growth
EVALUATE	Lesson 8 Plant life cycle	To provide opportunities for students to represent what they know about how living things, such as plants, have life cycles, and to reflect on their learning during the unit

A unit overview can be found in Appendix 8, page 81.

Alignment with the Australian Curriculum: Science

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

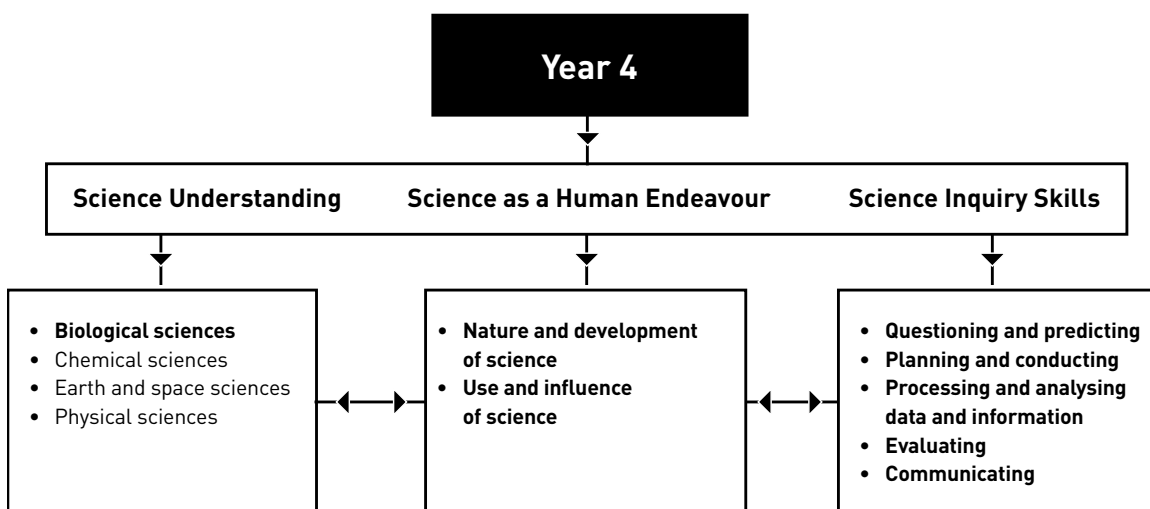
For ease of assessment the table below outlines the sub-strands and their aligned lessons.

Strand	Sub-strand	Code	Year 4 content descriptions	Lessons
Science Understanding (SU)	Biological sciences	ACSSU072	Living things have life cycles	1–8
Science as a Human Endeavour (SHE)	Nature and development of science	ACSHE061	Science involves making predictions and describing patterns and relationships	2–8
	Use and influence of science	ACSHE062	Science knowledge helps people to understand the effect of their actions	2, 7
Science Inquiry Skills (SIS)	Questioning and predicting	ACSIS064	With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge	6, 7
	Planning and conducting	ACSIS065	Suggest ways to plan and conduct investigations to find answers to questions	7
		ACSIS066	Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate	2, 3, 4, 6, 7
	Processing and analysing data and information	ACSIS068	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends	2–8
		ACSIS216	Compare results with predictions, suggesting possible reasons for findings	6, 7
	Evaluating	ACSIS069	Reflect on the investigation; including whether a test was fair or not	7
	Communicating	ACSIS071	Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports	1–8

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Interrelationship of the science strands

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



Relationship to overarching ideas

In the Australian Curriculum: Science, six overarching ideas support the coherence and developmental sequence of science knowledge within and across year levels.

In *Plants in action* these overarching ideas are represented by:

Overarching idea	Incorporation in <i>Plants in action</i>
Patterns, order and organisation	Students observe and describe the life cycle of flowering plants. They discuss and identify patterns and relationships within their observations of plant parts, plant stages and processes and factors affecting growth
Form and function	Students observe and investigate the parts of flowering plants and examine their function in the processes of growth, development and reproduction in the plant
Stability and change	Students develop a greater awareness that plants have basic needs such as light, and water and that changes in these factors will affect growth
Scale and measurement	Students measure plant growth and record the growth on a graph. They compare the measurements of the growth of plants under different conditions
Matter and energy	Students describe how light has an essential role in plant growth
Systems	Students study the parts of plants, the stages in the life cycle and the process that occur with growth. They explore how plant growth and development involves interactions between systems and components of systems

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Curriculum focus

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

Curriculum focus Years 3–6	Incorporation in <i>Plants in action</i>
Recognising questions that can be investigated scientifically and investigating them.	Students explore the life cycle of flowering plants. They observe similarities among plants and investigate relationships between the stages (seed, seedling, adult plant, flower and fruit) and the processes of germination and pollination. Students identify and investigate conditions necessary for plant growth and, with support, write questions for investigation and plan and conduct an investigation that incorporates the notion of fair testing. They observe and measure to collect data to answer their questions.

Achievement standards

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





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

General capabilities

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

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

Plants in action—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	Plants in action examples
Literacy	Literacy knowledge specific to the study of science develops along with scientific understanding and skills. Primary Connections learning activities explicitly introduce literacy focuses and provide students with the opportunity to use them as they think about, reason and represent their understanding of science.	In <i>Plants in action</i> the literacy focuses are: <ul style="list-style-type: none"> science journals labelled diagrams TWLH charts word walls tables procedural texts factual texts cross sections timelines.
 Numeracy	Elements of numeracy are particularly evident in Science Inquiry Skills. These include practical measurement and the collection, representation and interpretation of data.	Students: <ul style="list-style-type: none"> measure plant growth draw a scale for cross section diagram collect and represent data in tables collect data and represent data in simple graphs create a timeline of seed germination.
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: <ul style="list-style-type: none"> use digital cameras to record seed development Integrate digital images into word processing use interactive resource technology to view pollination animation.
 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: <ul style="list-style-type: none"> participate in beliefs groupings use reasoning to develop and respond to questions make predictions ask questions on a TWLH chart and answer them based on 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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 'Cultural perspectives' opportunities are highlighted. Important contributions made to science by people from a range of cultures are highlighted.

Cross-curriculum priorities

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

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

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



Aboriginal and Torres Strait Islander histories and cultures

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

Plants in action focuses on the Western science way of making evidence-based claims about the life cycles of plants.

Indigenous people have lived in Australia for more than 40 000 years—making use of plants for food, medicine, shelter and utensils. Centuries of living from the land has provided Indigenous people with deep and ongoing knowledge of Australian plants, their life cycles and their many uses throughout the stages of the life cycle.

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 *Plants in action* unit provides opportunities for students to develop an understanding of how the growth of flowering plants can be affected by environmental conditions. This can assist them to develop knowledge, skills and values for making decisions about individual and community actions that contribute to sustainable patterns of use of the Earth's natural resources.

Alignment with the Australian Curriculum: English and Mathematics

Strand	Sub-strand	Code	Year 4 content description	Lessons
English– Language	Language for interaction	ACELA1488	Understand that social interactions influence the way people engage with ideas and respond to others for example when exploring and clarifying the ideas of others, summarising their own views and reporting them to a larger group	1–8
	Text structure and organisation	ACELA1490	Understand how texts vary in complexity and technically depending on the approach to the topic, the purpose and the intended audience	3, 4, 5, 6, 8
	Expressing and developing ideas	ACELA1498	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	1–7
English– Literacy	Interacting with others	ACELY1687	Interpret ideas and information in spoken texts and listen for key points in order to carry out tasks and use information to share and extend ideas and information	1–8
		ACELY1688	Use interaction skills such as acknowledging another's point of view and linking students' responses 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	6
	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	3, 4, 5, 6
	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 structure and language features	6
		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	6
Mathematics– Measurement and Geometry	Using units of measurement	ACMMG084	Use scaled instruments to measure and compare lengths, masses, capacities and temperature	3, 4, 6, 7
Mathematics– Statistics and probability	Data representation and interpretation	ACMSP096	Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Includes tables, column graphs and picture graphs where one picture can represent many data values	7

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

Teacher background information

Introduction to plants

Plants can be distinguished from other living things by a number of distinctive characteristics. Plant cells are surrounded by a soft cell membrane and a rigid cell wall whereas animal cells have only a soft cell membrane. Unlike animals, plants cannot move from place to place and are usually rooted in one spot. Another unique characteristic of green plants is their ability to create their own food through a process called photosynthesis. During photosynthesis, plants use a green pigment called chlorophyll to capture the Sun's energy and convert water in the plant, and carbon dioxide from the air, into simple carbohydrates. These are used for food and as building material for cell walls. A by-product of photosynthesis is the oxygen we breathe.


Although they vary widely in appearance, virtually all flowering plants have three main parts: roots, a stem, and leaves. The root is the part of a plant usually found below ground. Roots anchor the plant in the soil and absorb the water and nutrients it needs to grow. The stem is the part of the plant usually found above ground. It provides structural support to lift the leaves up into the sunlight and transports nutrients between the roots and the leaves. Leaves are specialised for photosynthesis and are often thin and flat to maximise the amount of sunlight captured for photosynthesis, but they can be a variety of other shapes.

Flowering plants produce flowers and fruit as part of their reproductive cycle. Flowers are the reproductive organs of a plant and usually contain both male and female parts. After fertilisation, the female parts of a flower develop into seed-containing fruits.

Animals help disperse seeds when they eat the fruit and deposit their droppings away from the parent plant. The germination of these seeds completes the life cycle and provides for the replacement of the parent plant when it dies. This unit explores only the growth and development of flowering plants.

Note: Biologists describe a diagram of the internal parts of a flower cut longways, as a 'longitudinal section'. When the flower is cut at right angles to the long section, it is called a 'transverse section'.

In this unit we have used the generic term 'cross section' meaning to 'cut through'. We suggest that the biological terms 'longitudinal section' and 'transverse section' might be more appropriately introduced in detailed biological studies.

Indigenous perspectives relevant to the learning outcomes in PrimaryConnections units are identified by the icon  and included in the curriculum links for lessons.

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.

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

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

Lesson 1 What goes where?

AT A GLANCE

To capture students' interest and find out what they think they know about how living things, such as plants, have life cycles.

To elicit students' questions about plant parts, plant growth and the life cycle of flowering plants.

Session 1 Plant life stages jumble

Students:

- discuss a 'mystery box' of plant items and raise ideas about the relationships between them
- arrange pictures to represent the life cycle of flowering plants
- create a list of plant words to develop a word wall
- discuss ideas and questions for a TWLH chart.

Session 2 Garden Buddies *(optional)*

Students:

- observe, record and report on plants growing in their garden, and the jobs and activities done in the garden.

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, such as plants, have life cycles.

Key lesson outcomes

Science

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

- represent stages in the life cycle of flowering plants
- label parts of a plant: root, stem, leaves, flowers, fruit.

Literacy

Students will be able to:

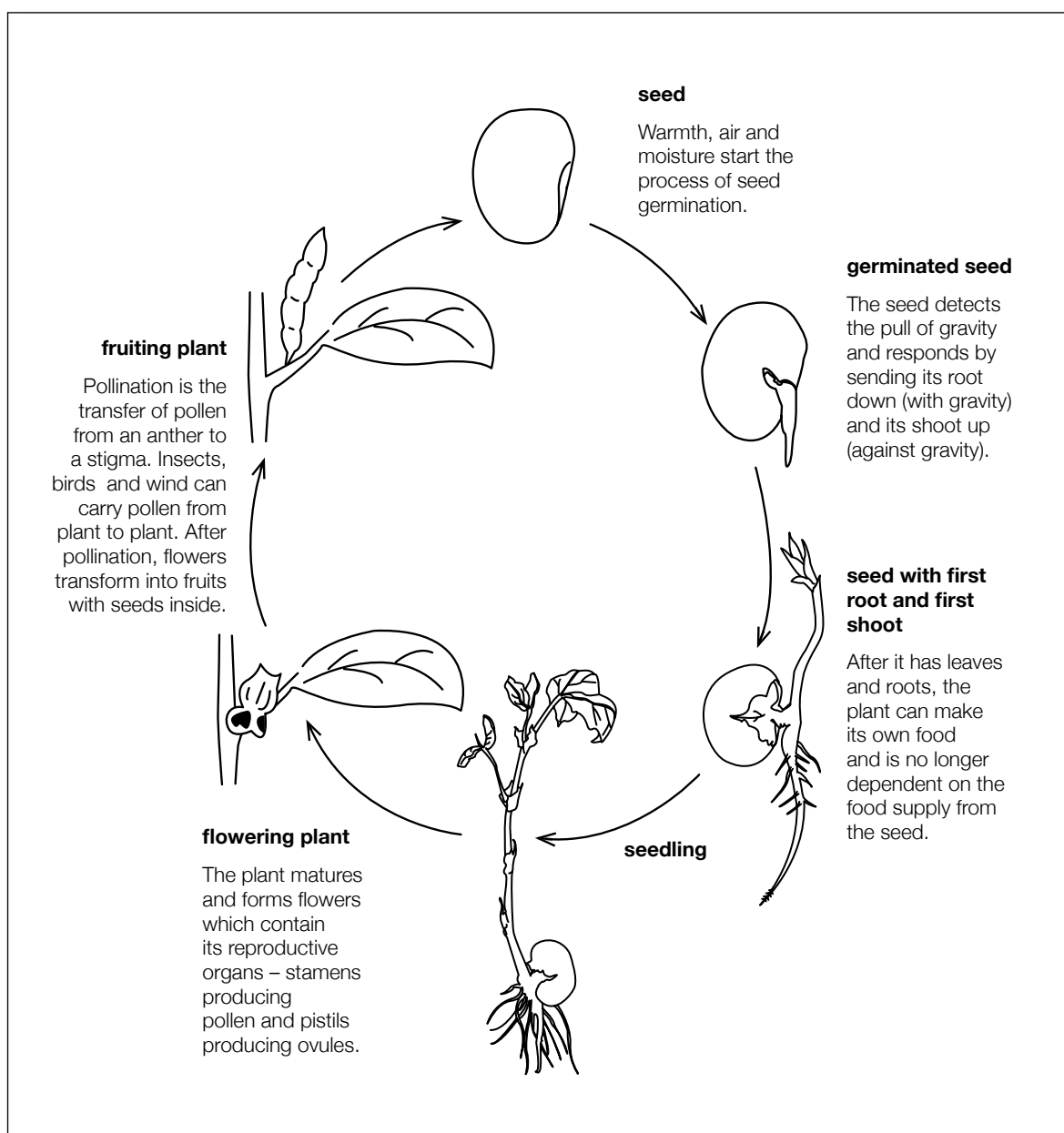
- contribute to discussions about plants
- understand the purposes and features of a labelled diagram
- create a labelled diagram
- contribute to the commencement of a TWLH chart and word wall
- record ideas in a science journal.

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

Session 1 Plant life stages jumble

Teacher background information

Every flowering plant starts life as a seed. With the right amount of warmth, air and moisture, 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 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. If the seeds experience suitable conditions for germination, the life cycle starts over again.



Life cycle of a flowering plant

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 large opaque box or bag ('mystery box')
- plant items and/or pictures of plants (eg, roots, stem, branch, leaves, seeds, small seedling, larger plant, flowers, fruit)

FOR EACH STUDENT

- science journal
- 1 copy of 'Plant life stages jumble' (Resource sheet 1)


Preparation

- Place the plant items in the mystery box so that students can't see them.
- 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 4) and prepare a large four-column chart for the class, with the following headings:

TWLH chart about how a plant grows and changes

What we think we know	What we want to learn	What we learned	How we know

Lesson steps

- 

1

Introduce the mystery box and explain that it contains a number of items that are linked together in some way. Explain to students that their task is to think of what they know about the items and work out how they are linked.

2

Show the items, one by one. In the Engage phase, do not provide any formal definitions or correct any answers as the purpose is to elicit students' prior knowledge. As you show each plant item, use questioning and discussion to help students share their ideas about plants and the particular plant item. Use questions such as:
 - What do you know about this item?
 - Can you see any links between the plant samples?
 - Do you know the names of these parts?
 - Could you put these into groups?
 - Why did you group them in that way?

3

Explain that students are going to show some of their ideas by arranging pictures in their science journal to represent the stages in a plant's life. 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.

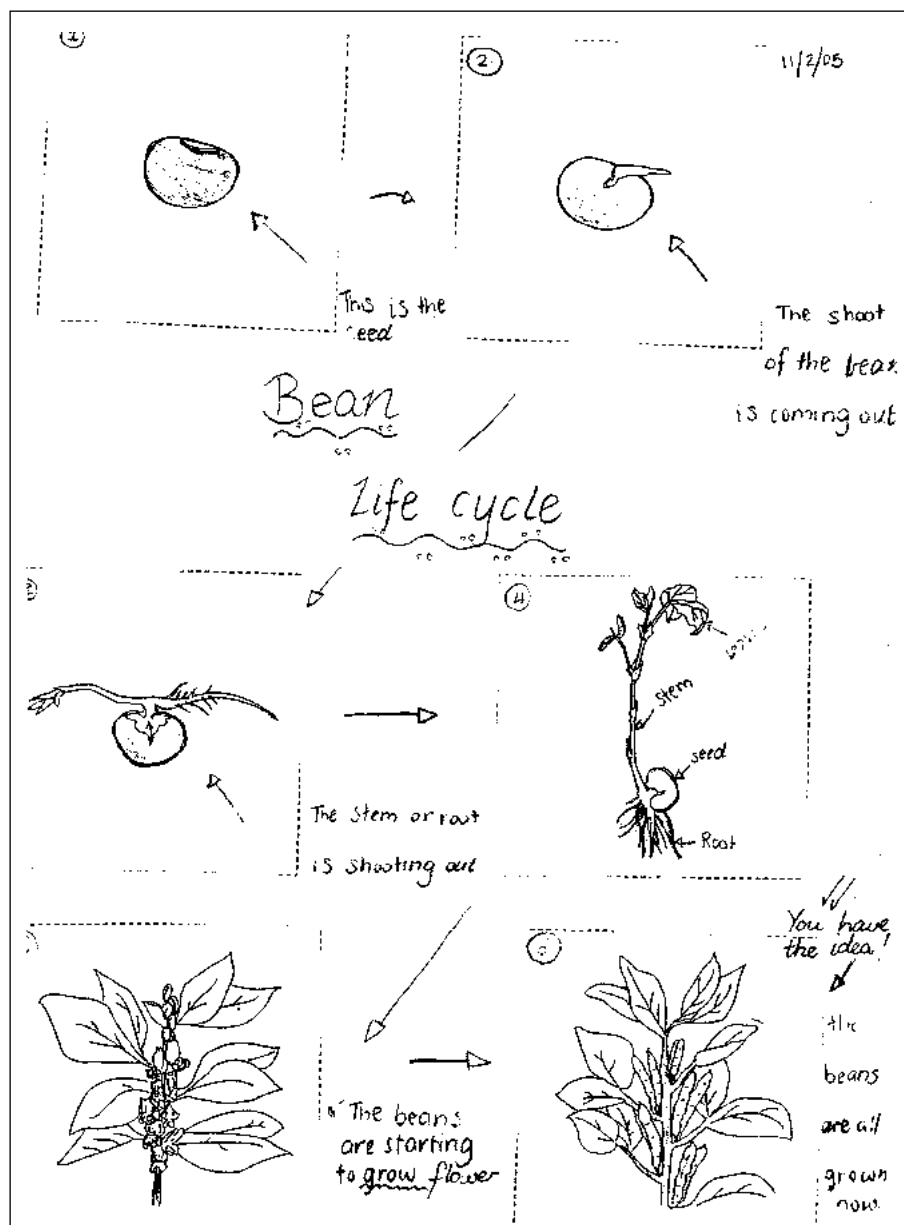
What does a science journal include?

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



- 4 Provide each student with a copy of 'Plant life stages jumble' (Resource sheet 1). Ask them to cut out the pictures and paste them into their science journal in the order they think best represents the stages of a plant's life.

Note: Avoid using the word 'cycle' at this point because students might arrange the pictures in a cycle even if they do not understand the concept.



Student work sample showing initial ideas about the life stages of a flowering plant



- 5 Ask students to add information about the stages of growth and about what might be happening. Ask them to draw arrows between the pictures to show how they think the pictures are related or the sequence in the stages of growth.

Explain that in this unit students will learn about the sequence in the stages of plant growth.

Note: This activity is used for diagnostic assessment. Encourage students, but do not provide correct answers at this stage.

- 6 Explain that scientific diagrams have certain features. Select an item from the mystery box, for example, a piece of fruit, and use it to show students how to draw a labelled diagram. With their assistance, label the parts. Discuss the purpose and features of such a diagram.

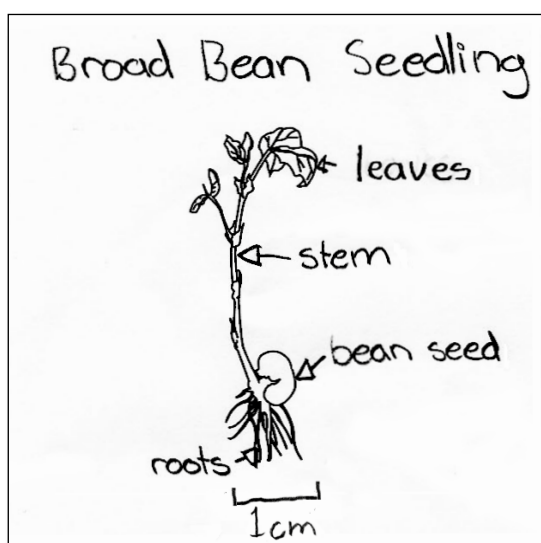
Literacy focus

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.



Student work sample of a labelled diagram



Ask students to label the diagrams in their journal entry to show what they know about plants.



- 7 Ask students to share their completed journal entry about the stages in plant growth with a partner and discuss similarities and differences.

- 8 Focus students' attention on how plants grow and change. Discuss the purpose and features of a TWLH chart.





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.

-  **9** Introduce the title and first column of the TWLH chart (What we **T**hink we know). Invite students to contribute ideas about how plants grow and change, and record these on the chart.
-  **10** Introduce the second column of the TWLH chart (What we **W**ant to learn) and ask students to suggest questions they might have. Record their questions on the chart.
-   **11** Start developing a word wall. Discuss the purpose and features of a word wall.

Literacy focus

Why do we use a word wall?

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


What does a word wall include?

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

Brainstorm words that students know about plants, asking questions such as:

- What are the names of some plants you know?
- What parts of a plant do you know?
- What different stages of a plant's life do you know?

Record students' responses on cards or paper strips, and discuss ways the words could be grouped, such as, plant names, plant parts, or stages in a plant's growth. Group the words according to students' suggestions for display as a word wall. Add headings to the word wall groups.

-  **12** Model a science journal entry about the lesson's activities using the class science journal and then ask students to write an entry about the lesson in their individual science journals. Provide students with prompts such as:
- Things I think I know about plants are ...
 - Things I'm not sure about are ...
 - Things I'm interested in finding out about are ...

Curriculum links



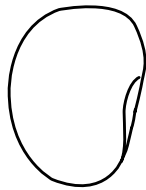
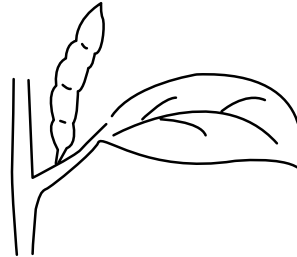
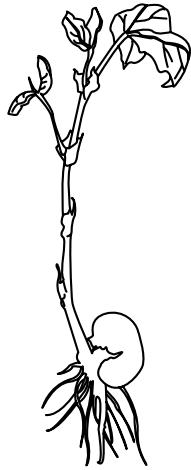
Indigenous perspectives

- See www.anbg.gov.au/anbg/aboriginal-trail.html for Indigenous knowledge on Australian native flowering plants.
- View the Yolgnu people of Ramingining's Plants and Animals story at www.12canoes.com.au/
- 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.science.org.au/primaryconnections).

Plant life stages jumble

Name: _____

Date: _____



Session 2 Garden buddies *(optional)*

Equipment

FOR THE CLASS

- soft toys to be the Garden Buddies
- disposable camera to accompany each Garden Buddy
- small plastic containers for each disposable camera
- carry bags for each Garden Buddy
- journal for each Garden Buddy (eg, A4 scrapbook, art diary, display book, folder with plastic sleeves)
- *optional*: A3 sheets of paper/cardboard

FOR EACH STUDENT

- *optional*: 1 copy of 'Information note for families' (Resource sheet 2) to send home with students
- 1 copy of 'Garden Buddies' visit task list' (Resource sheet 3)

Preparation

- According to the number of students in your class, decide how many Garden Buddies you will use.
- Organise how you will send the Garden Buddies home, and prepare a class roster.
- Prepare each Garden Buddy's travel pack by placing a Garden Buddy and a disposable camera (in its plastic container) in a carry bag.
- Prepare a journal for each Garden Buddy. This could include, a title page, a copy of the 'Information note for families' (Resource sheet 2), and a contents page to list students' names. Complete a model entry about your own garden.



Garden Buddy's travel pack containing a soft toy, disposable camera, plastic container and journal

Optional: Write the following headings on A3 sheets of paper/cardboard:

- Plants growing in our gardens
- Jobs that are done in our gardens
- Activities people do in our gardens

Lesson steps

- 1** Introduce the Garden Buddies and travel packs. Explain that the Garden Buddies are going to help students learn more about the plants in their own lives.
- 2** Explain how the Garden Buddies project will be organised in your classroom. For example, each student will take a Garden Buddy and a camera home with them for one to two nights. They will have a number of tasks to complete while the Garden Buddy is visiting (see Lesson step 7 for other ideas).
- 3** Show students the 'Garden Buddies' visit task list' (Resource sheet 3) and explain each task.
- 4** Show students your model entry in one of the journals.
- 5** *Optional:* Provide each student with a copy of the 'Information note for families' (Resource sheet 2). Ask students to take the note home to explain the project to their family, and to let you know when it would not be convenient for a Garden Buddy to visit. Display a class roster of when the Garden Buddies will visit students' homes.
- 6** As each student returns the Garden Buddy to school, they give a short oral presentation about the visit using their journal entry to support their presentation. Options for presentations might include students adopting the identity of the Garden Buddy and presenting information about the Garden Buddy's visit in the first person or making a video about the Garden Buddy visit.
- 7** *Optional:* After students make their Garden Buddy presentations, record information on the class sheets ('Plants growing in our gardens', 'Jobs that are done in our gardens' and 'Activities people do in our gardens').

Other ideas to organise Garden Buddies in your classroom:




- The whole class could work through the project simultaneously. For example, one week's homework task is to compile a list of the types of plants and animals in the garden, while the following week's task is to compile a list of jobs that are done regularly. After the students have completed the tasks for homework, they work on presenting final copies at school. The Garden Buddy and camera visit students' homes for one night each.
- The Garden Buddies project could become a long-term project, where students choose how they will present the information, such as, using a journal entry, building a model of the garden, making a video presentation or developing a PowerPoint presentation. The final project presentation could become part of a 'Garden show' to which parents and others are invited.

Curriculum links

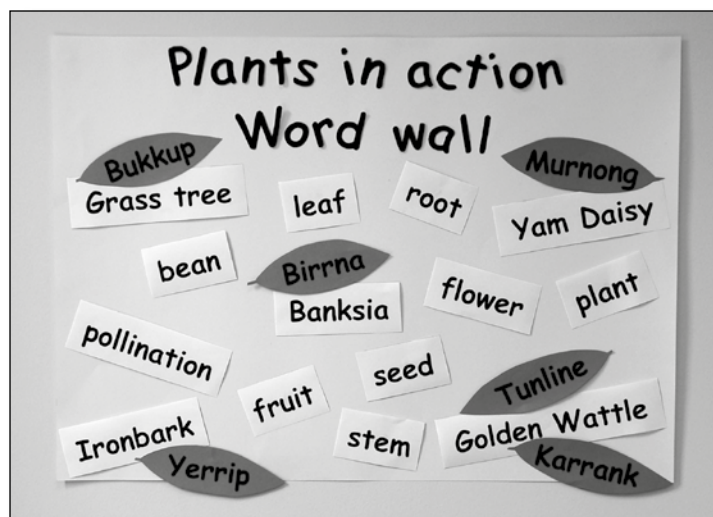


Indigenous perspectives

- Organise for students to learn more about plants in the local environment through consultation with local Indigenous community members and/or Indigenous education officers. With their assistance set up a plant trail in the school grounds, including plant labels with information on scientific, common and Indigenous plant names. See <http://www.anbg.gov.au/gardens/visiting/exploring/aboriginal-trail/index.html> for hints and protocols on establishing links with local Indigenous communities.
- Set up a plant press. In consultation with local Indigenous community members and/or Indigenous education officers collect, press and mount pressings or photographs of Indigenous plants to add to the word wall.

Plant trail observation record		
Photo of plant 	Pressed plant sample 	Drawing 
Common name Woolly Grevillea	Indigenous name unknown but the flowers were soaked in water to make a sweet drink the Aborigines called 'bool'	Description The plant has soft, woolly leaves that are short and sit out from the branch.
Scientific name Grevillea lanigera	Common uses attracts birds and used for nectar from the flowers	The flowers have pink on top and yellow at the bottom. They also have a long, pink part at the bottom.

Student work sample showing plant trail observation record



Plants in action word wall

- 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.science.org.au/primaryconnections).

Information for families

Name: _____

Date: _____

Introducing our Garden Buddies

This term our class will explore plant life cycles through the unit, *Plants in action*. As part of this unit we would like to learn about the gardens of students in our class. One activity is 'Garden Buddies', where a soft toy will travel home with students on a rostered basis to investigate gardens.



The Garden Buddies' travel packs

Each Buddy will be travelling in a bag containing:

- an instruction sheet explaining the tasks to be completed
- a journal
- a disposable camera (to take two photographs per garden).

What the Garden Buddy will do during the visit

Each student will be rostered to have a Garden Buddy visit for two consecutive nights (three over the weekend). The Garden Buddy would like to explore your home garden or another garden.

When the Garden Buddy is visiting, the Buddy's journal is available to record information such as:

- the types of plants in the garden
- how the plants are cared for and the jobs that are done in the garden
- activities that people do in the garden
- a sketch of the garden from a bird's eye view.

Two photographs need to be taken of the garden. At least one of these photographs should include the student with the Garden Buddy.

Please let me know of any days or specific dates when a Garden Buddy visit would **not** be convenient for your family.



Class Teacher



Garden Buddy's visit task list

Name: _____

Date: _____

Date Garden Buddy to be returned to school:

Here is a list of the tasks the Garden Buddy would like you to complete when they visit your house and garden.

After finishing a task, tick it off so that you know what you have completed ☒.



Tasks to do

- ☐ Introduce the Garden Buddy to your family and show the Garden Buddy around your garden.
- ☐ If the Garden Buddy has already visited other people's gardens, share the Garden Buddy's journal with your family.
- ☐ Write a list of the plants you can see.
- ☐ Write a list of how the plants are cared for and the jobs that need to be done in the garden.
- ☐ Write a list of the activities carried out in the garden.
- ☐ Draw a bird's eye view of the garden.
- ☐ Take, or ask someone to take, two photographs of your garden. **Put yourself and the Garden Buddy in at least one of the photos.**

☐ HAVE FUN!

Packing up the Garden Buddy

When you are returning the Garden Buddy to school, please make sure you have in the bag:

- ☐ the Garden Buddy
- ☐ the Garden Buddy's journal
- ☐ the disposable camera, in its container.

Please remember to return the Garden Buddy on the right day!



Lesson 2 What's inside a seed?

AT A GLANCE

To provide students with hands-on, shared experiences of the outside and inside appearance of a seed when dry and when soaked.

Students:

- discuss seeds
- work in teams to record observations of a dry bean seed
- work in teams to record observations of a soaked bean seed
- label a diagram of the inside of a bean.

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:

- making and recording observations of plants in a stage of their life cycle, recognising that environmental factors affect seed germination, and exploring ways scientists gather evidence for their ideas and develop explanations. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- observe and describe features of seeds and record observations
- compare dry and soaked seeds and describe the changes brought about by soaking.

Literacy

Students will be able to:

- identify the purpose and features of a table
- use a table to record observations
- create a labelled diagram of a bean seed
- represent their ideas about plants in their science journal.

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

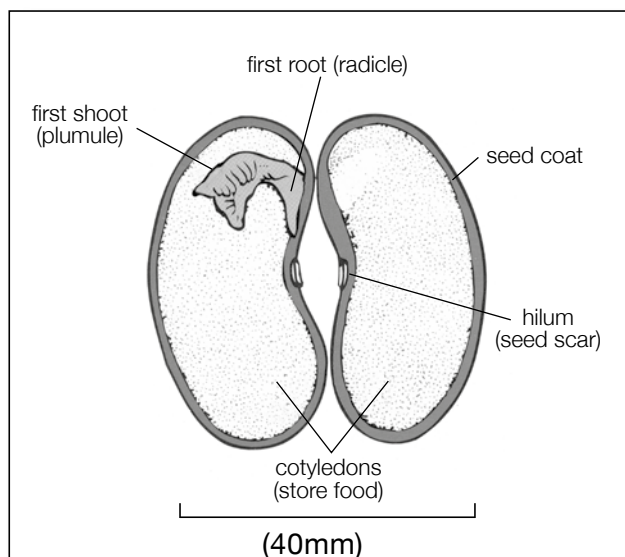
Teacher background information

Plant seeds contain a dormant plant embryo and a supply of food for the embryo to draw on when it begins to grow. These contents are covered in a tough seed coat that protects the embryo. A plant embryo is made up of three parts: the radicle, the plumule and the cotyledon or seed leaf. The radicle is the first root, the plumule is the first shoot and the cotyledon contains the food store. A bean plant draws its nourishment from the cotyledon before it has fully formed roots and leaves and is able to create its own food through photosynthesis. The hilum or seed scar is where the bean seed was attached to the plant.

Water is the trigger for seeds to begin germinating. When a seed soaks up water, the seed coat loosens and the embryo is activated by the moisture. If the embryo has enough warmth and air, it starts to grow.

Students' conceptions

Many students have different levels of understanding about 'living', believing that all living things move and non-living things do not. Consequently, they might believe that seeds are not living. After students have observed seeds germinating, you will be able to use their observations to challenge such beliefs by introducing the idea that the seed is living but is in a quiet or dormant state. This will help students adopt a more scientific understanding.



The anatomy of a broad bean seed

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'Observation record: Exploring seeds' (Resource sheet 4)

FOR EACH TEAM

- role badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Observation record: Exploring seeds' (Resource sheet 4) per team member
- 3 dry bean seeds (eg, red kidney or borlotti beans from the supermarket, not treated broad beans)
- 3 dry bean seeds cut open
- 3 soaked bean seeds
- 3 sheets of paper towel
- 1 magnifying glass

Preparation

- Read 'How to organise cooperative learning teams' (Appendix 1). Display an enlarged copy of the team skills chart and the team roles chart in the classroom. Prepare role badges and the equipment table.
- Prepare an enlarged copy of 'Observation record: Exploring seeds' (Resource sheet 4).
- Soak bean seeds overnight. Soak more seeds than the number of students in the class, in case of any mishaps during the lesson.



Try taking the seed coat off a soaked seed before the lesson to gauge any difficulties students might encounter. You might need to use a pair of sharp pointed scissors to help some students.

- Open some dry bean seeds, at least one for each team. The dry bean seeds are hard and will be difficult for students to open.

Note: This lesson can be done as a single session with the teacher soaking the seeds before the lesson, or it could be done in two sessions with the students soaking their own seeds overnight.

Lesson steps



- 1 Show students a bean seed and ask them what it is and what they know about it.
- 2 Write the headings 'Living', 'Not living', and 'Not sure' across the board. Ask students to think about whether a seed is 'living' or 'not living'. Ask them to move so that they are standing with others who have the same idea as they do, such as, 'living' at the back of the room, 'not living' at the front of the room and 'not sure' in the middle of the room.



- 3 Ask students in each group to discuss the reasons for their choice and ask each group to share their reasons with the whole class.



- 4 Ask students to complete one of the following sentences in their science journals:
 - 'I think a seed is (living/not living) because ...'
 - 'I'm not sure if a seed is living or not living because ...'

Living	Is a seed alive?	Not sure
<ul style="list-style-type: none"> Because you plant it in the soil and it grows Because the shell is protecting the plant Because when the seed is planted the shell breaks and the plant grows Because it has water inside 	<ul style="list-style-type: none"> Because the seed is hard and won't open Because it doesn't move Because it doesn't breathe 	<ul style="list-style-type: none"> Because it is not a plant yet Because it hasn't been planted yet Because it hasn't got any roots yet Because it needs water and sunlight to be alive

Classroom chart showing students' understanding of seeds as living or not living

- 5 Explain that students will be working in collaborative learning teams to explore seeds and record their information in a table. 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 badges or wristbands to help them (and you) know which role each team member has. Draw students' attention to the equipment table and discuss its use. Explain that this table is where team Managers will collect and return equipment.
- 6 Show students an enlarged copy of 'Observation record: Exploring seeds' (Resource sheet 4), and discuss the purpose and features of the table.






Literacy focus

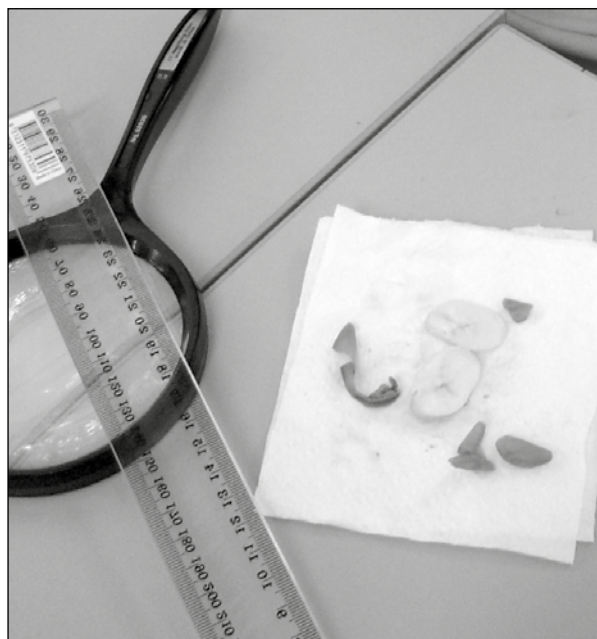
Why do we use a table?

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

What does a table include?

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

- 7 Explain that teams will first look at dry bean seeds. Explain that dry seeds are hard and difficult to open and so you have prepared some earlier.
- 8 Form teams and allocate roles. Ask Managers to collect team equipment.
- 9  Ask teams to observe dry bean seeds and complete the 'Dry bean' column of the 'Observation record: Exploring seeds' (Resource sheet 4), except for the drawing section.
- 10  Model drawing a labelled diagram of a seed. Review the purpose and features of a labelled diagram (see Lesson 1). Discuss each label, using the information provided in 'Teacher background information'. Students complete the drawing section of the 'Observation record: Exploring seeds' (Resource sheet 4).
- 11  Explain that for the next part of the lesson, you have soaked seeds in water overnight. Ask students to predict how this seed will be different from the dry bean seed and why.
- 12 Show students the soaked seeds. Demonstrate how to take the seed coat off a soaked seed and open the seed.
- 13 Ask team Managers to collect the soaked bean seeds.
- 14   Ask teams to observe the soaked bean seeds and complete the 'Soaked bean' column of the 'Observation record: Exploring seeds' (Resource sheet 4).

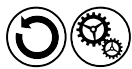


Observing a soaked bean seed



15 Ask students to compare a bean seed that was soaked overnight with one that was not soaked. Ask questions such as:

- What are the differences between the seeds?
- What do you think caused the differences?



16 Introduce the term 'germination' and explain to students that the process of soaking the seeds was the first step in the germination of the seed. Ask them to share their ideas about the role of water in germination (see 'Teacher background information').

17 Add new information to the third column (**W**hat we learned) and fourth column (**H**ow we know) of the TWLH chart.

18 Update the word wall with words and images.

Curriculum links

Mathematics

- Measure and record the size of bean seeds.



Indigenous perspectives

Storytelling is an integral part of Indigenous Australians' lives—both past and contemporary. Many Indigenous people are skilled storytellers and some are now choosing to preserve their stories through printed literature.

- In arid regions of Australia seeds contribute to Indigenous peoples' diet. Explore how Indigenous women gather and grind seeds for flour at: http://k6.boardofstudies.nsw.edu.au/linkages/IntegratedUnits/aboriginal/tech_learn02.html
- Read *Waterlilies* by Diane Lucas to explore Indigenous peoples' use of Australian native plants and seeds. Collect Australian native seeds and create seed creatures as a writing stimulus. Lucas, D. (2007). *Waterlilies*. Palmerston, NT: Waterlily Publications.
- 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.science.org.au/primaryconnections).

Observation record: Exploring seeds

Name: _____ Date: _____

	Dry bean		Soaked bean	
Shape				
Colour				
Texture				
Smell				
Size				
Drawing	Outside of seed	Inside of seed	Outside of seed	Inside of seed

Lesson 3 Bean seed germination

AT A GLANCE

To provide students with hands-on, shared experiences of the changes that occur in a germinating seed.

Students:

- explore packaged bean seeds
- read and discuss a procedural text for a bean seed germination activity
- work in teams to prepare bean seeds
- make ongoing observations and recordings of bean seed germination.

EXPLORE

Lesson focus

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

Assessment focus



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

- seeds as a stage of the plant life cycle and the changes that occur in seed germination. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- make observations and measurements of seed germination
- contribute to planning structured formats for recording measurements and observations
- describe how the orientation of a planted seed affects the growth of the root and shoot when the seed germinates.

Literacy

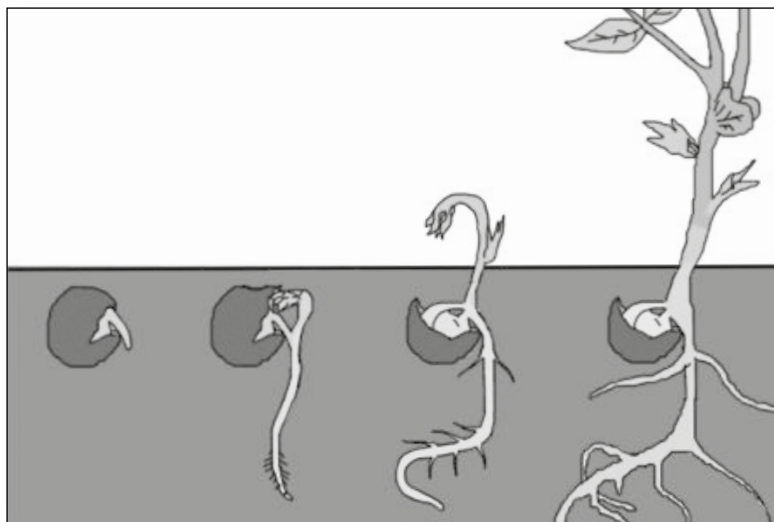
Students will be able to:

- contribute to discussions about seed germination
- understand the purpose and features of a procedural text
- use a procedural text for investigation
- record observations of seed germination using a labelled diagram.

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

Teacher background information

Once germination of a seed has started, the radicle or first root bursts through the seed coat. Soon afterwards, the plumule or first shoot emerges and begins to grow upwards. Roots grow downwards because they detect the pull of gravity. Shoots grow upwards away from the attraction of gravity and towards the sunlight. Once the plumule senses sunlight, the plant's first leaves unfurl. When it has leaves and roots, the plant can make its own food and no longer depends on the food supply from the seed.



Major stages of seed germination

Image from the PrimaryConnections Science Background CD
(courtesy of Victorian Department of Education and Early Childhood Development)

Equipment

FOR THE CLASS

- class science journal
- packet of dry bean seeds
- word wall
- TWLH chart
- 1 enlarged copy of 'Procedure: Bean seed germination' (Resource sheet 5)
- digital camera to record ongoing development of seeds (these photographs can be used in the *Explain* phase)

FOR EACH TEAM

- role badges or wristbands for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Procedure: Bean seed germination' (Resource sheet 5)
- 3 clear plastic cups
- 3 sheets of paper towel for each cup
- 3 pegs (or labels) for students to identify their seeds
- 1 soaked bean seed for each student (this investigation can be done with bean seeds from the food shelves of a supermarket, but seeds packaged for garden use are more likely to germinate)
- plant nursery (eg, a tray or box lid large enough for each team's plastic cups)

Preparation

- Prepare an enlarged copy of 'Procedure: Bean seed germination' (Resource sheet 5).
- Soak the beans overnight or organise students to soak them.



Germinated seeds in re-sealable bag

Note: You might prefer to use re-sealable bags instead of cups.

Note: Have students plant more than one type of seed to increase the chances of successful germination. Students could arrange the seeds in different ways, such as, 'scar side up', 'scar side down', in their own cups or bags.

Note: Use a digital camera to record ongoing development of seeds to provide photographs for the *Explain* phase.

Lesson steps



- 1 Show students a packet of dry beans, and ask why the beans are kept in a waterproof packet. Encourage students to think about the effect of water on the seeds (as in Lesson 2). Instruct students to wash their hands after handling the seeds. Seeds might have been treated with chemicals to stop them going mouldy.
- 2 Read through an enlarged copy of 'Procedure: Bean seed germination' (Resource sheet 5) with the class, and discuss the purpose and features of procedural texts.

Literacy focus

Why do we use a procedural text?

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

What does a procedural text include?

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

- 3 Explain that students will be working in collaborative learning teams but that each team member will have their own cup and beans. Form teams and allocate roles. Ask Managers to collect team equipment.



- 4 Ask teams to complete steps 1 and 2 of the 'Procedure: Bean seed germination' (Resource sheet 5). Before they begin step 3, ask them to suggest which way up their bean seeds need to be placed so that they will grow.

Discuss how students might determine the 'top' and 'bottom' of the seed, for example, by looking at the shape or the hilum. Ask teams to arrange the seeds in their container so that each team member's seed is placed in a different direction—'scar side up', 'scar side down', and 'vertically'.

Position the seeds between the paper towel and the side of the cup, halfway up the side of the cup to provide room for the root and shoot to grow.



Plant nursery

- 5 Ask teams to complete steps 4 to 6 of the 'Procedure: Bean seed germination' (Resource sheet 5). Explain that students will need to keep the paper towel in the cup moist, and ask them how they might do this.

- 6 Ask students to begin recording their observations in their science journal. Model how to set out the record, including the date, a labelled diagram and measurements.
- 7 Set aside the same time each day for 7 to 12 days for teams to observe and record the changes in the germinating bean seeds. Ask teams to share ways of recording observations, and model ways of recording. Ensure they understand the importance of measuring the length of both the root and shoot.



Student measuring bean seed growth

- 8 Ask students about any effect the orientation of the seed in the cup has had on the growth of the seedling.
- 9 As the seeds begin to germinate, introduce correct language for the plant parts that appear and add these to the class word wall and the TWLH chart. (See 'Teacher background information' for language to use.)
- 10 *Optional:* Continue to observe the growth of the bean seed over the course of the term, making weekly observations, measurements and recordings after the initial germination period. Students might like to plant their seedlings in pots of soil so they can watch them grow and develop. Use a digital camera to record growth.

Curriculum links

Mathematics

- Measure the growth of the root and shoot.

Information and Communication Technology (ICT)

- View animations of germination from the internet.
- Use a digital camera to record plant growth.



Indigenous perspectives

Many Australian native plants require fire for their seeds to germinate. Indigenous fire management practices encourage seed germination and promote the growth of new seedlings in the ash-bed.

- Research conditions that affect native seed germination such as, smoking, heating, soaking and scarification. Ask students to predict why native seeds require these conditions. See <http://asgap.org.au/seed.html>

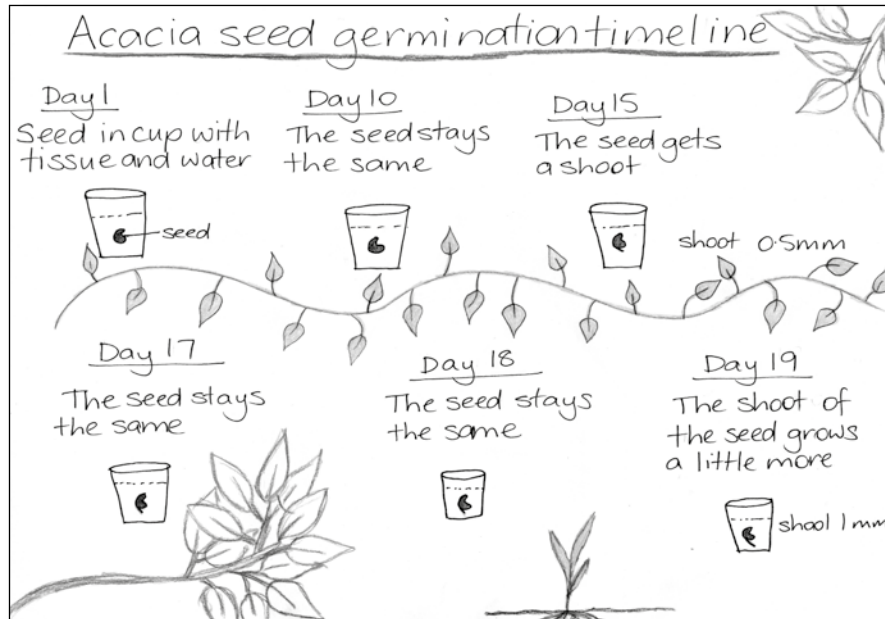
- Germinate Australian native seeds and compare growth with bean seeds.

See www.anbg.gov.au/PROPGATE/germinat.htm

Note: Some native seeds, for example, acacia seeds, require soaking in near boiling water prior to germination. See <http://asgap.org.au/seedsupp.html> for Australian native seed suppliers, including those that supply small amounts to schools.

- Some Australian native plants depend on animals for germination and dispersal of their seeds. Indigenous people use this knowledge in the collection of their food. Research the role emus and other Australian native animals play in this process.

See <http://asgap.org.au/APOL14/jun99-6.html>



Student work sample of a germination timeline

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

Procedure: Bean seed germination

Name: _____ **Date:** _____

Aim

To observe and record the germination and early growth stages of a bean seed.

Equipment

For each team	For each team member
<ul style="list-style-type: none"> • role badges for director, manager and speaker • 1 copy of 'Procedure: Bean seed germination' (Resource sheet 5) • 3 plastic cups • 3 sheets of paper towel for each cup • 3 pegs or labels • 1 magnifying glass • 3 soaked bean seeds • container of water 	<ul style="list-style-type: none"> • 1 science journal • 1 ruler • 1 lead pencil • 1 eraser

Activity steps

- 1 Fold one sheet of paper towel in half and line the plastic cup with it.
- 2 Scrunch two sheets of paper towel and put them in the middle of the cup to hold the paper lining firm against the sides of the cup.
- 3 Place the seed in between the paper lining and the cup.
- 4 Label your cup.
- 5 When your teacher gives the instruction, pour water into the centre of the cup.
- 6 Put your cup in the plant nursery.

Bean seed recording

Watch your bean seed grow through the early stages of its life cycle. Keep a careful record of the growth in your science journal.

To make an accurate record of the bean seed's early life, you need to include:

- labelled diagrams
- measurements of the growth of various parts.

Each time you record information about your bean seed, include the time, date and the day of growth (for example, Day 1, Day 2).

Start recording in your science journal now.

Lesson 4 Flowers and pollination

AT A GLANCE

To provide students with hands-on, shared experiences of the internal parts of a flower and their role in pollination.

Students:

- explore the parts of a flower
- draw and label a diagram of a flower
- read a factual text about the parts of a flower
- read a factual text about pollination.

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:

- the internal parts of flowers, their role in pollination and how they change into fruits containing seeds—all part of the plant life cycle. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes

Science

Students will be able to:

- accurately draw and label a diagram of a flower
- explain the role of the flower and pollination in forming seeds and fruit
- describe how a flower changes into a fruit containing seeds.

Literacy

Students will be able to:

- contribute to discussions about flowers and pollination
- create a labelled diagram of a flower
- read and view factual texts
- identify and recall key ideas in factual texts
- understand the purpose and features of a cross section diagram
- construct a cross section diagram of a flower.

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

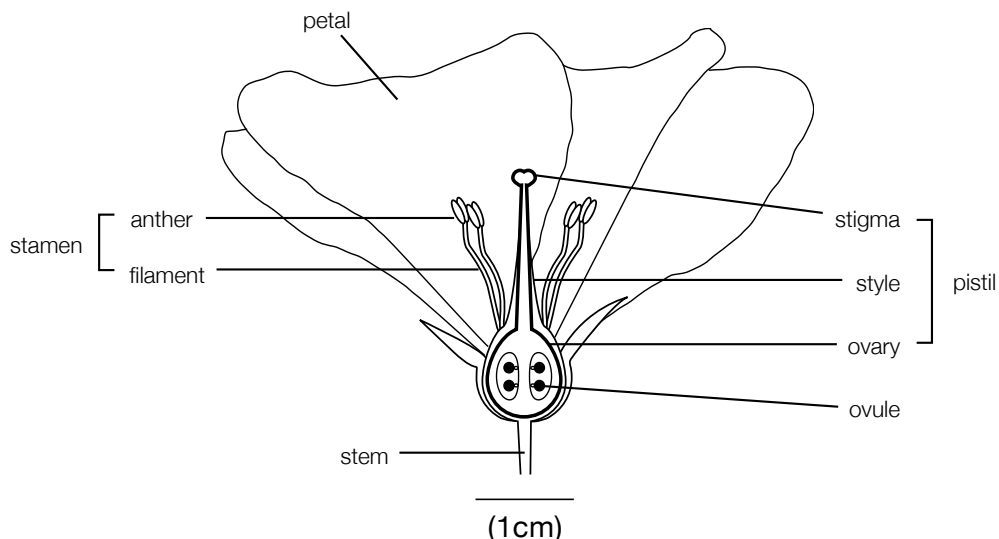
Teacher background information

The flower of a plant contains its reproductive organs. The male parts of the flower are the stamens. Each stamen generally has a long stalk called the filament, with an anther at the end. The anthers carry pollen, which contain the male reproductive cells of the plant. The female parts of the flower are usually found in the centre and are referred to as the pistil. Each pistil has an expanded tip called the stigma, an elongated stalk, the style, and an enlarged base, the ovary. The ovary contains ovules, which are the female reproductive cells of the plant.

When pollen from another plant of the same species lands on the stigma, the pollen grains grow a tube that carries the pollen to the ovules, which are then fertilised.

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 but others rely on insects, birds, bats and even mammals to collect pollen and transfer it from flower to flower. Plants that rely on insects and birds for pollination usually have bright flowers to attract them.

Pollen can also be carried by the wind. Species that rely on this method of pollination often have small, dull flowers and light, fluffy pollen because they do not need to attract pollinators to reproduce. Some species of water plants rely entirely on water to carry their pollen from flower to flower.



Cross section of a flower

Note: Biologists describe a diagram of the internal parts of a flower cut longways as a 'longitudinal section'. When the flower is cut at right angles to the long section, it is called a 'transverse section'.

In this unit we have used the generic term 'cross section' meaning to 'cut through'. We suggest that the biological terms 'longitudinal section' and 'transverse section' might be more appropriately introduced in detailed biological studies.

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- mixed flowers, including those that clearly show the pistil and stamen (eg, daffodil, lily, tulip)
- 1 enlarged copy of 'Cross section of a flower' (Resource sheet 6)
- a factual text about flowers and one about pollination (see PrimaryConnections website for suggestions)
- a pollination animation (see PrimaryConnections Science Background Resource on PrimaryConnections website) and the appropriate technology for viewing it
- *optional: The private life of plants*, Episode 3: 'Flowering', David Attenborough (2003), BBC Worldwide Ltd

FOR EACH TEAM

- role badges for Director, Manager and Speaker
- each team member's science journal
- flower samples (at least 2 per team member)
- 1 magnifying glass
- 1 pair tweezers
- 6 toothpicks
- 1 small tray to hold the flower samples
- 1 copy of 'Cross section of a flower' (Resource sheet 6) per team member

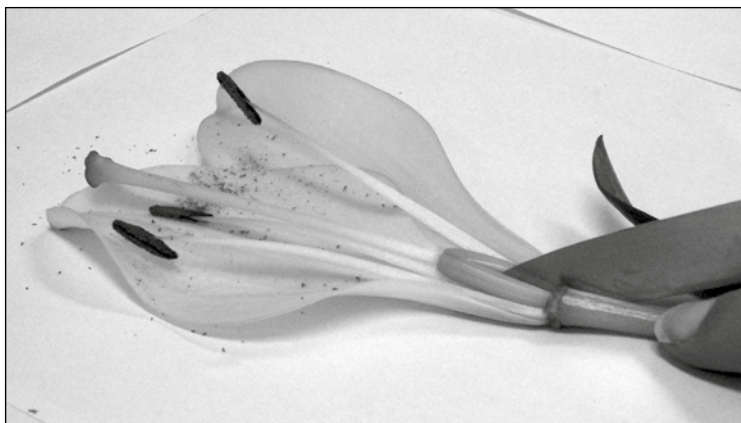
Preparation

- Prepare an enlarged copy of 'Cross section of a flower' (Resource sheet 6).
- Purchase or ask students to bring in samples of flowers that demonstrate differences in shape, size, colour and perfume, including samples that clearly show the pistil and stamens.



Lilium, clearly showing pistil and stamens

- Organise a flower specimen for each team that is cut longways through the pistil. (Biologists call this a 'longitudinal section'.)



Making a cut through the pistil

- *Optional:* View Episode 3 of 'The private life of plants' to check that the language is appropriate for your class and familiarise yourself with the information (see 'Equipment'). The first 20 to 25 minutes are particularly useful for this topic. You can turn the sound off and provide your own commentary.

Lesson steps



- 1 Lead a discussion about the shapes, sizes, colour and perfume of the flower samples that you have organised. Ask questions such as:
 - How are flowers the same?
 - How are they different?
 - Why are they important to plants?
 - What parts can you identify?
 - Ask students what they know about the parts of the flower and record their responses in the class science journal.
- 2 Explain to students that they will be working in collaborative learning teams to explore the parts of a flower. Demonstrate how to use the magnifying glass to assist their observations.



Student observing the parts of a flower



- 3 Review the features of a labelled diagram (see Lesson 1). Model how to draw a scale, that is, a horizontal line with a vertical bar at each end, placed horizontally under the picture. The size of the measured feature, for example, 1 cm, is written under the line.

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

- 5 Have students observe a flower using a magnifying glass.



- 6 Once teams have completed their observation, ask them to share their findings about flowers and their parts.



- 7 Provide teams with a second flower, which is cut longways through the pistil. Demonstrate how to use the tweezers and the toothpicks to help with their investigations. Discuss how using these tools can help them explore the flower samples. Direct students to open out the cut area to explore the flower parts. Ask them to draw a diagram with a scale in their science journal.

- 8 Consolidate this investigation by sharing a factual text about flowers. 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.

Using an enlarged copy of 'Cross section of a flower' (Resource sheet 6), model how to label the flower parts: stem, petal, filament, anther, stamen, style, stigma and pistil. Discuss the purpose and features of a cross section.

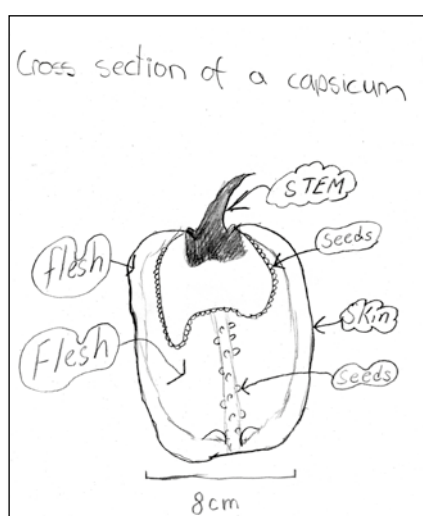
Literacy focus

Why do we use a cross section?

We use a **cross section** to show the inside of an object.

What does a cross section include?

A **cross section** includes a title, a drawing and an indication of scale. The main features are labelled and lines or arrows connect the label to the feature.



Student work sample of a cross section

- 9 Provide each student with a copy of the unlabelled diagram 'Cross section of a flower' (Resource sheet 6). Students then review their drawings and label the resource sheet using their new vocabulary.


Note: The scale relates to the actual size of the flower.

- 10 Ask students to consider what purpose the flower has in the life cycle of the plant. Use the **Think: Pair: Share** strategy:

Think: Individual students consider the questions: What are the things you notice about flowers, such as scent and colours? What is the relationship between flowers and other living creatures, such as bees and birds?

Pair: Each student discusses their ideas with a partner.

Share: Each pair shares their ideas with the class.

- 11** Read students a factual text about pollination, or provide them with a copy of a text to read in small groups. If possible, show students the animation of the pollination process on the PrimaryConnections Resource on the Primary Connections website (Life and Living; How Plants Function; Plant Systems C).
- 12** Review the TWLH chart and the word wall, adding any new ideas or relevant vocabulary.
-  **13** Ask students to reflect on the activity and add new information to their journals. Provide students with prompts such as:
 - Two new ideas that I have about flowers and pollination are...
 - Someone I would share my new ideas with would be ... because ...
 - Something I have learned about working in collaborative learning teams is ...
 - Something I have learned about investigating and recording is ...
- 14** *Optional:* View Episode 3 of 'The private life of plants', pausing often to allow students to record their ideas about what they have seen (see 'Equipment').

Curriculum links

Studies of Society and Environment

- Research the lives of famous botanists, for example, Sir Joseph Banks.
- Visit the Australian National Botanic Gardens website at www.anbg.gov.au.

The Arts

- Research the lives of artists known for their floral art, for example, Margaret Preston.
- Review famous paintings of flowers, such as, *Sunflowers* by Van Gogh and *Waterlilies* by Monet.

Information and Communication Technology (ICT)

- Use interactive item: Pollination process on the PrimaryConnections Resource on the PrimaryConnections website (Life and Living; How Plants Function; Plant Systems C).



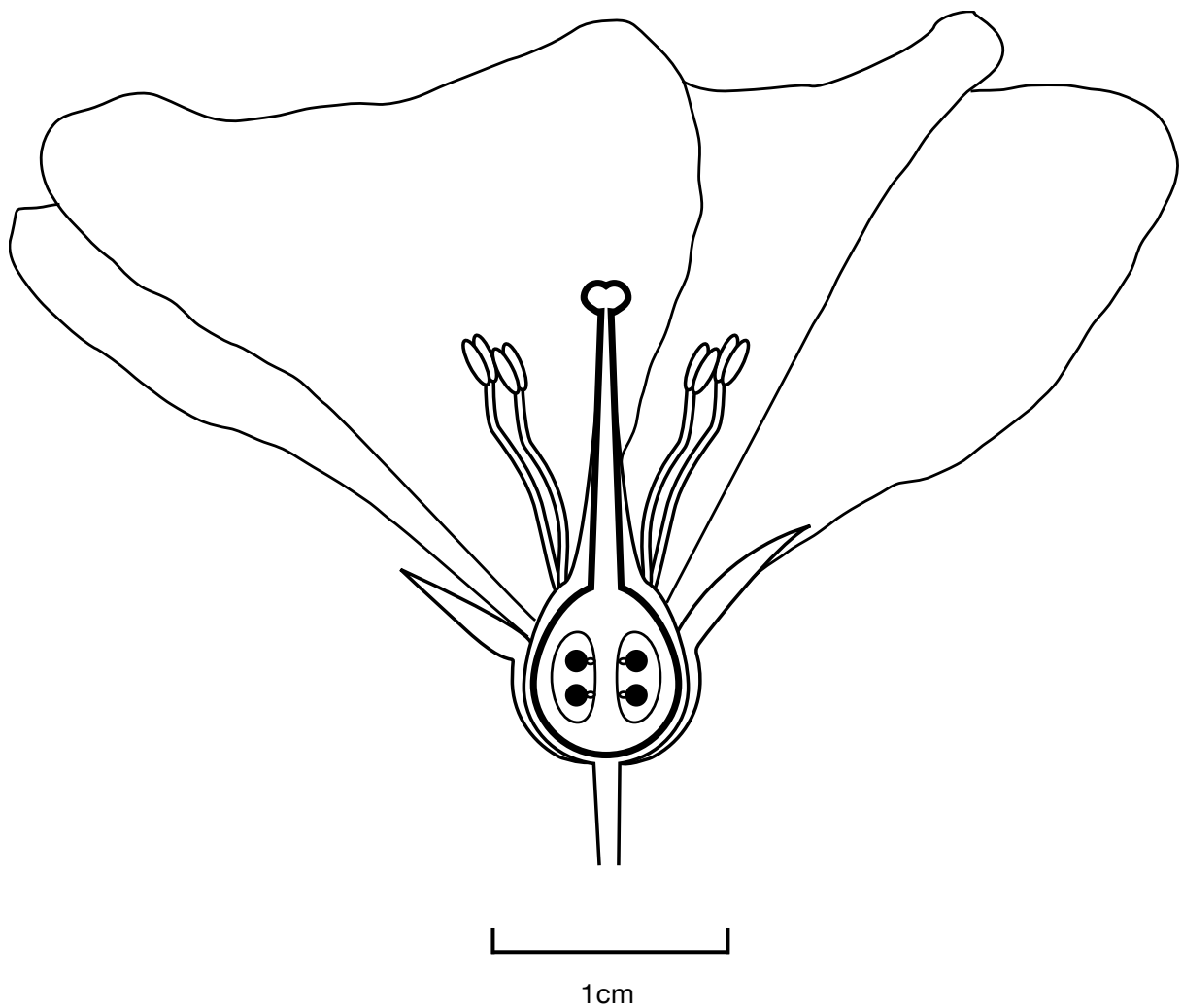
Indigenous perspectives

Native bees are one of the many important pollinators of Australia's unique wildflowers and are a vital part of the Australian bush environment. Indigenous elders have knowledge on where to find different bees, what plants are important to them, where they nest and how seasonality affects bee reproduction and food collecting. Some Indigenous people collect sugarbag (honey) from native bee nests to eat and use the beeswax for many purposes including didgeridoo mouthpieces.

- Explore the role of native bees in the process of pollination of Australian native plants. See www.aussiebee.com.au/beesinyourarea.html
- PrimaryConnections recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the PrimaryConnections website (www.science.org.au/primaryconnections).

Cross section of a flower

Name: _____ Date: _____



AT A GLANCE

To provide students with hands-on, shared experiences of the seeds inside fruits and read about the way fruits develop.

Students:

- observe and draw fruits and the seeds inside them
- read about the way fruits develop from fertilised 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:

- the development of fruits and seeds, and their role in the plant life cycle. You will also monitor their developing science inquiry skills (see page 2).

Key lesson outcomes**Science**

Students will be able to:

- explain that seeds develop within a fruit
- explain that the fruit protects the developing seeds and helps the seeds to be dispersed away from the parent plant.

Literacy

Students will be able to:

- contribute to discussions about the role of fruits in the plant life cycle
- record ideas about fruits and seeds using writing and labelled diagrams.

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

Teacher background information

After fertilisation, the fertilised ovules develop into seeds and the ovary grows larger and ripens into a fruit. The fruit protects the seeds until they have matured, and in many cases help to disperse the seeds away from the parent plant. Plants use many clever mechanisms to disperse their seeds. Bright, tasty fruit is often eaten by animals and birds, which deposit the seeds in their droppings. Some other fruits and seeds are designed to be dispersed by the wind, for example, the delicate, feathery seeds of the dandelion. Species of plants that live near or in water often have floating fruit and seeds adapted to water transportation. Coconuts and the fruit of many mangrove species are good examples.

Note: Botanists have a different meaning for the word ‘fruit’ than is used in everyday language. Botanists consider tomatoes, cucumbers, runner beans and pumpkins to be fruits as they contain seeds.

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of ‘From flowers to fruit’ (Resource sheet 7)
- a factual text about fruits and seed, and one about seed dispersal (see PrimaryConnections website for suggestions)
- 1 knife for cutting fruit
- *optional:* Baker, J. (1995) *The story of rosy dock*. Milsons Point, NSW: Random House
- *optional:* *The private life of plants*, Episode 1: ‘Travelling’. David Attenborough (2003). BBC Worldwide Ltd
- *optional:* 2–3 sheets of A3 paper for a ‘What seed is this?’ chart (see ‘Preparation’)

FOR EACH TEAM

- role badges or wristbands for Director, Manager and Speaker
- each team member’s science journal
- a variety of fruits to be cut open for students to draw
- small trays or plates to rest cut fruit on
- paper towel

Preparation

- Prepare an enlarged copy of ‘From flowers to fruit’ (Resource sheet 7).
- Purchase or ask students to bring in a whole piece of small fruit, such as, an apple, orange, stone fruit, berry or nut or a cut piece of a larger fruit, such as, a melon or pumpkin, with the seeds still inside.
- *Optional:* To familiarise yourself with the information and language, view Episode 1 of *The private life of plants* (see ‘Equipment’). This episode runs for approximately 45 minutes. The first 20 to 25 minutes are particularly useful for this topic.
- *Optional:* Ask students to bring in a seed from home to make a ‘What seed is this?’ chart. The seed might come from students’ gardens or kitchens. Prepare a chart with the following headings:

What seed is this?

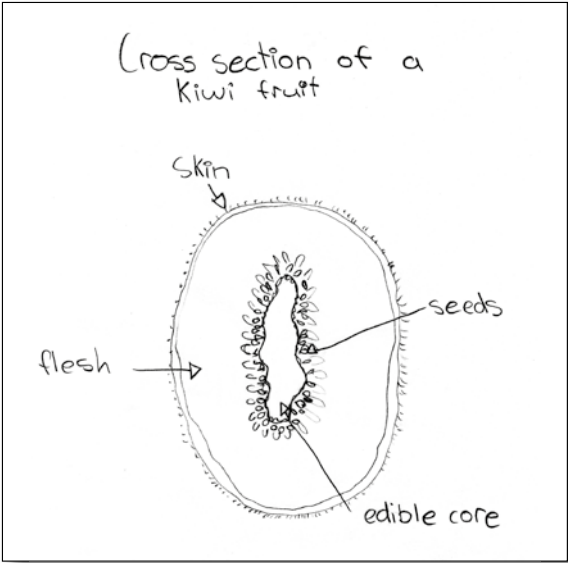
Seed	Name of seed

Note: The first column will contain an actual seed attached to the paper.

Lesson steps



- 1 Review the previous activity in which students investigated flowers and pollination. Ask students what they think might happen after the flower has been pollinated.
- 2 Explain that students will be working in collaborative learning teams to investigate the inside of fruits to look at seeds and their arrangements within the fruit. Review the purpose and features of a cross section (see Lesson 4). Model how to draw a cross section to show the arrangement of the seeds inside a fruit.



Student work sample of a cross section



- 3 Form teams and allocate roles. Ask Managers to collect team equipment.
- 4 Cut and distribute samples of fruit. Ask students to draw cross sections for a number of samples. Teams might swap fruit to investigate a wider range of samples.
- 5 Read a factual text that describes how fruits develop from the fertilised flower. Introduce the information sheet 'From flowers to fruit' (Resource sheet 7) to support the factual text reading.



- 6 Discuss the role of fruit in the plant's life cycle (to protect the seeds until they are ready to be released and to assist in dispersal). Ask students why seeds develop within a

fruit, using questions such as:

- Why are some fruits good to eat?
- How will this help spread the seeds away from the plant?
- Why do the seeds need to be spread away from the plant?



- 7** Lead a discussion about how fruits provide one way that seeds can be spread. Ask students what other ways there are. Prompt them to think about times they might have seen seeds, such as, prickles in their socks or a dandelion they have blown.



- 8** Ask students why plants need to make seeds. Lead a discussion about how the life cycle continues after the parent plant dies, and the cyclical nature of plant development.

- 9** *Optional:* View Episode 1 of 'The private life of plants', pausing often to allow students to record their ideas about what they have seen (see 'Equipment').

- 10** *Optional:* Read or view 'The story of rosy dock', and discuss the effect of imported seeds on local environments (see 'Equipment').

- 11** *Optional:* Use the seeds students have brought in, and/or those found in the cutting and drawing investigation, to create a 'What seed is this?' chart. After students have finished drawing seeds, attach a sample of each seed (where possible) to the chart and record the name of the fruit next to the seed. Invite students to bring other seeds from home to add to the chart.

Curriculum links

Technology

- Students design and test a method of seed dispersal using sunflower or pumpkin seeds, such as, by flight, floating in water, fastening to something.

Information and Communication Technology (ICT)

- Use interactive technology and or digital cameras to record students' cross sections.

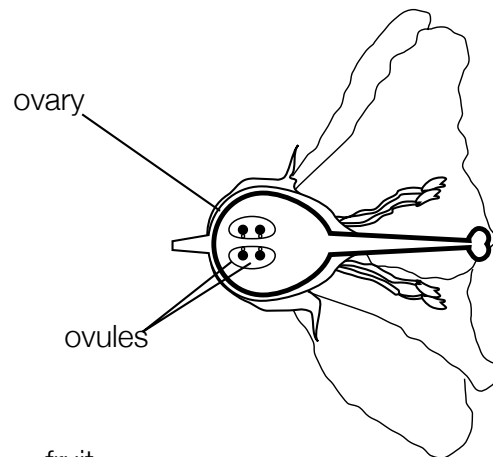
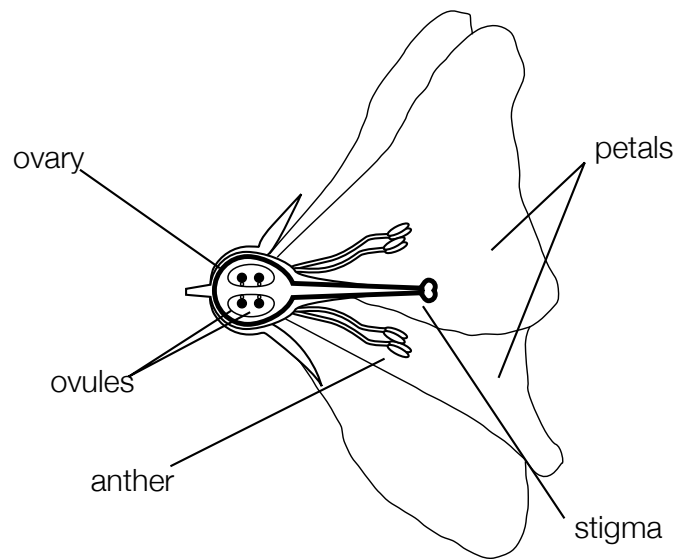


Indigenous perspectives

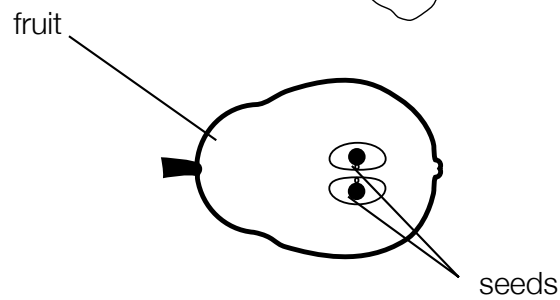
- Research the uses of plants by Indigenous Australians and other cultures. See Clarke, Phillip. (2007) *Aboriginal People and Their Plants*. NSW: Rosenberg Publishing. http://www.anbg.gov.au/gardens/education/programs/pdfs/aboriginal_plant_use_and_technology.pdf and www.museumvictoria.com.au/pages/3286/Twined-Together-post-visit.pdf
- Explore bush tucker and diet by comparing contemporary and traditional Indigenous foods. See Diet and bush tucker at www.det.wa.edu.au/education/abled/apac/lessons/pdfs/APAC154.pdf For information, recipes and activities on all aspects of bush tucker, see <http://www.anbg.gov.au/gardens/education/programs/primary-learning/using-bush-plants.html>
- Watch a family digging for bush potato. See www.australianscreen.com.au/titles/bush-tucker-is-everywhere/clip1
- 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.science.org.au/primaryconnections).

From flowers to fruit

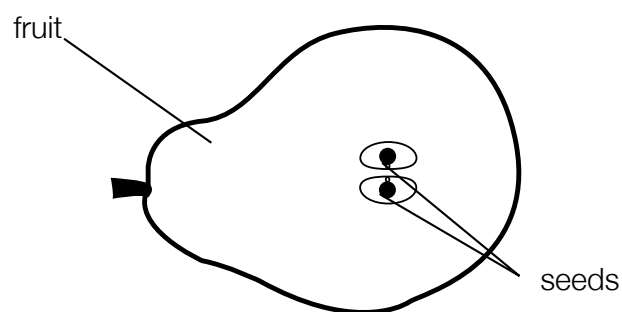
Name: _____ Date: _____



After 10 days



After 30 days



After 60 days

After pollination, the ovary of the flower ripens into a fruit and the ovules develop into seeds.

Lesson 6 Patterns in plants

AT A GLANCE

To support students to represent and explain their understanding and observations of seed germination and the growth of seedlings.

To introduce current scientific views about the life cycles of plants.

Students:

- create timelines of seed germination and the growth of a seedling
- create representations of seed germination and the growth of a seedling
- review their understanding of 'living' and 'not living'.

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.

EXPLAIN

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:

- the structure of seeds, the stages of germination and parts of seedlings during the plant life cycle, and how science involves scientists gathering evidence, recording and representing observations accurately to develop explanations. You will also monitor students' developing science inquiry skills (see page 2).

You are also able to look for evidence of students' use of appropriate ways to represent what they know and understand about the life cycle of flowering plants and give them feedback about how they can improve their representations.

Key lesson outcomes

Science

Students will be able to:

- describe the stages and changes in the germination process
- explain the role of the roots, shoot and leaves of the growing seedling.

Literacy

Students will be able to:

- contribute to discussions about their seed germination investigation
- understand the purpose and features of a timeline
- construct a timeline of the germination and growth of seedlings
- use scientific terms and subject-specific vocabulary appropriately in their writing and in presentations
- make a presentation on a science topic.

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

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart

FOR EACH TEAM

- each team member's science journal
- role badges or wristbands for Director, Manager and Speaker

Preparation

- Select one or more of the representation options below to use in Lesson step 12:
 - Plot a graph showing the increase in root and shoot length.
 - Integrate digital images, such as, diagrams or photographs, with text in a word processing document.
 - Create a PowerPoint presentation.
 - Write a factual narrative text, for example, 'The story of my bean', and illustrate it with photographs or drawings.
- Decide whether the representations will be done by individual students or in teams. Prepare resources and equipment as needed.

Lesson steps

- 1 Review the purpose of the seed germination investigations. Ask questions such as:
 - What have we been investigating about germination of seeds?
 - What have you been observing, measuring and recording?
- 2 Explain that students are going to use their records of observation from the seed germination activity in Lesson 3 to create a representation of seed germination. Model the development of a timeline, for example, 'a day at school' broken into one-hour units.
- 3 Discuss the purpose and features of a timeline.

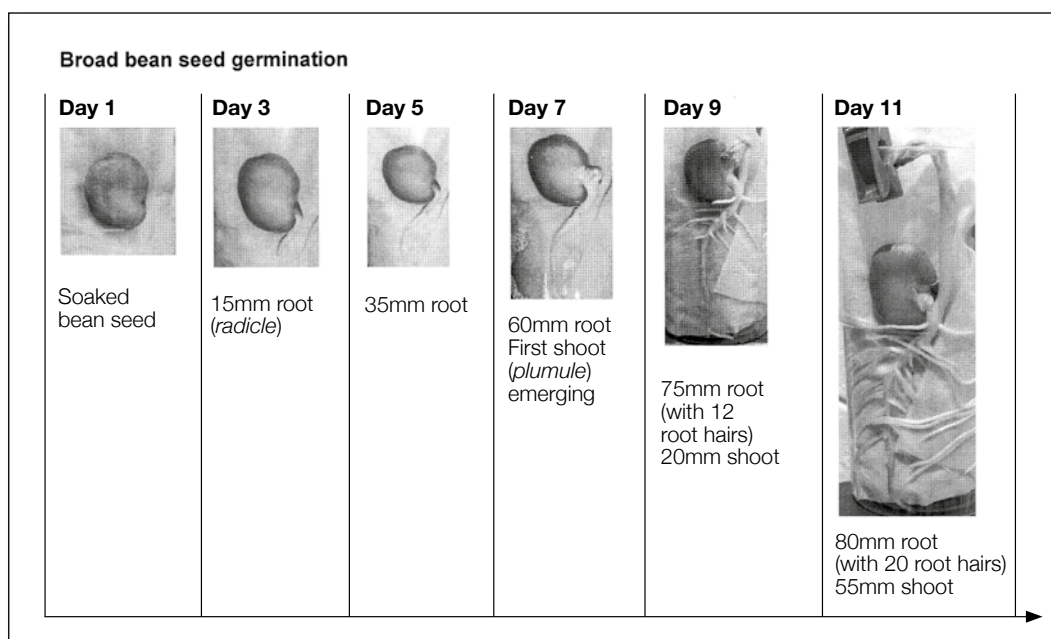
Literacy focus

Why do we use a timeline?

We use a **timeline** to show events in the order they happened.

What does a timeline include?

A **timeline** includes a heading and units of time. Each event is indicated on the timeline using words or symbols.



Student work sample of a timeline

- 4 Lead a discussion about the seed germination activity, focusing on questions such as:
 - What changes to the seed and seedling did you observe?
 - What happened first? What happened second? (and so on).
- 5 After students have completed their timelines, ask them to share them in small groups or with the class. As students share their timelines, ask them to discuss how they are similar or different. As a whole class, discuss questions such as:
 - On which day did the roots generally appear?
 - On which day did the shoots generally appear?
 - Why does the root go down?

- Why does the shoot go up?
 - Where does the seedling get its food from before the plant has leaves and roots?
- 6** Draw students' attention to the words that were added to the word wall during the seed germination activity, such as, seed, root, stem, seed leaf or cotyledon, leaf, seedling. Review the meaning of the words and ask students to review and modify (where necessary) their timelines to include correct vocabulary.
- 7** Update the third and fourth columns of the TWLH chart (What we **L**earned, **H**ow we know).



- 8** Discuss with students where they think the seed fits into the plant life cycle, and why.
- 9** Write the headings 'Living', 'Not living' and 'Not sure' across the board (as for Lesson 2). Ask students to think about what they learned in the 'What's inside a seed?' (Lesson 2) and 'Bean seed germination' (Lesson 3) activities and whether they think a seed is 'living' or 'not living'. Ask them to move so that they are standing with others who have the same idea as they do, such as, 'living' at the back of the room, 'not living' at the front of the room, and 'not sure' in the middle of the room.

This activity is an opportunity for formative assessment of students' understanding of 'living' and 'not living'.



- 10** Ask students in each group to discuss their reasons, and then ask each group to share with the whole class.



- 11** Ask whether students have changed groups since they did this activity in Lesson 2. If so, invite them to describe why they changed. Record responses in the class science journal.

- 12** If any students believe seeds are not living, ask 'What do seeds grow into?'. Review the idea introduced in Lesson 2 that seeds fit under the 'living' heading as they have the potential for growth even though they are currently in a dormant state.



- 13** *Optional:* Explain that students are going to represent the early stages of plant growth. Introduce one or more of the following representation options:

- Plot a graph showing the increase in root and shoot length. Discuss the purpose and features of a graph.

Literacy focus

Why do we use a graph?

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

What does a graph include?

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

- Integrate digital images, such as, diagrams or photographs, with text in a word processing document.
- Create a PowerPoint presentation.
- Write a factual narrative text, for example, 'The story of my bean', and illustrate it with photographs or drawings. Discuss the purpose and features of a narrative.

Literacy focus

Why do we use a narrative?

We use a **narrative** to tell the story of connected events. It is often used to entertain and inform the audience.

What does a narrative include?

A **narrative** might be spoken or in written form and might include pictures or props.

Invite students to select which of the available options they will use to represent the early stages of plant growth. Provide students with the necessary equipment so that they can work individually or in teams.



- 14 *Optional:* Arrange for students to share their representations with an audience, such as, another class or at a school assembly.
- 15 *Optional:* Invite a guest speaker, such as the school gardener, local nursery person or garden enthusiast.

Curriculum links

Mathematics

- Plot graphs to represent other data about seed germination and seedling growth.

Information and Communication Technology (ICT)

- Combine digital images with word processing.
- Use digital images in PowerPoint presentations.
- Plot graphs using spreadsheets.



Indigenous perspectives

- Discuss Indigenous peoples' use of wattles. See www.anbg.gov.au/gardens/education/programs/pdfs/aboriginal-use-of-wattles.pdf
- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website (www.science.org.au/primaryconnections).

Lesson 7

Investigating conditions for plant growth

AT A GLANCE

To support students to plan and conduct an investigation of the conditions that affect plant growth.

Students:

- discuss conditions that affect plant growth
- learn how to write questions for investigation
- work in collaborative learning teams to plan and set up an investigation of the conditions that affect plant growth
- observe and record the results of their investigations.

Lesson focus

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

Assessment focus



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

Key lesson outcomes

Science

Students will be able to:

- identify conditions that affect plant growth
- with support, develop a question to investigate conditions that affect plant growth
- make a prediction about the effect of a variable on plant growth
- with support, plan an investigation that incorporates a control and fair testing
- describe conditions plants require for growth.

Literacy

Students will be able to:

- use language and visual representations to design and record an investigation into the conditions that affect plant growth
- record observations.

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

Teacher background information

To grow and thrive, plants need certain conditions in their environment. Like animals, they need water to survive. They also require light and carbon dioxide from the air. Green plants cannot grow in complete darkness because, without energy from light, they cannot make food. The process of photosynthesis relies on water, carbon dioxide from the air and light energy; plants use these components to produce carbohydrates and oxygen.

Plants also need minerals that they absorb through their roots. Usually nutrients come from the soil, but they can also be applied artificially as fertiliser or in liquid form for hydroponic gardens.

Plants will grow well only within the temperature range they are adapted to. A plant that is too hot or too cold will not thrive.

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'Plant growth investigation planner' (Resource sheet 8)
- water and water spray bottles

FOR EACH TEAM

- role badges or wristbands for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Plant growth investigation planner' (Resource sheet 8) per team member
- fast-growing plant seeds (eg, cress or wheat)
- $\frac{1}{4}$ teaspoon measure
- cotton wool or paper towel
- 1 small container (eg, patty pan or egg carton)
- 1 name peg or name label per team member
- 1 magnifying glass
- *optional*: soil $\frac{1}{2}$ cup per container as required
- *optional*: sand $\frac{1}{2}$ cup per container as required

Preparation

- Read 'How to write questions for investigation' (Appendix 5).
- Read 'How to conduct a fair test' (Appendix 6).
- Prepare an enlarged copy of 'Plant growth investigation planner' (Resource sheet 8).

Lesson steps



- 1 Review the unit activities and ask questions such as:

- What conditions would the seeds need to keep growing into an adult plant?
- What things might slow or stop plant growth?
- How could we find out?

Use students' answers to make a list of things that might affect plant growth, such as, light, water, soil and temperature. Introduce the term 'variables' as things that can be changed, measured or kept the same in an investigation. Explain that when a variable is kept the same it is said to be 'controlled'.

Explain that students will work in collaborative learning teams to determine what effect one of these things has on plant growth.



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

- What happens to plant growth when we change the amount of light?
- What happens to plant growth when we change the type of soil?
- What happens to plant growth when we change the temperature?



- 3 Explain how to use the 'Plant growth investigation planner' (Resource sheet 8). For example, students might plan to investigate 'What happens to a plant's growth when we change the amount of light it receives?'. For their investigation, students then determine what they will:

- **Change:** amount of light
- **Measure/Observe:** such as, plant height, number of leaves, colour of leaves, number of plants growing
- **Keep the same:** type of soil, amount of water, temperature, type of seeds.







- 4 Ask students:

- How could you test whether light is needed for plant growth? (By taking away light and then comparing seedlings grown in the dark with seedlings grown in the light.)
- How could you test whether soil is needed for plant growth? (By taking away soil and then comparing seedlings grown in soil with those grown in cotton wool or paper.)
- How could you test whether warmth is needed for plant growth? (By taking away warmth and then comparing seedlings grown in the cold with seedlings grown in warm conditions.)
- How could you test if water is needed for plant growth? (By taking away water and then comparing seedlings grown in dry conditions with seedlings grown in moist conditions.)

- 5 Students will need to compare plant growth without one factor, for example, water, and control plants grown under what they think are ideal conditions. Ask them:

- What ideal conditions do you think are needed for the control plants? (Air, moisture, warmth and soil.)

Each team will need to set up two sets of plants: test plants lacking one ideal condition and control plants under ideal conditions.

- 6 Ask each team to decide what question they are going to investigate. Ask each student to complete an investigation planner.
- 7 Explain that wheat or cress seeds grow quickly and will allow students to see results in a short time. Introduce the equipment and materials they will be able to use.
- 8 Form teams and allocate roles. Ask team Managers to collect team equipment.
-  9 Ask teams to set up their team investigations.
-  10 Organise students to use their science journals to record observations using words, measurements and diagrams. Organise daily observation at the same time each day, and include team discussion and recording time.
-   11 After a period of time, for example, seven to ten days, have students review their investigation observations and complete their investigation planner, recording their findings and conclusions. Share team findings with the class. The completed investigation planner provides a work sample for summative assessment of the investigation outcomes.
- 12 Update the TWLH chart and the word wall with words and images.

Curriculum links

Information and Communication Technology (ICT)

- Use interactive technology and/or digital cameras to represent investigation data.



Indigenous perspectives

Some Indigenous people use fire to manage the land with systematic burning used to promote new plant growth and to force animals out into the open for hunting. Smokey fires are used to attract birds of prey and to conceal hunters.

- Research fire management and firestick farming for plant regeneration. See http://members.ozemail.com.au/~mmichie/engag_envir.htm www.environment.org.au/learn/Burning-Issues-Online/BurningIssues.html
- 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.science.org.au/primaryconnections).

Plant growth investigation planner

Student 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
Write and draw your observations in your science journal		

Presenting results

Can you show your results in a graph?									

Explaining results

When you changed what happened to the seed's growth?

Why did this happen?

Did the results match your prediction?

Evaluating the investigation

What challenges did you experience doing this investigation?

How could you improve this investigation?
(fairness, accuracy)

Lesson 8 Plant life cycle

AT A GLANCE

To provide opportunities for students to represent what they know about how living things, such as plants, have life cycles, and to reflect on their learning during the unit.

Students:

- arrange and annotate pictures to represent the sequence of events in a flowering plant life cycle
- review the unit by using the science journal, word wall, TWLH chart and other resources developed during the unit
- 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:

- the parts and life cycle of flowering plants.

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

Key lesson outcomes

Science

Students will be able to:

- describe and explain the relationships between the stages (seed, seedling, adult plant, flower and fruit) and processes (germination and pollination) that make up the plant life cycle
- recognise that the stages in the plant's life form a cycle rather than a linear sequence
- describe conditions plants require for growth.

Literacy

Students will be able to:

- contribute to discussions about plant life cycles
- use correct scientific terms and subject-specific vocabulary
- reflect on their learning through a science journal entry.

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

Equipment

FOR THE CLASS

- class science journal
- word wall
- TWLH chart
- 1 enlarged copy of 'Procedure: Bean seed germination' (Resource sheet 5)

FOR EACH STUDENT

- each team member's science journal
- 1 copy of 'Plant life stages jumble' (Resource sheet 1)
- *optional*: 1 copy of 'Procedure jumble: Bean seed germination' (Resource sheet 9)

Preparation

- Prepare an enlarged copy of 'Procedure: Bean seed germination' (Resource sheet 5).
- *Optional*: Preview the interactive crossword 'The life cycle of flowering plants' on the PrimaryConnections website.

Lesson steps



- 1 Review the 'Plant life stages jumble' from Lesson 1 where students arranged pictures to represent stages in a plant's life. Explain that they are going to do this activity again to show how much they have learned.
- 2 Provide each student with a new copy of the 'Plant life stages jumble' (Resource sheet 1). Ask them to cut out the pictures and glue them into their science journals in the order they think best represents a flowering plant's life.

Note: As in the *Engage* lesson, do not prompt students to place them in a cycle as this is an assessment task.

Plants in Action

Name: _____

During Term 1 we learnt a great deal about the germination of a seed. Using the Life Cycle jumble sheet, prepare a presentation to represent a flowering plant's life cycle. You need to include as much information as you can, to show all that you have learnt about seeds and plants. (Your presentation must be neatly set out)

The bean is now finished!
The bean has the leaves, a stalk and lovely green beans. Inside the bean is a seed and if you replant the bean seeds a new life cycle begins.



The stamen is lots of tubes which has pollen on the end and that's where the bee and insects collect most of its pollen.



The bright and colourful petals attract the bees and other insects to the one flower.

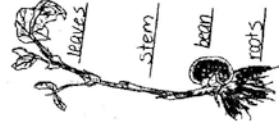


This is the bean to start off with. The seed is not dead but the seed is dormant which means the bean is sleeping. It needs

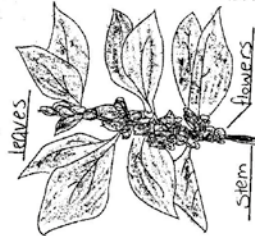


The seed now has a radicle which is the first root.

An animal or insect pollinates a plant by putting pollen on their feet and nose feeds more pollen to another plant.



The bean is still on but the plant now has a stalk, leaves and a root.



Then came the flowers of the bean and the seed coat fell off and the leaves got bigger.

The plant needs water, clean soil, sunlight, shade and lots of care to grow.



The seed has now fully opened up and the root has

grown longer. The root looks like it has spikes on it but it is growing more roots. The bean is now growing a first leaf, called a plumule.

A Bean Life Cycle

Student work sample showing the life cycle of a flowering plant

- 3 Ask students to label the pictures to show the parts of the plant, and write about what is happening to the plant at each stage. Ask them to include arrows that link the pictures into a sequence (cycle), with words written on the arrows naming processes such as germination, growth and pollination.

- 4 *Optional:* 'Procedure jumble: Bean seed germination' (Resource sheet 9)
Remind students about the bean seed germination activity. Ask them to imagine that another class is thinking of doing this activity, and they will need to prepare instructions for the others to follow.

Review the features of a procedural text (see Lesson 3), using an enlarged copy of the 'Procedure: Bean seed germination' (Resource sheet 5) as an example. Record the headings (aim, equipment, steps) on the board to help students as they unjumble the steps.

Provide each student with their own copy of 'Procedure jumble: Bean seed germination' (Resource sheet 9) and ask them to cut this up and arrange the strips in the correct order. Ask students to glue the strips into their science journals, adding headings as they go like those in 'Procedure: Bean seed germination' (Resource sheet 5).

- 5 Review the TWLH chart to identify what students have learned and the observations made during the unit that show how we know these things.

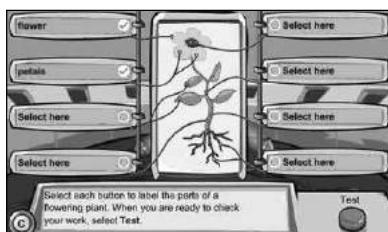
- 6 Ask students to read through their science journals and review the unit's activities. Ask them to write a journal entry reflecting on the unit. You might provide them with a set of questions to guide their reflections, such as:

- What new things did you learn during this unit?
- What was an activity you enjoyed doing? Why?
- What was an activity you would like to change? Why?
- What did you learn about working with others when you were in your teams?

Curriculum links

Information and Communication Technology (ICT)

- Use interactive crossword puzzle *The life cycle of flowering plants* on the Primary**Connections** website (see Curriculum Resources: Plants in Action: Other).



The Le@rning Federation

(www.thelearningfederation.edu.au)

Plant scan, Curriculum Corporation, 2004. The Le@rning Federation learning object L31.

Students undertake a quiz on plant parts and functions. They label features of plants and match the correct function with plant parts.

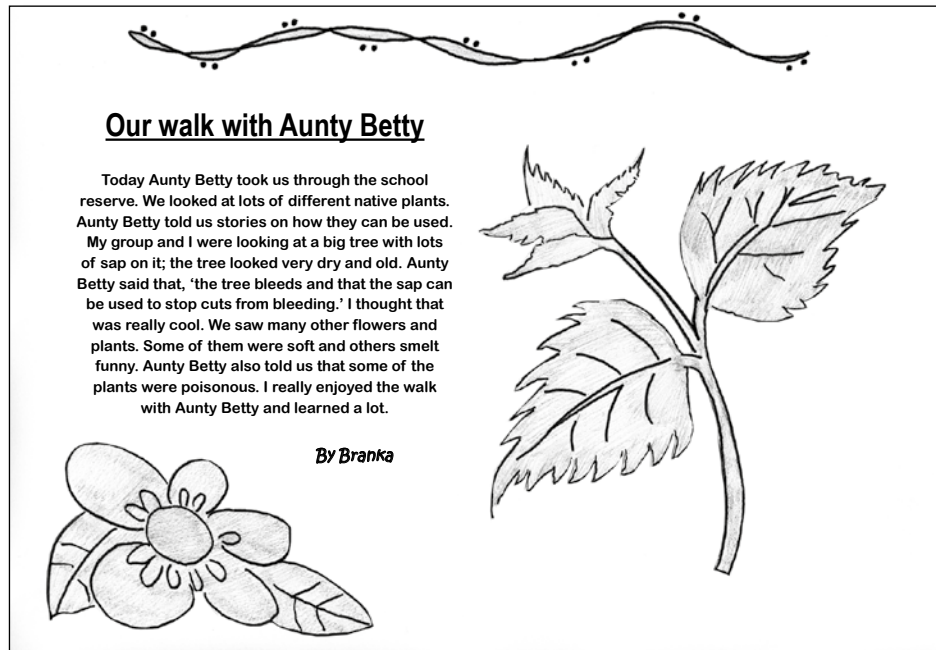


Indigenous perspectives

- Complete a web quest on Indigenous peoples' use of Australian native plants. See <http://science.uniserve.edu.au/school/quests/nativeplants.html>
- Use story telling, creative writing or role-play to demonstrate understanding of Indigenous peoples' use of Australian native plants.

See: <http://www.anbg.gov.au/gardens/visiting/exploring/walks/aboriginal-trail/index.html>

http://www.anbg.gov.au/gardens/education/programs/pdfs/aboriginal_plant_use_and_technology.pdf



Student work sample of a recount

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

Procedure jumble: Bean seed germination

Name: _____ Date: _____



Fold one sheet of paper towel in half and line the plastic cup with it.



Put your bean seed in the plant nursery.



For each team member

- 1 science journal
- 1 ruler
- 1 lead pencil
- 1 eraser



Scrunch two sheets of paper towel and put them in the middle of the cup to hold the paper lining firm against the sides of the cup.



Procedure: Bean seed germination



Label your cup.



When your teacher gives the instruction, pour water into the centre of the cup.



For each team

- role badges for director, manager and speaker
- 1 copy of 'Procedure: Bean seed germination' (Resource sheet 5)
- 3 plastic cups
- 3 sheets of paper towel for each cup
- 3 pegs or labels
- 1 magnifying glass
- 3 soaked bean seeds



To observe and record the germination and early growth stages of a bean seed.



Place the seed in between the paper lining and the cup.



Appendix 1

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

Introduction

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

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

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

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

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

Team structure

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

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

Team roles

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

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

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

Manager

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

Speaker

The Speaker is responsible for asking the teacher or another team's Speaker for help. If the team cannot resolve a question or decide how to follow a procedure, the Speaker is the only person who might leave the team and seek help. The Speaker shares any information they obtain with team members. The teacher might 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

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

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

TEAM SKILLS

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

Appendix 2

How to use a science journal

Introduction

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

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

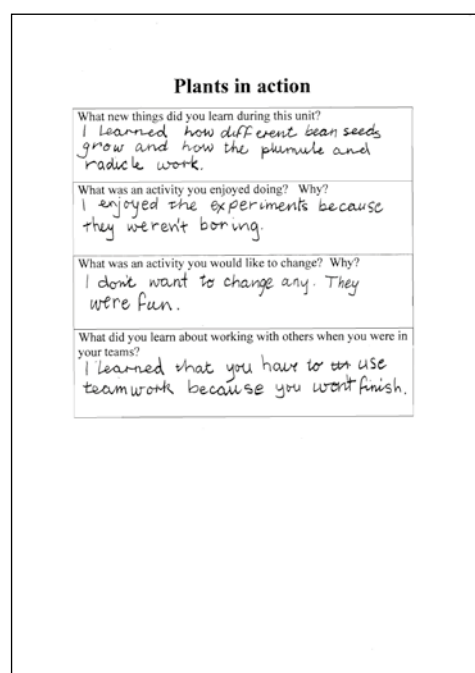
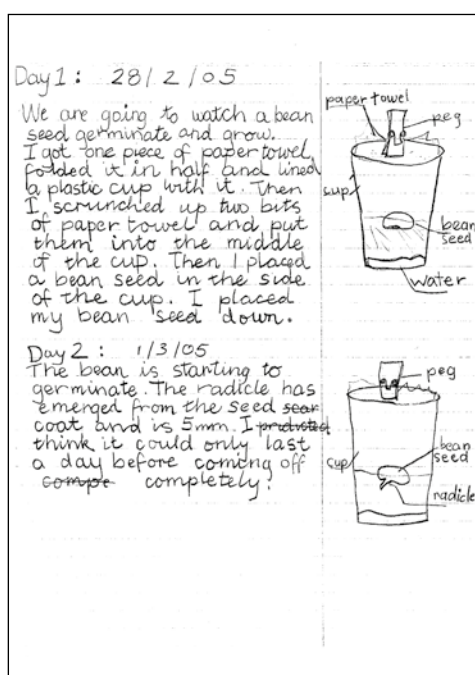
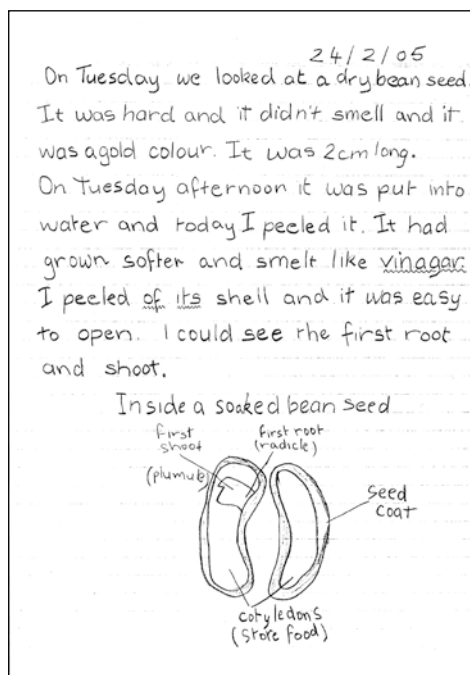
Monitoring students' journals allows you to identify students' alternative conceptions, find evidence of students' learning and plan future learning activities in science and literacy.

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

Using a science journal

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

- 7 Combine the use of resource sheets with journal entries. After students have pasted their completed resource sheets in their journal, they might like to add their own drawings and reflections.
- 8 Use the science journal to assess student learning in both science and literacy. For example, during the *Engage* phase, use journal entries for diagnostic assessment as you determine students' prior knowledge.
- 9 Discuss the importance of entries in the science journal during the *Explain* and *Evaluate* phases. Demonstrate how the information in the journal will help students develop literacy products, such as posters, brochures, letters and oral or written presentations.



Plants in action science journal

Appendix 3

How to use a word wall

Introduction

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

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

Goals in using a word wall

A word wall can be used to:

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

Organisation

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

Choose robust material for the word cards. Write or type words on cardboard and perhaps laminate them. Consider covering the wall with felt-type material and backing each word card with a self-fastening 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.

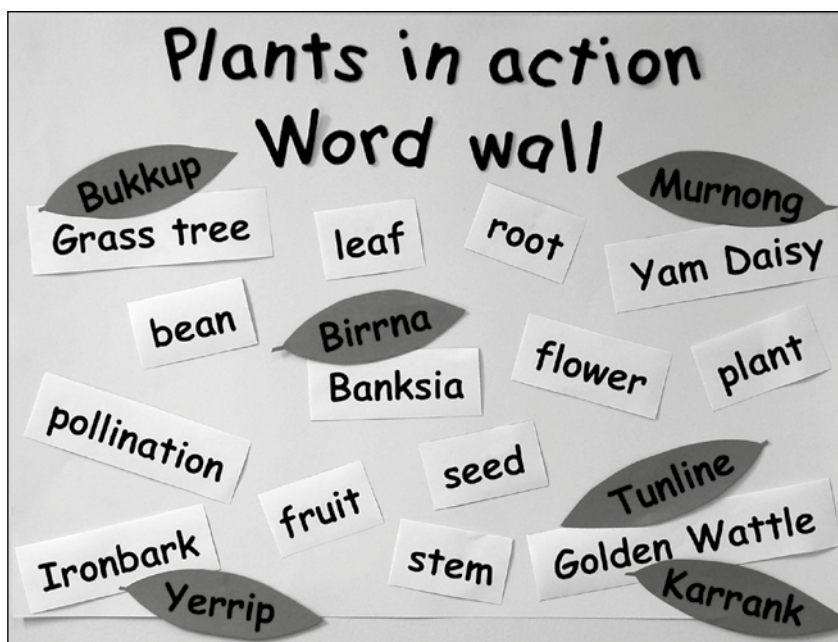
The purpose is for students to be exposed to a print-rich environment that supports their science and literacy experiences.

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 the *Plants in action* unit might be organised using headings, such as 'Parts of a plant', 'Stages in plant growth', 'Germination' and 'What plants need to grow'.

Invite students to contribute different words from different languages to the word wall. Group words about the same thing, for example, the different parts of a plant on the word wall so that the students can make connections. Identify the different languages used, such as, using different coloured cards or pens to record the words.

A large circular display titled "WORD WALL" in large, bold, black letters. The circle is filled with numerous small white cards, each containing a word and a simple drawing. The words are arranged in a grid-like pattern. The display is decorated with colorful streamers and tinsel at the bottom.

- 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 individually during literacy experiences. Organise multi-level activities to cater for the individual needs of students.



Appendix 3 73

Appendix 4

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.

Plants in action 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?)
<p>We think that plants need water and soil to grow.</p> <p style="text-align: right;">➔</p>	<p>What conditions do plants need to grow?</p> <p style="text-align: right;">➔</p>	<p>Plants need air, water, warmth, soil and light to grow.</p> <p style="text-align: right;">➔</p>	<p>In our investigation we grew cress. Cress grew well when it had water, light, air and soil.</p> <p>The cress did not grow well if any of those conditions were missing, for example, no water or no light.</p>

Appendix 5

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, measured 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 *Plants in action* refers to two things (variables) and the relationship between them—for example, an investigation of the things (variables) that affect plant growth might consider the effect of light or soil type. The question for investigation could be:

Q1: What happens to plant growth when we change the amount of light?

In this question, *plant growth* depends on *light*. Sunlight is the thing that is **changed** (independent variable) and plant growth is the thing that is **measured or observed** (dependent variable).

Q2: What happens to plant growth when we change the soil type?

In this question, *plant growth* 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).

An example of the way students can structure questions for investigation in *Plants in action* is:

What happens to _____ when we change _____?

dependent variable **independent 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 plant growth?’

- Use questioning to elicit the things (**independent variables**) students think might affect the **dependent variable** (for example, plant growth).

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 plant growth when we change the temperature?’ or ‘What happens to plant growth 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 6

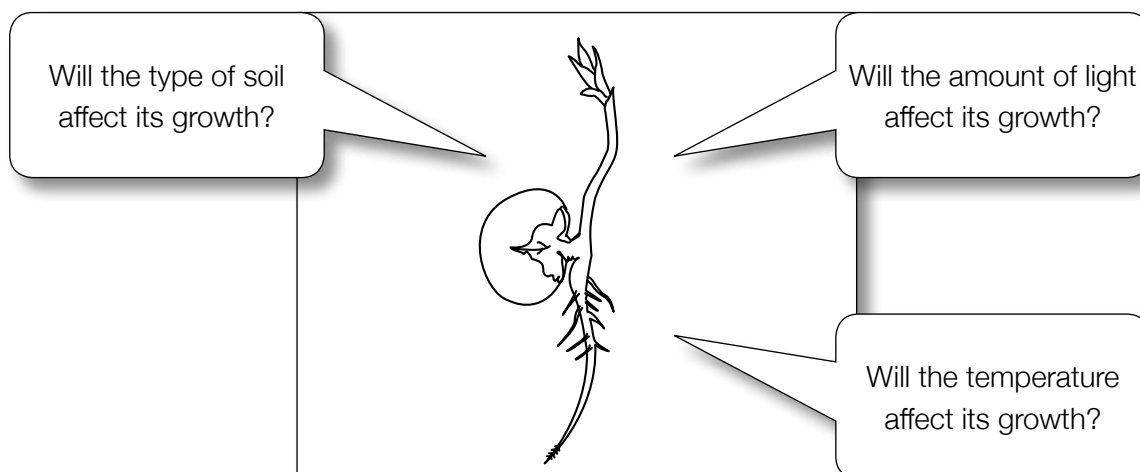
How to conduct a fair test

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 *Plants in action*, students investigate the things that affect plant growth.



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.

‘Cows **Moo** Softly’ is a useful scaffold to remind students how to plan a fair test:

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

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

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

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

CHANGE	the amount of light each plant receives	Independent variable
MEASURE/ OBSERVE	plant growth	Dependent variable
KEEP THE SAME	the amount and type of soil, the water and the fertiliser	Controlled variables

Appendix 7

Plants in action equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	3	4	5	6	7	8
		SESSION	1	2							
Equipment and materials											
carry bag	1 per Garden Buddy			●							
containers											
Book: Baker, J. The story of rosy dock. optional	1 per class							●			
– box or bag, large, opaque	1 per class		●								
– container, small (eg, patty pan or egg carton)	1 per team									●	
DVD. The private life of plants Attenborough, David (BBC Worldwide Ltd, 2003, DVD optional)	1 per class						●	●			
– plant nursery (eg, tray or box lid (large enough for each teams’ plastic cups)	1 per team					●					
– plastic container, small, for disposable camera	1 per Garden Buddy			●							
– tray, small to hold flower or fruit samples	1 per team						●	●			
cotton-wool (or paper towel)	1 piece per cup									●	
disposable camera	1 per Garden Buddy			●							
journal (eg, A4 scrapbook)	1 per Garden Buddy			●							
knife	1 per class							●			
magnifying glass	1 per team				●		●			●	
paper/cardboard A3 optional	3 sheets per class			●				●			
paper towel	3 sheets per team				●			●			
paper towel	3 sheets per cup					●					
pegs or labels for identification	3 per team					●				●	

EQUIPMENT ITEM	QUANTITIES	LESSON	1	1	2	3	4	5	6	7	8
			1	2							
Equipment and materials (continued)											
plant materials											
– dry bean seeds	3 per team (lesson 2) 1 per student (lesson 3)			•	•	•					
– dry bean seeds cut open (eg, red kidney or borlotti beans)	3 per team			•							
factual text about flowers and pollination	1 per class						•				
factual text about fruits and seeds, seed dispersal	1 per class							•			
– flower samples	2 per student						•				
– fruits - a variety to be cut open for students to draw	collection per team							•			
– mixed flowers, including those that clearly show the pistil and stamen (eg, daffodils, lily, tulip)	collection per class						•				
– plant items (eg, roots, stems, branch, leaves, seeds, small seedlings, larger plant, flowers, fruit)	collection per class		•								
– plants seeds, fast growing (eg, cress or wheat)	sufficient quantity per team									•	
pollination animation (Science background Resource, or online, Primary Connections website)	1 per class						•				
– soaked bean seeds	3 per team				•						
– soaked bean seeds (recommend plant seeds as these are more likely to germinate)	1 per student					•					
plastic cups, clear	3 per team					•					
¼ teaspoon measure	1 per team									•	
sand optional	½ cup measure per cup									•	
soft toy	1 per garden buddy			•							
soil optional	½ cup measure per cup									•	
toothpicks	6 per team						•				
tweezers	1 per team						•				
water spray bottles	2 per class									•	

EQUIPMENT ITEM	QUANTITIES	LESSON		1	1	2	3	4	5	6	7	8
		SESSION		1	2							
Resource sheets												
'Plant life stages jumble' (RS1)	1 per student		•									•
'Information note for families' (RS2) <i>optional</i>	1 per student			•								
'Garden Buddy's visit task list' (RS3) <i>optional</i>	1 per student			•								
'Observation record: Exploring seeds' (RS4)	3 per team				•							
'Observation record: Exploring seeds' (RS4), enlarged	1 per class				•							
'Procedure: Bean seed germination' (RS5)	1 per team					•						
'Procedure: Bean seed germination' (RS5), enlarged	1 per class					•						•
'Cross section of a flower' (RS6), enlarged	1 per class							•				
'Cross section of a flower' (RS6)	1 per team							•				
'From flowers to fruit' (RS7), enlarged	1 per class								•			
'Plant growth investigation planner' (RS8)	1 per team member										•	
'Plant growth investigation planner' (RS8), enlarged	1 per class										•	
'Procedure jumble: Bean seed germination' (RS9), enlarged	1 per class											•
'Procedure jumble: Bean seed germination' (RS9) <i>optional</i>	1 per student											•
Teaching Tools												
class science journal	1 per class		•		•		•	•	•	•	•	•
collaborative learning role badges	1 set per team				•		•	•	•	•	•	
collaborative learning team roles chart	1 per class				•		•	•	•	•	•	
collaborative learning team skills chart	1 per class				•		•	•	•	•	•	
student science journal	1 per student		•		•		•	•	•	•	•	•
TWLH chart	1 per class		•		•		•	•	•	•	•	•
word wall	1 per class		•		•		•	•	•	•	•	•
Multimedia												
Digital camera <i>optional</i>	1 per class						•					

Appendix 8

Plants in action unit overview

	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY		ASSESSMENT OPPORTUNITIES
ENGAGE	<p>Students will be able to represent their current understandings as they:</p> <ul style="list-style-type: none"> • represent stages in the life cycle of flowering plants • label parts of a plant: root, stem, leaves, flowers, fruit. 	<p>Students will be able to:</p> <ul style="list-style-type: none"> • contribute to discussions about plants • understand the purpose and features of a labelled diagram • create a labelled diagram • contribute to the commencement of a TWLH chart and word wall • record ideas in a science journal. 	<p>Students:</p>		
	<p>Lesson 1 What goes where?</p> <p>Session 1 Plant life stages jumble</p> <p>Session 2 Garden Buddies (optional)</p>		<p>Session 1 Plant life stages jumble</p> <ul style="list-style-type: none"> • discuss a 'mystery box' of plant items and raise ideas about the relationships between them • arrange pictures to represent the life cycle of flowering plants • create a list of plant words to develop a word wall • discuss students' ideas and questions for a TWLH chart. <p>Session 2 Garden Buddies (optional)</p> <ul style="list-style-type: none"> • observe, record and report on plants growing in their garden, and the jobs and activities done in the garden. 		<p>Diagnostic assessment</p> <ul style="list-style-type: none"> • 'Plant life stages jumble' (Resource sheet 1) • Plant life cycle • Labelling • Science journal entries • Garden Buddy's journal entry. • Garden Buddy's oral presentation • 'Information note for families' (Resource sheet 2) • 'Garden Buddy's visit task list' (Resource sheet 3)

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

EXPLORE		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
Lesson 2 What's inside a seed?		<ul style="list-style-type: none"> observe and describe features of seeds and record observations compare dry and soaked seeds and describe the changes brought about by soaking. 	<ul style="list-style-type: none"> identify the purpose and features of a table use a table to record observations create a labelled diagram of a bean seed represent their ideas about plants in their science journal. 	<ul style="list-style-type: none"> discuss seeds work in teams to record observations of a dry bean seed work in teams to record observations of a soaked bean seed label a diagram of the inside of a bean. 	Formative assessment <ul style="list-style-type: none"> Science journal entries 'Observation record: Exploring seeds' (Resource sheet 4)
Lesson 3 Bean seed germination		<ul style="list-style-type: none"> make observations and measurements of seed germination contribute to planning structured formats for recording measurements and observations describe how the orientation of a planted seed affects the growth of the root and shoot when the seed germinates. 	<ul style="list-style-type: none"> contribute to discussions about seed germination understand the purpose and features of a procedural text use a procedural text for investigation record observations of seed germination using a labelled diagram. 	<ul style="list-style-type: none"> explore packaged bean seeds read and discuss a procedural text for a bean seed germination activity work in teams to prepare bean seeds make ongoing observations and recordings of bean seed germination. 	Formative assessment <ul style="list-style-type: none"> Science journal entries 'Procedure: Bean seed germination' (Resource sheet 5)

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EXPLORE		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
Lesson 4 Flowers and pollination		<ul style="list-style-type: none"> accurately draw and label a diagram of a flower explain the role of the flower and pollination in forming seeds and fruit describe how a flower changes into a fruit containing seeds. 	<ul style="list-style-type: none"> contribute to discussions about flowers and pollination create a labelled diagram of a flower read and view factual texts identify and recall key ideas in factual texts understand the purpose and features of a cross section diagram construct a cross section diagram of a flower. 	<ul style="list-style-type: none"> explore the parts of a flower draw and label a diagram of a flower read a factual text about the parts of a flower read a factual text about pollination. 	Formative assessment <ul style="list-style-type: none"> 'Cross section of a flower' (Resource sheet 6) Labelled diagram Cross section diagram
Lesson 5 Flower, fruits and seeds		<ul style="list-style-type: none"> explain that seeds develop within a fruit explain that the fruit protects the developing seeds and helps the seeds to be dispersed away from the parent plant. 	<ul style="list-style-type: none"> contribute to discussions about the role of fruits in the plant life cycle record ideas about fruits and seeds using writing and labelled diagrams. 	<ul style="list-style-type: none"> observe and draw fruits and the seeds inside them read about the way fruits develop from fertilised flowers. 	Formative assessment <ul style="list-style-type: none"> Science journal entries 'From flowers to fruit' (Resource sheet 7)

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	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
EXPLAIN Lesson 6 Patterns in plants	Students will be able to:	Students will be able to:	Students:	Formative assessment <ul style="list-style-type: none"> • Representation(s) of early plant growth • Living/non-living beliefs grouping
	<ul style="list-style-type: none"> • describe the stages and changes in the germination process • explain the role of the roots, shoot and leaves of the growing seedling. 	<ul style="list-style-type: none"> • contribute to discussions about their seed germination investigation • understand the purpose and features of a timeline • construct a timeline of the germination and growth of seedlings • use scientific terms and subject-specific vocabulary appropriately in their writing and in presentations • make a presentation on a science topic. 	<ul style="list-style-type: none"> • create timelines of bean seed germination and growth of a seedling • create representations of seed germination and the growth of a seedling • review their understanding of 'living' and 'not living'. 	

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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 7 Investigating conditions for plant growth	<ul style="list-style-type: none"> • identify conditions that affect plant growth • with support, develop a question to investigate conditions that affect plant growth • make a prediction about the effect of a variable on plant growth • with support, plan an investigation that incorporates a control and fair testing • describe conditions required for growth by plants. 	<ul style="list-style-type: none"> • use language and visual representations to design and record an investigation into the conditions that affect plant growth • record observations. 	<ul style="list-style-type: none"> • discuss conditions that affect plant growth • learn how to write questions for investigation • work in collaborative learning teams to plan and set up an investigation of the conditions that affect plant growth • observe and record the results of their investigations. 	Summative assessment of Science Inquiry Skills <ul style="list-style-type: none"> • Investigation of conditions for plant growth • 'Plant growth investigation planner' (Resource sheet 8)

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EVALUATE				
Lesson 8 Plant life cycle	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
	Students will be able to:	Students will be able to:	Students:	
	<ul style="list-style-type: none">describe and explain the relationships between the stages (seed, seedling, adult plant, flower and fruit) and processes (germination and pollination) that make up the plant life cyclerecognise that the stages in the plant's life form a cycle rather than a linear sequencedescribe conditions plants require for growth.	<ul style="list-style-type: none">contribute to discussions about plant life cyclesuse correct scientific terms and subject-specific vocabularyreflect on their learning through a science journal entry.	<ul style="list-style-type: none">arrange and annotate pictures to represent the sequence of events in a plant life cyclereview the unit by using the science journal, word wall, TWLH chart and other resources developed during the unitreflect on their learning during the unit.	Summative assessment Science Understanding <ul style="list-style-type: none">Plant life stages jumble with labels and cycle arrows'Plant life stages jumble' (Resource sheet 1)Procedure jumble'Procedure jumble: Bean seed germination' (Resource sheet 9)

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