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The
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astronomer, Professor
Brian Schmidt,
2011 Nobel Laureate

Feathers, fur or leaves?

Year 3

Biological sciences



PrimaryConnections project

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Professional learning program

The Primary**Connections** program includes a sophisticated professional learning component and exemplary curriculum resources. Research shows that this combination is more effective than using each in isolation.

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

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

www.science.org.au/primaryconnections

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Feathers, fur or leaves?

Year 3

Biological sciences



What is that? Is it alive? How is it like other things I know? Humans have always sought to make sense of the world around them by grouping things they see, for example, as edible, threatening or useful. Scientists develop classification systems to try to understand the diversity of life and how species are related throughout history. As more and more species disappear from the face of the Earth, we are caught up in a race to discover what we never knew we had.

The *Feathers, fur or leaves?* unit is an ideal way to link science with literacy in the classroom. It provides opportunities for students to explore features of living things, and ways they can be grouped together. Through hands-on activities, students explore how living things can be grouped on the basis of observable features and can be distinguished from non-living things. They use this knowledge to investigate the animal groups in the leaf litter of their own school grounds.



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Foreword

The Australian Academy of Science is proud of its long tradition of supporting and informing science education in Australia. 'PrimaryConnections: 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 PrimaryConnections approach has been embraced by schools since its inception in 2004, and there is substantial evidence of its effectiveness in helping teachers transform their practice. It builds teacher confidence and competence in this important area, and helps teachers use their professional skills to incorporate elements of the approach into other areas of the curriculum. Beginning and pre-service teachers find the approach do-able and sustainable. PrimaryConnections 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. PrimaryConnections 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 PrimaryConnections website.

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 PrimaryConnections prepares students well to participate in evidence-based discussions of these and other issues.

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

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

Professor Suzanne Cory, AC PresAA FRS

President

Australian Academy of Science

2010–2013

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

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).

Alignment with the Australian Curriculum: Science

The Australian Curriculum: Science (2010) 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.'

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 affects peoples' lives and how science is influenced by society and can be used to inform decisions and actions.
Science Inquiry Skills	
	Evaluating claims, investigating ideas, solving problems, drawing valid conclusions and developing evidence-based arguments.

There are four PrimaryConnections units for each year of primary school – one for each science domain of the Australian Curriculum. Each unit contains detailed information about its alignments with all aspects of the Australian Curriculum: Science and its links to the Australian Curriculum: English and Mathematics.

The PrimaryConnections teaching and learning model

This unit is one of a series designed to exemplify the PrimaryConnections 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 are illustrated below:

PrimaryConnections 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 PrimaryConnections 5Es teaching and learning model can be found at: www.science.org.au/primaryconnections/teaching-and-learning

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.

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

Feathers, fur or leaves?

Phase	Lesson	At a glance
ENGAGE	Lesson 1 Wondering about the world Session 1 Discovered journal Session 2 Home explorers	To capture students' interest and find out what they think they know about how living things can be grouped on the basis of observable features and can be distinguished from non-living things. To elicit students' questions about living and non-living things and animal groups.
	Lesson 2 Sorting out life	To provide hands-on, shared experiences of how to distinguish between living and non-living things.
EXPLORE	Lesson 3 Animal sort	To provide hands-on, shared experiences of how to distinguish between plants and animals using observable features.
	Lesson 4 What am I?	To provide hands-on, shared experiences of different ways of grouping animals based on observable features.
	Lesson 5 Animal assemblies	To support students to represent and explain their understanding of how to identify living things and animal groups based on observable features, and to introduce current scientific views.
ELABORATE	Lesson 6 Taxonomists in training Session 1 Scooping up leaf litter Session 2 Looking at leaf litter	To support students to plan and conduct an investigation of the animal groups present in the leaf litter in the school grounds.
EVALUATE	Lesson 7 Classifying collections	To provide opportunities for students to represent what they know about how living things can be grouped on the basis of observable features and can be distinguished from non-living things, 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

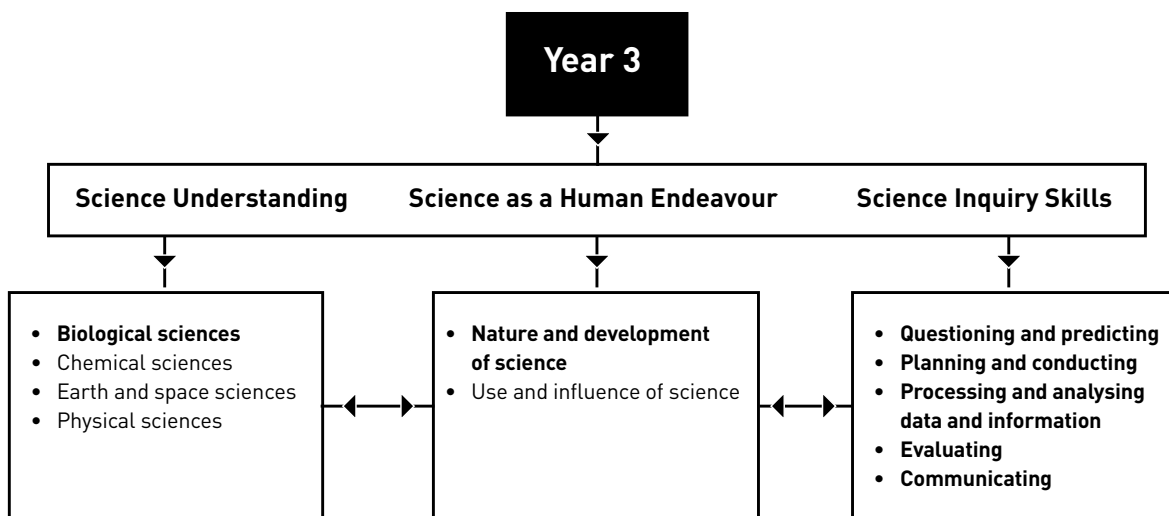
Feathers, fur or leaves? embeds three strands of the Australian Curriculum: Science. The particular sub-strands and their content for Year 3 that are relevant to this unit are shown below.

Strand	Sub-strand	Code	Year 3 content descriptions	Lessons
Science Understanding	Biological sciences	ACSSU044	Living things can be grouped on the basis of observable features and can be distinguished from non-living things	1–7
Science as a Human Endeavour	Nature and development of science	ACSHE050	Science involves making predictions and describing patterns and relationships	1–5
Science Inquiry Skills	Questioning and predicting	AC SIS053	With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge	1, 6
	Planning and conducting	AC SIS054	Suggest ways to plan and conduct investigations to find answers to questions	6
		AC SIS055	Safely use appropriate materials, tools or equipment to make and record observations, using formal measurements and digital technologies as appropriate	6
	Processing and analysing data and information	AC SIS057	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends	2, 3, 6
		AC SIS215	Compare results with predictions, suggesting possible reasons for findings	6
	Evaluating	AC SIS058	Reflect on the investigation, including whether a test was fair or not	6
	Communicating	AC SIS060	Represent and communicate ideas and findings in a variety of ways such as diagrams, physical representations and simple reports	1

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

Interrelationship of the Science Strands

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



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

Relationship to Overarching ideas

In the Australian Curriculum: Science, six overarching ideas support the coherence and developmental sequence of science knowledge within and across year levels. In *Feathers, fur or leaves?*, these overarching ideas are represented by:

- **Patterns, order and organisation:** Students make observations and discuss patterns of similarity. Through the branching key they discover scientific criteria for grouping.
- **Form and function:** Students learn to recognise key features of living things and patterns of similarity between them.
- **Stability and change:** Students learn to recognise key features of living things that remain constant over long periods of time and appreciate their use in identification.
- **Scale and measurement:** Students learn to recognise and compare the size of living things according to scale diagrams using formal units of measurement.
- **Matter and energy:** Students learn to identify and compare living and non-living matter.
- **Systems:** Students learn to correctly identify different components of living and non-living systems and discover a system with hierarchical classification of living things.

Curriculum focus

The curriculum focus for Years 3–6 is ‘recognising questions that can be investigated scientifically and investigating them’. In *Feathers, fur or leaves?*, students detect similarities between objects and living things and learn how science organises them into a system. They discuss questions for investigation and respond to at least one question through a structured science inquiry.

Achievement standards

Assessment against the year level Achievement standards of the Australian Curriculum: Science 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 of the Science Understanding in the *Evaluate* phase.

By the end of the unit, teachers will be able to make evidence-based judgements on whether the students have achieved below, at or above the Australian Curriculum: Science Year 3 achievement standard. Rubrics to help teachers make these judgements are available on the website: www.science.org.au/primaryconnections/curriculum-resources



SAFETY

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.

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' and are embedded throughout this unit. For further information see: www.australiancurriculum.edu.au/GeneralCapabilities

'Feathers, fur or leaves?' – Australian Curriculum General capabilities

General capabilities	Australian Curriculum description	<i>Feathers, fur or leaves?</i> examples
Literacy	Learning activities explicitly introduce the literacy focuses and provide students with the opportunity to use them as they think about and represent their understanding of science.	In <i>Feathers, fur and leaves</i> the literacy focuses are: <ul style="list-style-type: none"> • science chat-boards • science journals • word walls • labelled diagrams • tables • T-charts • branching keys • procedural texts • line drawings • graphs
 Critical and creative thinking	Students develop critical and creative thinking as they learn to generate and evaluate knowledge, ideas and possibilities, and use them when seeking new pathways or solutions	Students <ul style="list-style-type: none"> • use reasoning to develop questions for inquiry • use a beliefs continuum • formulate, pose and respond to questions • consider different ways of thinking about classification and definitions • develop evidence-based claims.
 Numeracy	Mathematics is an important factor in science as students are able to practise and apply maths skills and knowledge in ways that are relevant and constructive.	Students <ul style="list-style-type: none"> • collect, interpret and represent data through tallies, tables and graphs • use measurement to understand the size of a specimen.
Information and communication technology (ICT) competence	ICT competence develops as students learn to use ICT appropriately and effectively when investigating, creating and communicating their ideas and experiences.	Students are given optional opportunities to: <ul style="list-style-type: none"> • use digital cameras to record specimens • use digital microscopes to observe specimens • use Interactive Resource technology to view, record and analyse information • use the internet to research further information on animals and plants.
Ethical behaviour	Students develop ethical behaviour as they learn to understand and act in accordance with ethical principles.	Students <ul style="list-style-type: none"> • develop and use a 'Code for Caring' when collecting and observing plant and animal specimens.
 Personal and social competence	Students develop personal and social competence as they learn to understand and manage themselves, their relationships, lives, work and learning more effectively.	Students <ul style="list-style-type: none"> • work collaboratively in teams • follow a procedural text for working safely • participate in discussions.
 Intercultural understanding	Intercultural understanding is developed as students learn to value their own culture and beliefs and those of others, creating connections and cultivating respect between people.	<ul style="list-style-type: none"> • Cultural perspectives opportunities are highlighted where relevant • Important contributions made to science by people from a range of cultures are highlighted where relevant.

Cross curriculum priorities

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

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

Two of these are embedded within this unit as described below. For further information see: www.australiancurriculum.edu.au/CrossCurriculumPriorities



Aboriginal and Torres Strait Islander histories and cultures

PrimaryConnections has developed an Indigenous perspective framework which has informed practical reflections on intercultural understanding. It can be accessed at: www.science.org.au/primaryconnections/indigenous/

Feathers, fur or leaves? focuses on the Western science criteria for grouping animals based on their observable features. Indigenous cultures may group things in the world using different criteria. For example:

'I watched bemused as students made two piles that I could not identify. Their Yolngu teacher was quite pleased. Her explanation to me afterwards was that the shells were sorted by moieties, Dhuwa and Yirritja, the two halves into which Yolngu people place just about everything: people, plants, animals, landforms and physical phenomena.'

Linkson, Mark. (1999). *Some issues in providing culturally appropriate science curriculum support for Indigenous students*. Australian Science Teachers' Journal, 45(1), 41-48.

PrimaryConnections recommends working with Indigenous community members to access contextualised, relevant Indigenous perspectives. Protocols on seeking out and engaging Indigenous community members are discussed in state and territory Indigenous education policy documents and can be found on the PrimaryConnections website.

Sustainability

Through the classification of many different animals students are made aware of some of the diversity of life, in particular smaller invertebrates (animals without a backbone). They start to discover the ecosystem of the leaf litter and soil which is a crucial, and often little known, component of the biosphere. *Feathers, fur or leaves?* therefore provides building blocks for students to better understand environments and how human activity can impact them.

Alignment with the Australian Curriculum: English and Maths

Strand	Sub-strand	Code	Year 3 content descriptions	Lessons
English – Language	Language variation and change	ACELA1475	Understand that languages have different written and visual communication systems, different oral traditions and different ways of constructing meaning	1, 5, 7
	Language for interaction	ACELA1476	Understand that successful cooperation with others depends on shared use of social conventions, including turn-taking patterns, and forms of address that vary according to the degree of formality in social situations	6
	Text structure and organisation	ACELA1478	Understand how different types of texts vary in use of language choices, depending on their function and purpose, for example tense, mood, and types of sentences	1, 2, 4, 5, 6, 7
	Expressing and developing ideas	ACELA1483	Learn extended and technical vocabulary and ways of expressing opinion including modal verbs and adverbs	2, 3, 5, 7
English – Literature	Responding to literature	ACELT1596	Draw connections between personal experiences and the worlds of texts, and share responses with others	2, 3, 4, 5, 7
	Creating literature	ACELT1791	Create texts that adapt language features and patterns encountered in literacy texts, for example characterisation, rhyme, rhythm, mood, music, sound effects and dialogue	1
English – Literacy	Interaction with others	ACELY1676	Listen to and contribute to conversations and discussions to share information and ideas and negotiate in collaborative situations	1–7
		ACELY1792	Use interaction skills, including active listening behaviours and communicate in a clear, coherent manner using a variety of everyday and learned vocabulary and appropriate tone, pace, pitch and volume	1–7
	Interpreting, analysing, evaluating	ACELY1679	Read an increasing range of different types of texts by combining contextual, semantic, grammatical and phonic knowledge, using text processing strategies, for example monitoring, predicting, confirming, rereading, reading on and self-correcting	1, 6
Mathematics	Number and Algebra	ACMNA052	Recognise, model, represent and order numbers to at least 10 000	4, 6
	Measurement and Geometry	ACMMG061	Measure, order and compare objects using familiar metric units of length, mass and capacity.	3
	Statistics and probability	ACMSP069	Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies	2, 3, 4, 6
		ACMSP070	Interpret and compare data displays	2, 3, 6

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

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

Introduction to scientific classification

Teacher background information

Living vs. non-living things

Looking at the world around us, we instinctively seek to identify living and non-living things. However, it is hard to absolutely define life. Scientists agree that life on Earth generally has characteristics such as:

- being made up of one or more cells with regulated internal compositions
- being able to metabolise energy, for example by eating organic compounds or through photosynthesis
- being able to grow and reproduce at least at some stage of its life cycle
- being able to sense and respond to its environment.

Classification of living things

We classify living things into groups to make sense of the world around us and to communicate about it. The classification system used by scientists today is similar to the one devised by Carolus Linnaeus in the 1700s. He grouped living things on the basis of observable characteristics and created a ranked hierarchical system of identification.

The highest level of classification is the kingdom. He identified *Regnum Animale*, *Regnum Vegetabile* and *Regnum Lapideum (mineral)* which is the basis of the parlour game 'Animal, Vegetable or Mineral?'

Today, scientists recognise that there are more kingdoms, for example, the kingdom of Fungi. Scientists are also working to re-classify species to reflect shared ancestry – to group things that are closely related and not just things that look related.

Plants

The kingdom of plants is comprised of multicellular organisms that use the energy of the Sun to provide their energy through photosynthesis. They generally have structures to capture light, such as leaves, and structures to capture water and nutrients from the environment, such as roots. Plants rely on external forces to move them from place to place, for example wind, water or animals dispersing seeds.

Animals

The kingdom of animals is comprised of multicellular organisms that must eat other things to survive. They generally have body structures such as claws, teeth and digestive systems for catching and eating their food. All animals are able to move from place to place using internal structures, for example muscles and skeletons, at some stage in their life cycle.

Animal ethics

This unit describes investigations involving invertebrates. Each Australian state and territory has animal ethics requirements for school investigations involving vertebrate animals (those with a backbone, such as birds or guinea pigs). You will need to comply with any requirements of the relevant *Animal Welfare Act* and any school policies if you choose to use vertebrates in the classroom.

Insects and crustaceans are invertebrates and are not covered by the *Animal Welfare Act* but still require care and consideration.

Students' conceptions

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

Students may attribute their own meanings to the terms 'alive' or 'living'. For example, they may think movement is a key characteristic of life, and therefore would think that the Sun and fire are alive but plants and eggs are not (Carey, 1985; Stepan, 1985). They may think that the presence of fruit is an indicator of life (Carey, 1985), however a plant can be alive even when not producing fruit.

Some students may believe that non-living is the same as dead, whereas things that used to be alive are only a small part of all non-living things.

Students commonly hold anthropomorphic views of animals—that is, they attribute human motivation, features or behaviours to animals (Carey, 1985; Stepan, 1985). These views are often promoted in storybooks and films.

Some students do not apply guidelines developed by scientists when determining the classification of living things. For example, some students might decide whether or not something is an animal based on whether it lives on land or how many legs it has (Bell, 1993). However, there are many animals that live in water and animals might have no legs (snakes) or dozens of legs (millipedes).

Some students believe that classification systems are mutually exclusive rather than hierarchical. For example, some students might believe that an ant is just classified as an ant i.e. it is not an insect (Driver et al., 1994). However, scientists denote ants are part of a group called insects, and insects within a group called animals. Similarly, within the group called 'ants' there are many different types of ants. All living things can be identified as belonging to several groups at different levels of the hierarchy.

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- Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V., (1994), *Making sense of secondary science: Research into children's ideas*. London and New York: RoutledgeFalmer.
- Stepan, J (1985) 'Biology in elementary school: Children's conceptions of life', *American Biology Teacher*, 47 pp 222-225.

Use the accompanying Science Background CD to access more in-depth science information in the form of text, diagrams and animations. Note that this background information is intended for the teacher only.



Lesson 1 Wondering about the world

AT A GLANCE

To capture students' interest and find out what they think they know about how living things can be grouped on the basis of observable features and can be distinguished from non-living things.

To elicit students' questions about living and non-living things and animal groups.

Session 1 Discovered journal

Students

- describe different ways to group specimens
- share observations of features of specimens
- make claims about whether specimens are non-living, plants or animals.

Session 2 Home explorers

Students

- identify a living and a non-living specimen at home
- write a journal entry, including an annotated drawing.

ENGAGE

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 can be grouped on the basis of observable features and can be distinguished from non-living things.

Key lesson outcomes

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

- contribute to discussions about specimens, their observable features, and how to classify them
- identify the purpose and features of a science journal
- identify possible questions for investigation
- identify living and non-living things in their home
- create a labelled diagram and journal entry to represent and communicate their findings.

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

Session 1 Discovered journal

Teacher background information

In this session, students are presented with a collection of diary entries about different curious specimens. These specimens have been chosen to initiate inquiry and debate in the class. They are described for your information below.

The egg-shaped rock

The specimen may have the shape of an egg, but birds do not produce such decoration. It is in fact a polished stone; the orange patterns are different crystals in the rock. Another way for an egg to look like this is for a human to have coloured it. Even if it were an actual egg, the fact that it is cold and hard would indicate that it is no longer living. Unlike seeds, eggs need to be kept at certain temperatures in order to incubate.

Note: Unfertilised chicken eggs are destined to become non-living as the cells inside will not grow or reproduce. When exactly they cease to be classified as living is a matter of debate among scientists.

The Venus flytrap

Venus flytraps (*Dionaea muscipula*) are plants that have evolved a special mechanism for surviving in nutrient-poor soils. They produce their energy from photosynthesis using sunlight like other plants; however, they have specially modified leaves which capture small animals. The traps have touch-sensitive hairs and if two hairs are touched in quick succession the trap will close. This means a trap only closes if something appears to be moving inside, for example, rather than a raindrop falling on it. The trap closes using a complex mechanism which is very different from using muscles like animals. If the prey has escaped, or if it was a false alert, the traps open again after twelve hours. Otherwise the prey takes ten days to be digested. The plant recoups nitrogen and phosphorus that it needs to continue to grow and reproduce this way.

The millipede

If a living thing needs to eat other things to survive (heterotroph) and can move independently using muscles at (at least) one stage in their lives, then scientists classify it as an animal. There are many different groups within the group 'Animals' (see Lesson 4), one of which is 'insects'. Something with three distinct body parts and six legs is both an insect and an animal. The millipede, with its multiple repeating segments and many legs, is an animal that is classified as a 'myriapod'.

Natural Science Collections

Natural science collections, often housed in Natural History Museums, were created so that people could see actual objects rather than just read descriptions of them. The collections can cover a wide range of artifacts from rocks and fossils to animal skins and can also include living specimens such as those in botanical gardens and zoos. Historically, some Natural History Museums also collected human specimens and artifacts, sometimes without consent from the populations involved, but collection practices are evolving with new ethical guidelines.

Equipment

FOR THE CLASS

- class science journal
- large sheets of paper for class science chat-board (see 'Preparation')
- 1 enlarged copy of 'Explorer's journal' (Resource sheet 1), (see 'Preparation')
- 4 large sheets of paper (see 'Preparation')
- 7 A4 sheets of paper for signs (see 'Preparation')
- tape or glue
- specimens or photos of specimens (see 'Preparation')
- 1 table for the specimens

FOR EACH STUDENT

- science journal
- self-adhesive note

Preparation

- Read 'How to use a science journal' (Appendix 2).
- Read 'How to use a word wall' (Appendix 3).
- Read 'How to use a TWLH chart' (Appendix 4).
- Set up and organise at least six different specimens for the Natural Science table including:
 - two non-living things, for example, a polished rock and a rough rock
 - two plants, including a Venus flytrap
 - two small animals, including a millipede.

Note: Photos are available on the PrimaryConnections website if you cannot find specimens. Check your state/territory requirements on the classroom use of animals.

- Prepare seven A4 signs with the headings: 'Agree', 'Disagree', 'Not sure'; 'Animal', 'Insect', 'Both' and 'Neither'.
- Prepare a place in the classroom for the class science chat-board. On two large pieces of paper write the headings: 'Word wall' and 'Our questions'; these can be written on directly or by using self-adhesive notes that can be reorganised.



Feathers, fur or leaves? science chat-board

- Enlarge 'Explorer's journal' (Resource sheet 1). Paste each journal page on to a separate large piece of paper and add to the class science chat-board or staple pages together to make a 'Big Book' with a spare sheet next to each entry for recording thoughts.
- *Optional:* Store the science chat-board, the Explorer's journal and the word wall on an interactive whiteboard or on a computer connected to a projector. See the PrimaryConnections *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections/
- *Optional:* Access the children's' picture story book – Trenc, Milan. (1993) *The Night at the Museum*. Woodbury, NY: Barron's Educational Series, (ISBN 0812064003).

Lesson steps



- 1 Introduce the collected specimens to the class (see 'Preparation') and allow students time to observe and discuss what they see.
- 2 Discuss with students how these specimens will be the beginning of a Natural Science collection table that they will be creating in the classroom. Discuss what a Natural Science Museum is.
Optional: Read *The Night at the Museum* by Milan Trenc (see 'Preparation')
- 3 Introduce the science chat-board and discuss its purpose and features.

Literacy focus**Why do we use a science chat-board?**

A **science chat-board** is a display area where we share our changing questions, ideas, thoughts and findings about a science topic.

What does a science chat-board include?

A **science chat-board** might include a title, words, pictures, questions, ideas and reflections with dates.

- 4 Introduce the 'Explorer's journal' (Resource sheet 1) displayed on the science chat-board. Explain that this is the journal of an explorer who was looking for new specimens for a museum. Read with the class and discuss any difficult words or phrases.
- 5 Discuss how the explorer shows the size of the specimen. Use a ruler to show actual size of each specimen. Ask students why they think the explorer put the measurement in his journal.
- 6 Introduce the class science journal and discuss its purpose and features.




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** might include dates and times, written text, drawings, measurements, labelled diagrams, photographs, tables and graphs.

Compare and discuss the similarities and difference between the Explorer's journal and the class science journal.

- 7 Draw students' attention to the fact that the explorer asked questions but didn't record what they thought the answers might be (their 'claims'). Explain that the students will think about what the answers might be.
- 8  Turn to 'Specimen one' of the Explorer's journal and ask students to consider the claim 'It is living'. Place the signs 'Agree', 'Disagree' and 'Unsure' (see 'Preparation') at separate parts of the rooms and ask students to stand in front of their answer. Ask students to discuss with other students in front of the sign why they chose that answer.
- 9   Tally the number of students that agree with each claim. Ask each group to share their reasons and evidence for choosing that claim and record next to the tally.

Note: The purpose of this activity is to elicit students' existing conceptions so you can take account of their ideas in the following lessons. Do not correct alternative conceptions at this stage.

- 10  Go to 'Specimen two' and repeat Lesson steps 8 and 9 with the claim 'It is a plant'.
- 11  Go to 'Specimen three' and repeat Lesson steps 8 and 9 asking students to consider the claims: 'It is an animal', 'It is an insect', 'It is both' and 'It is neither'. Change the signs displayed to 'Animal', 'Insect', 'Both' and 'Neither'.



- 12** Discuss how not everyone agreed about each specimen. Explain that students will be exploring what living things, plants and animals are so that they can make accurate labels for the Natural Science table.
- 13** Draw students' attention to the 'Our questions' section of the class science chat-board. Explain that this is where students will be able to display questions that they might have after each lesson. Model one question for the students. For example:
- How do we know if something is living?
- 14** Ask students if they can think of any other questions about non-living things, plants or animal groups. Write the questions and the student's name on self-adhesive notes and add to the 'Our questions' section of the class scientists' chat-board.
- Note:** An optional opportunity for students to do research on their specific questions that are not currently answered in the *Explore* lessons is provided in the *Explain* lesson.
- 15** Draw students' attention to the word wall section of the class science chat-board and discuss its' purpose and features.

Literacy focus

Why do we use a word wall?

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

What does a word wall include?

A **word wall** might include a topic title or picture and words which we have seen or heard about the topic.

Ask students what words from today's lesson would be useful to place on the word wall.



Invite students to contribute words from different languages to the word wall, including local Indigenous names of animals, plants and groups if possible and discuss.

Australian Curriculum links

English

- Create journal entries with examples of writing using joined letters that are clearly formed and consistent in size to serve as a model for students.
- While working on the word wall, discuss different communication systems of different languages.

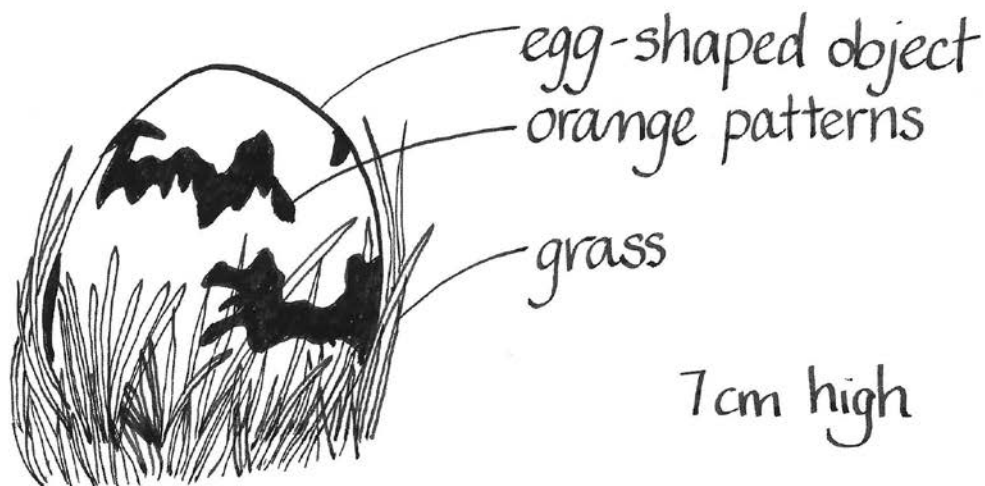
Explorer's journal

1.04.2011

Wallaman waterfall,
AustraliaSpecimen 1

I am so happy to be on this trip. There are so many things to see!

Today I found this:



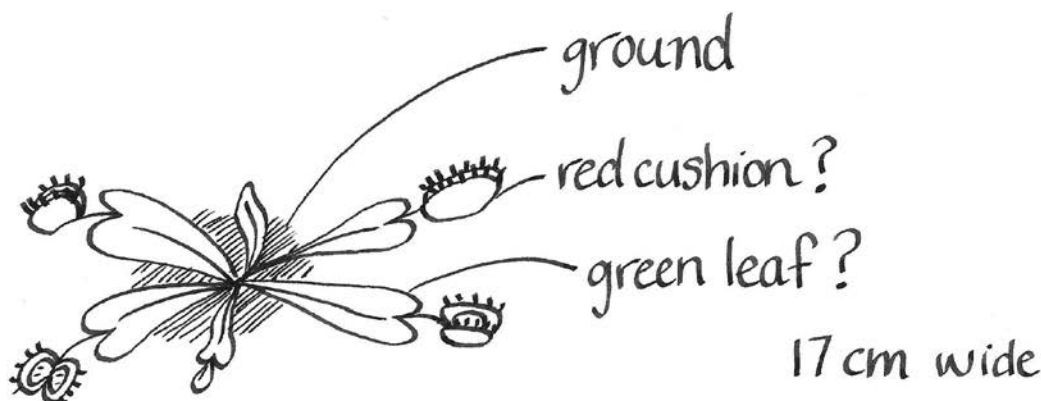
It looks like an egg but it is hard, cold and heavy. I wonder if it is alive or not?

Explorer's journal

11.05.2011

Green Swamp,
North AmericaSpecimen 2

This is what I found on my walk today:

I saw a fly land on one of the cushions
and this is what happened:

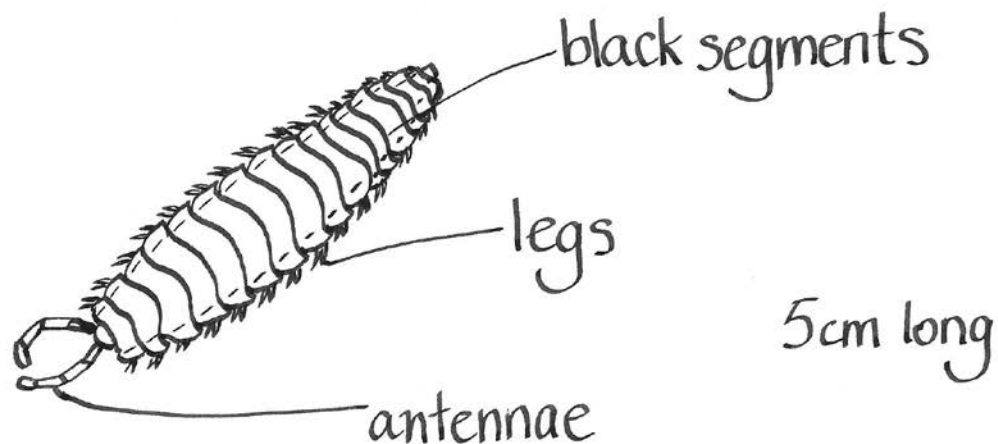
Much later the fly was gone! Was it eaten?
Very strange. Have I found a plant? Or is
it an animal? Maybe it is something else?

Explorer's journal

21.05.2011
Amazon Forest
South America

Specimen 3

After it rained today, I went out for a walk.
This is what I found:



Is it an insect? Is it an animal?
Could it be both? Or maybe it is neither?

Session 2 Home explorers

Teacher background information

In this session, students will be asked to collect and observe living things at home.

To ensure students' safety and to ensure they act ethically, the class will agree to respect a 'Code of Caring'. This might include:

- Search carefully, disturbing the surroundings as little as possible.
- Replace stones and logs after searching underneath them.
- Do not remove plants.
- Do not collect known dangerous animals.
- Wear gloves when searching. Small animals can be aggressive, for example, bite or sting, when their habitat is disturbed.
- Handle small animals carefully. Use spoons and damp brushes, not fingers, as animals could be crushed accidentally.
- Place small animals in small, sealable plastic containers with air holes.
- Label container with the area collected so the small animals can be returned (the labels can also provide information such as date collected).
- When collecting, keep different types of small animals in separate containers so they don't injure or attack each other.
- After a short time, return the small animals to where they were found or make suitable classroom homes for them.

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- 'Code for caring' poster (see 'Preparation')
- 1 enlarged copy of 'Home explorer's journal'

FOR EACH STUDENT

- 1 copy of 'Information note for families' (Resource sheet 2)
- 1 copy of 'Home explorer's journal' (Resource sheet 2)
- 'Home explorer's folder' (eg a Manila folder)

Preparation

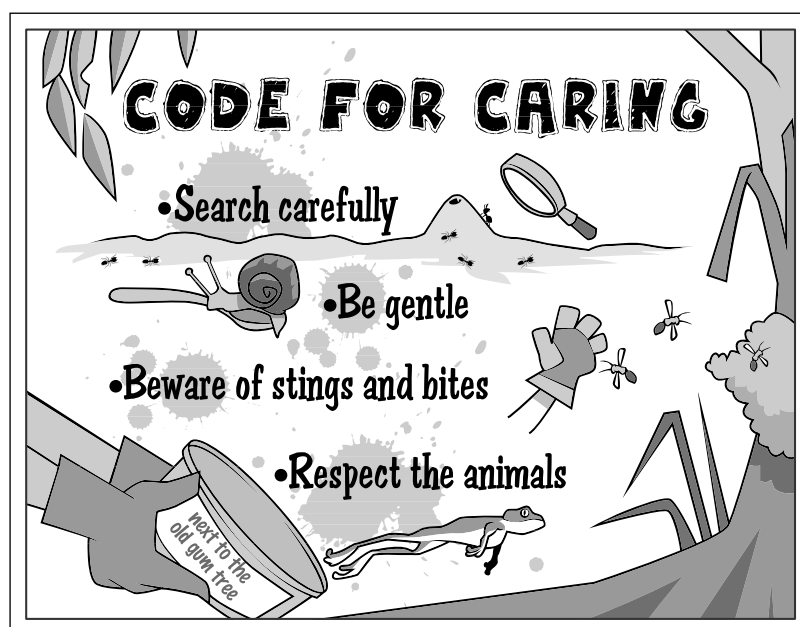
- Students will be presenting the information they collect at home in the next lesson. Write this date on the 'Information note for families' (Resource sheet 2).
- Make a 'Home explorer's folder' for each student, including 'Information note for families' and 'Home explorer's journal' (Resource sheet 2).

- Prepare a blank poster with the title 'Code for caring' (see Lesson step 3).
- Prepare an enlarged copy of 'Home explorer's journal' (Resource Sheet 2).
- *Optional:* Display the 'Information note for parents' and 'Home explorer's journal' (Resource sheet 2), and the 'Code for caring' poster on an interactive whiteboard or on a computer connected to a projector. See the **PrimaryConnections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous session using the class science journal, Natural Science table and science chat-board.
- 2 Explain that students are going to explore their own home to look for interesting objects to write a journal entry about. Ask students to look for at least two things to describe:
 - something they think is not living
 - something they think is living

Tell students that if they find something that they are unsure of they might like to put that in their journal too, just like the explorer.
- 3 Introduce the blank poster with the title 'Code for caring'. Discuss what a code is. Negotiate and record on the poster ways for students to care for small animals (see 'Teacher background information').



Sample 'Code for caring' poster

- 4 Introduce the 'Home explorer's folder' prepared for each student. Read through 'Information note for families' and 'Home explorer's journal' (Resource sheet 2).
- 5 Introduce an enlarged copy of 'Home explorer's journal' (Resource sheet 2). Discuss how students will complete the 'Home explorer's journal' to record information.



- 6 Ask students to find living and non-living things in the classroom. Ask questions such as:
- How can we find out if it is living? How can we tell?
 - When we want to find something living, what should we look for?
 - When we want to find something non-living, what should we look for?

List students' ideas in the class science journal.

- 7 Review the drawings in 'Explorer's journal' (Resource sheet 1) and discuss the purpose and features of labelled diagram.

Literacy focus

Why do we use a labelled diagram?

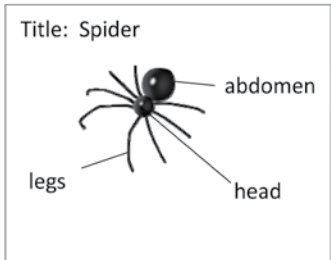
We use a **labelled diagram** to show the shape, size and features of an object.

What does a labelled diagram include?

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

Discuss what key features need to be represented in a labelled diagram, and which can be omitted, for example, labelled diagrams are not usually coloured.

- 8 Model how to fill in a journal entry about a plant in the class science journal as per the instructions on 'Information note for families' (Resource sheet 2).

Name: <u>Veronica</u>	Date: <u>9 June</u>
Location: <u>On the tree in my backyard</u>	
Specimen 1	
Title: Spider 	I think this specimen is <u>living</u> because: it can run and it can eat.

Work sample of 'Home explorer's' journal

Remind students that they can also take photographs of objects they are writing about but that this does not replace the need for a labelled diagram.

- 9 Update the word wall section of the class science chat-board with words and images.

Australian Curriculum links

Mathematics

- Discuss how to measure things using familiar metric units of length and record them on the diagrams so that the entries from the class can be compared.
- After discussing the need to record the time, explore how to tell time to the minute and investigate the relationship between units of time.

Information note for families

Introducing the 'Home explorer's' project

This term, our class is studying how living things can be grouped on the basis of observable features and can be distinguished from non-living things. Students are asked to explore their home, garden and/or surrounds and choose:

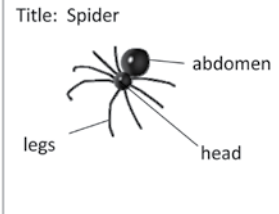
- Something that is non-living (eg stone, plastic bag, toy car)
- Something that is living (eg goldfish, dog, caterpillar).

Students are asked to write a journal entry for each one on the provided 'Home explorer's journal' sheet.

Each entry should include:

- Their name
- The date
- Where they found it (location)
- A labelled diagram of the specimen
- Whether it is living or non-living and why they think that.

Students are also invited to take a photo and/or, if appropriate, bring the specimen in to school to share with the class.

Name: <u>Veronica</u> Date: <u>9 June</u>	
Location: <u>On the tree in my backyard</u>	
Specimen 1	
Title: <u>Spider</u> 	I think this specimen is <u>living</u> because: <u>it can run and it can eat.</u>

Work sample of 'Home explorer's' journal

Code for caring

The class has established a 'Code for caring' to help students search carefully without disturbing the search area. This includes:

- Replace stones and logs after searching under them.
- Leave all plants and gardens undisturbed.
- Leave all dangerous animals alone.
- Wear gloves to avoid bites and stings.
- Use spoons and damp brushes when picking up small animals to avoid crushing them.
- When observing animals, keep them in a labelled container that has air holes and after a short time return the animal to where it was found.

If students find something that they are unsure of whether it is living or non-living, they are encouraged to complete a journal entry about it for discussion in class.

Students are asked to bring their completed journal entries and specimens to school by:

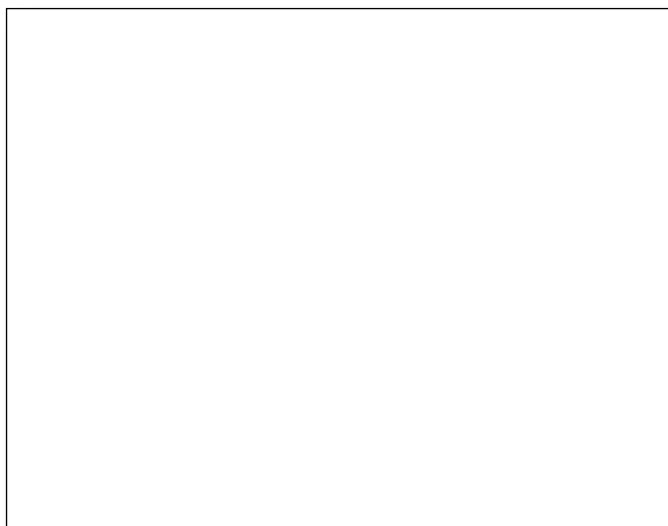
Class teacher _____

Home explorer's journal

Name: _____ Date: _____

Location: _____

Specimen 1



I think this specimen is living because:



Name: _____ Date: _____

Location: _____

Specimen 2



I think this specimen is non-living because:



Lesson 2 Sorting out life

AT A GLANCE

To provide hands-on, shared experiences of how to distinguish between living and non-living things.

Students

- discuss the specimens and journal entries from their home exploration
- identify the features of living things and describe how they differ from non-living things.

Lesson focus

The *Explore* phase provides students with hands-on experiences of the topic's science phenomenon while building their science inquiry skills. 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. In this lesson you will monitor students' developing understanding of how living things can be distinguished from non-living things.

Key lesson outcomes

Students will be able to:
• contribute to discussions about specimens, their observable features, and how to classify them
• share responses and opinions with others
• identify living and non-living things from shared specimens
• consider claims about living specimens and identify patterns in data
• create a shared description of what makes something living

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

Teacher background information

Something is living if...

Some of the criteria scientists use to determine if something is living can be difficult to detect, for example, the presence of cells. A commonly used mnemonic is MRS GREN:

- **Movement:** All animals move, at least at some stage of their lives. Some plants can open and close their leaves and sunflowers orient their flowers to follow the Sun. However, for many plants their 'movement' is their 'growth'. For example, roots explore the soil by growing into it.
- **Respiration:** Respiration is a scientific term indicated by the release of energy stored in organic compounds such as sugar. Our respiratory system is the area where the gas necessary for our respiration (oxygen) and the by-product of the reaction is released (carbon dioxide). Plants use respiration but they can also make their own sugars using the energy from the Sun (photosynthesis).
- **Sensitivity:** A living thing gathers information about its environment and reacts in consequence. For example, we avoid things that cause us pain. Plants react to their environment by growing towards the light or even by releasing alarm hormones when eaten by a predator.
- **Growth:** Living things have the ability to grow. Non-living things such as stalactites can also grow but it is an external process (the deposit of minerals on a spike) rather than an internal process (growing by means of absorbed energy and nutrients that are reorganised).
- **Reproduction:** Living things come from other living things and can often create new living things. A worker bee is sterile but is born from a fertile queen and is therefore alive. Plants have the ability both to reproduce sexually (creating seeds) and asexually, such as runner plants.
- **Excretion:** Living things excrete things such as excess gases, salts and waste in order to keep their internal composition constant.
- **Nutrition:** Living things need to acquire the necessary elements for growth and reproduction from the world around them. Animals need to eat other things to acquire energy to survive (heterotrophs). Plants need to absorb certain minerals such as phosphorous in order to capture energy from the Sun (photosynthesise).

Some of these characteristics require sophisticated machines to detect them, and it can be hard to tell the difference between hibernation and death – for plants in particular. Common sense and experience help us decide whether something might be alive, for example, a branch that has fallen to the ground is likely to no longer be living but a bare tree that we saw lose its leaves two months ago is more likely to still be alive. Sometimes time will tell, for example, if an egg eventually hatches or a seed germinates then it was alive the whole time.

When parts of plants are cut off, for example, flowers, branches and fruit, they still have cells using energy, producing energy and reacting to the environment so plant parts can be considered as living. When plant parts are dried and brown and unable to regenerate then they are definitely dead. When exactly they cease to be classified as living things can still be a matter of debate for scientists. This is made more difficult by the fact that branch and flower cuttings can sometimes produce new roots and thus become an entire plant again.

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- 3 table labels ('Non-living', 'Living', 'Unsure')
- 3 wall labels ('Non-living', 'Living', 'Unsure')
- 1 enlarged copy of 'What makes it living?' (Resource sheet 3)

FOR EACH STUDENT

- journal entries from Lesson 1, Session 2
- student's specimens from home
- journal entries from home (see Lesson 1, Session 2)

Preparation

- Prepare three areas of display space on which students can place their journal entries, labelled 'Non-living', 'Living' and 'Unsure'. Prepare an equipment table with the same labels for students to place any specimens they bring.
- Enlarge a copy of 'What makes it living?' (Resource sheet 3).
- *Optional:* Display 'What makes it living?' (Resource sheet 3) on an interactive whiteboard or on a computer connected to a projector. See the **PrimaryConnections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous session using the class science journal, Natural Science table and science chat-board. Review 'Day one' of the 'Explorer's journal' (Resource sheet 1) and students' answers to claims about living and non-living things.
- 2 Remind students of their thoughts about the home explorer's task and ask if they would like to change their answers to the questions:
 - How can we find out if it is living?
 - When we want to find something living, what should we look for?
 - When we want to find something non-living, what should we look for?
 Record students' answers in the class science journal.
- 3 Introduce the 'Non-living', 'Living' and 'Unsure' wall sections (see 'Preparation'). Ask students to put their completed journal entries from home (see Lesson 1, Session 2) in the appropriate section. Place labels on the Natural Science table and ask students to place their specimens in the relevant area.



- 4 As a class, review the journal entries and specimens. Ask students if there are any classifications that they disagree with. If so, ask them to say why they think that. Ask questions such as:

- That's interesting, can you tell me more about...?
- Scientists think... What do you think about that?

Note: In this lesson it is appropriate to introduce scientific concepts (see 'Teacher background information') after students have had the opportunity to explain their understanding.



- 5 Introduce the enlarged copy of 'What makes it living?' (Resource sheet 3) and read through with students. Discuss the claim, 'It can reproduce'. Ask students what they think that means. Discuss how for animals it means having babies and for plants it means creating seeds or growing another one of itself.

Discuss the purpose and features of a table.

Literacy focus

Why do we use a table?

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

What does a table include?

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

Review the claims in the table and see if students' answers from Lesson step 2 are included. If not, add extra claims to reflect them.



- 6 Write the name of something that is living, for example a cat, and write its name in column two of the table. Discuss whether each claim is true for that specimen. Tick the box if it is applicable and cross if it is not.
- 7 Choose a plant, such as a rose bush, and repeat Step 6. When answering the claim 'It moves' ask students if they think a plant can move on its own without the help of the wind (plants open and close their flowers, turn towards the Sun).

Optional: Show a time lapse video of a plant moving. For example:
www.teachersdomain.org/resource/tdc02.sci.life.colt.plantsgrow

- 8 Choose two more very different specimens that are living and repeat Lesson step 6.

Note: The claims that should be ticked for all specimens are: 'It needs water', 'It grows', 'It can reproduce' and 'It moves'.



- 9 Review the results for all specimens for each claim and conclude whether it could be true for all living things. If so, ask students to check against their journal entry of a living thing. Highlight the claims that are true to create an agreed description of living things.



- 10 Using the agreed description, review the 'Unsure' wall section and specimens, and identify if they are living or non-living things.



- 11 Explain that you are going to call out names of things. Ask students to sit if they think the thing is non-living and stand if it is living. Remind students to use the agreed description to help them decide. Play several rounds of the game naming familiar objects in faster and faster succession.

- 12 Revisit the 'Specimen one' section of the class science chat-board. As a class record what students have learned (for example, that the egg is probably not living) and how they came to that conclusion (for example, because it can't eat or drink).
- 13 Review the 'Our questions' section of the class science chat-board and answer any questions that can be answered. Record what students have learned next to the question and how they came to that conclusion (their evidence).
- 14 Update the word wall section of the class science chat-board with words and images.
Optional: Ask students to look for animal and plant specimens and create further journal entries for the Natural Science table.

Feathers, fur or leaves?

What makes it living?

Name: _____ Date: _____

Tick the claims that are true for each living thing that you find.

Claims	Living thing				
	cat	rose	ant	grass	magpie
It needs water.	✓	✓	✓	✓	✓
It has legs.	✓	✗	✓	✗	✓
It can reproduce.	✓	✓	✓	✓	✓
It grows.	✓	✓	✓	✓	✓
It has feathers.	✗	✗	✗	✗	✓
It is green.	✗	✓	✗	✓	✗
It moves.	✓	✓	✓	✓	✓
It is warm.	✓	✗	✗	✗	✓
It has eyes.	✓	✗	✓	✗	✓

Which of these claims do you think all living things have? Circle them.

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Resource sheet 3

EXPLORE

Work sample of 'What makes it living?'

What makes it living?

Name: _____ Date: _____

Tick the claims that are true for each living thing that you find.

Claims	Living thing				
It needs water.					
It has legs.					
It can reproduce.					
It grows.					
It has feathers.					
It is green.					
It moves.					
It is warm.					
It has eyes.					

Which of these claims do you think all living things have? Circle them.



Lesson 3 Animal sort

AT A GLANCE

To provide hands-on, shared experiences of how to distinguish between plants and animals using observable features.

Students

- classify picture cards as 'Animals', 'Plants' or 'Unsure' and discuss their choices
- work in teams to identify the defining features of animals
- distinguish the features of plants.

Lesson focus

The *Explore* phase provides students with hands-on experiences of the topic's science phenomenon while building their science inquiry skills. 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. In this lesson you will monitor students' developing understanding of how to distinguish plants from animals based on their features.

Key lesson outcomes

Students will be able to:
• contribute to discussions about specimens, their observable features, and how to classify them
• share responses and opinions with others
• determine the size of a plant or animal
• identify and group plants and animals using picture cards
• identify claims about what makes something an animal by identifying patterns in data
• create a shared description of what makes something an animal

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

Teacher background information

Something is an animal if...

All animals are able to move themselves from place to place at least one stage of their lives. For example, the larvae of oysters swim before the animal fixes itself on to a rock. This capacity for independent movement is a key difference from plants that have to rely on external things such as wind, water and animals to move their seeds. Animals therefore have characteristics that allow them to move from place to place, such as muscles.

The other key difference is that animals have to eat to gain energy they are not able to create their own sugars using carbon dioxide and energy from the Sun the way a plant can. Some carnivorous plants trap and digest animals but this is to get their nutrients (such as phosphate) rather than to get energy. A few plants have lost the ability to photosynthesize but they still have roots and leaves from when they used to be able to so. They are classified as still being in the kingdom of plants.

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- team skills chart
- team roles chart
- Natural Science table
- 2 new table labels ('Plants', 'Animals')
- class set of living things cards (see 'Preparation')
- 1 enlarged copy of 'What makes it living?' (Resource sheet 3)
- 1 enlarged copy of 'What is an animal?' (Resource sheet 5)

FOR EACH TEAM

- role badges for Director, Manager, Speaker
- each team member's science journal
- 1 copy of 'Living things cards' (Resource sheet 4)
- 1 copy of 'What is an animal?' (Resource sheet 5)

Preparation

- Read 'How to organise collaborative learning teams (Appendix 1). Display an enlarged copy of the team skills chart and the team roles chart in the classroom. Prepare role badges.
- Prepare a set of living things cards by photocopying an enlarged 'Living things cards' (Resource sheet 4) and cutting it out. To ensure durability, laminate the cards or copy the resource sheet onto thick card.
- *Optional:* Display the 'Living things cards' (Resource sheet 4) and 'What is an animal?' (Resource sheet 5) on an interactive whiteboard or on a computer connected to a projector. See the PrimaryConnections *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous session using the class science journal, Natural Science table and science chat-board. Review 'Specimen two' of the 'Explorer's journal' (Resource sheet 1) and students' answers to claims about plants and animals.

Optional: Ask students to present any new specimens they have for the Natural Science table.

- 2 Explain that today the class will sort the living specimens on the Natural Science table into plants, animals and unsure. Discuss with students how they would know if something was an animal, asking questions such as:

- How can we find out if it is an animal?
- How can we tell?
- When we want to find an animal, what should we look for?
- When we want to find a plant, what should we look for?

Record students' answers in the class science journal.

- 3 Introduce the class set of living things cards. Discuss the measurements that are next to each picture and the different sizes of the specimens.
- 4 Explain that the students will be working in collaborative learning teams to sort the cards as 'Plants', 'Animals' or 'Unsure'.

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 use role badges to help them (and you) know which role each member has.



- 5 Form teams and allocate roles. Allow time for teams to sort the cards into the three groups: 'Plants', 'Animals' or 'Unsure'.

- 6 Introduce the enlarged copy of 'What is an animal?' (Resource sheet 5) and discuss how it resembles 'What makes it living?' (Resource sheet 3). Explain that teams will each be creating their own description of an animal using their copy of 'What is an animal?' (Resource sheet 5).

- 7 Review the claims in the table and see if students' answers from Lesson step 2 are included. If not, add extra claims to reflect them. Explain that teams can also add their own claims.

- 8 Model the process by choosing one animal and completing the checklist in one column for that animal. Ask students to choose four very different looking animals from the cards to write at the top of each column.

Optional: Ask students to consider what claims could be true for plants.



- 9 Form teams and allocate roles. Allow time for students to examine the animal cards and make their conclusions.



- 10 As a class, read through the enlarged copy of 'What is an animal?' and discuss teams' conclusions by asking questions such as:

- Did anyone else come to the same conclusion?
- Does anyone else have different claims?

Discuss how people can have different ideas of what it means to be an animal.



- 11** Explain that scientists consider that all the living things shown on the cards that are not plants are called 'animals'. Discuss with students by asking questions such as:
- Do you agree with the scientists' claim? Why or why not?
 - Why do you think scientists classify them all as animals?

Record an agreed scientific description of an animal by identifying what claims on 'What is an animal?' (Resource sheet 5) are true for all the animal cards.



- 12** Revisit the 'Specimen two' section of the class science chat-board. As a class record what students have learned (for example, that the thing eating insects is a plant) and their evidence for that conclusion (for example, because it has leaves and roots).
- 13** Review the 'Our questions' section of the class science chat-board and answer any questions that can be answered. Record what students have learned next to the question and how they came to that conclusion.
- 14** Update the word wall section of the class science chat-board with words and images.
- 15** Ask teams to keep the animal cards from their 'Living things cards' (Resource sheet 4) for the next lesson.

EXPLORE

Feathers, fur or leaves?

What is an animal?

Name: _____ Date: _____

Tick the claims that are true for each animal that you find.

Claim	Animal				
	chicken	shark	centipede	eagle	kangaroo
It has legs.	✓	✗	✓	✓	✓
It has feathers.	✓	✗	✗	✓	✗
It is green.	✗	✗	✗	✗	✗
It moves.	✓	✓	✓	✓	✓
It is warm.	✓	✗	✗	✓	✓
It has eyes.	✓	✓	✓	✓	✓
It has roots.	✗	✗	✗	✗	✗
It has leaves.	✗	✗	✗	✗	✗
It eats things.	✓	✓	✓	✓	✓

Which of these claims do you think all animals have? Circle them.

PrimaryConnections®
Resource sheet 5

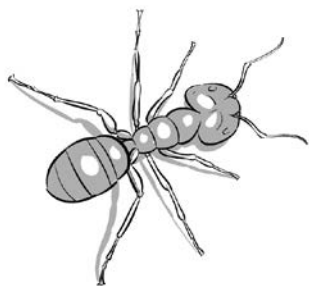
Work sample of 'What is an animal?'

Australian Curriculum links

Mathematics

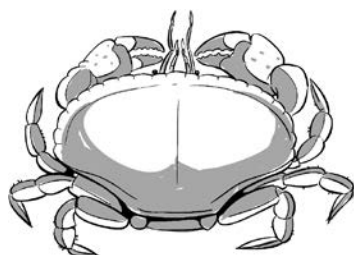
- Order the living things from 'Living things cards' (Resource sheet 4) using the units of length represented on the scale.

Living things cards



ant

3mm long



crab

20cm across



snake

1m long



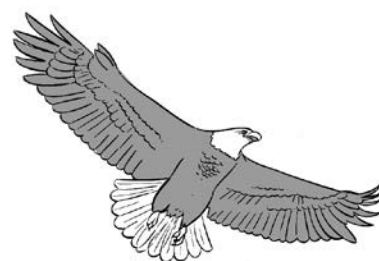
earthworm

7cm long



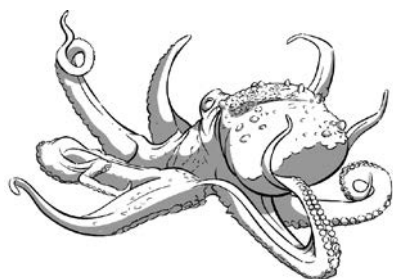
spider

5cm long



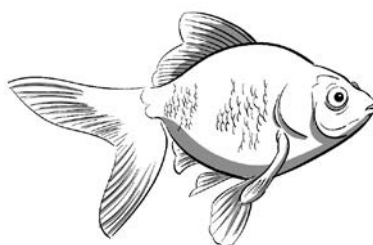
eagle

2m across



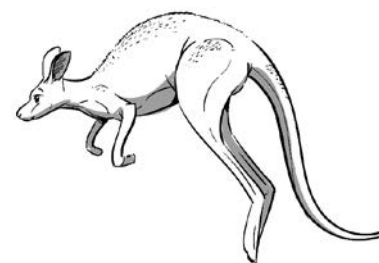
octopus

1m long



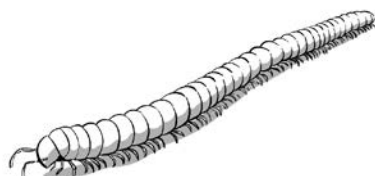
goldfish

20cm across



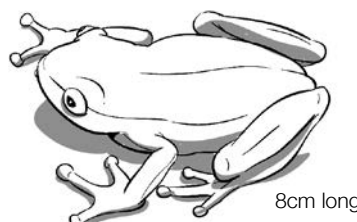
kangaroo

1m high



millipede

5cm long

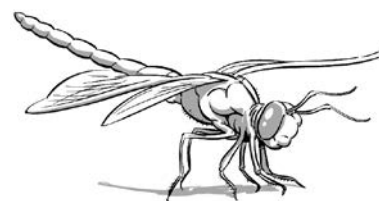


frog

8cm long



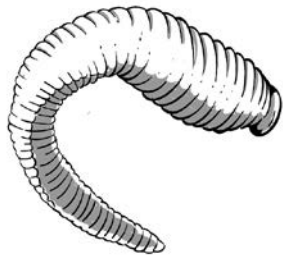
3mm long



dragonfly

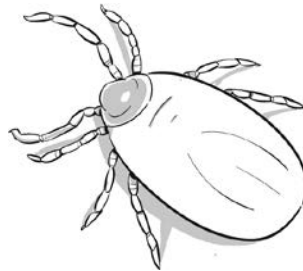
5cm long

Living things cards



leech

4cm long



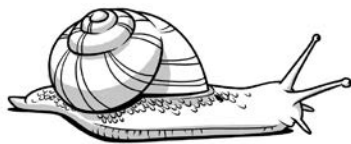
tick

6mm long



human

180cm high



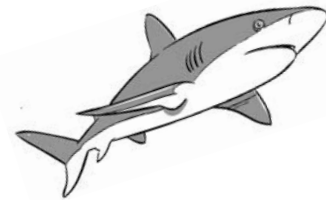
snail

4cm long



axolotl

20cm long



shark

4m long



centipede

6cm long



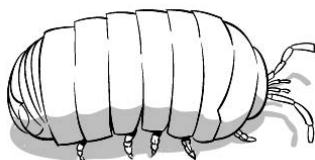
lizard

12cm long



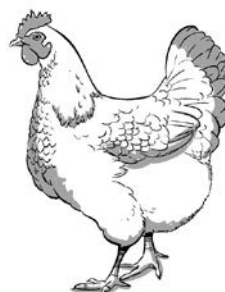
rice grass

80cm high



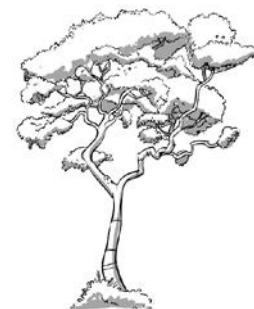
slater

1cm long



chicken

40cm high



tree

8m high

What is an animal?

Name: _____ Date: _____

Tick the claims that are true for each animal that you find.

Claim	Animal				
It has legs.					
It has feathers.					
It is green.					
It moves.					
It is warm.					
It has eyes.					
It has roots.					
It has leaves.					
It eats things.					

Which of these claims do you think all animals have? Circle them.



Lesson 4 What am I?

AT A GLANCE

To provide hands-on, shared experiences of different ways of grouping animals based on observable features.

Students

- identify different features that may be useful for identifying animals
- discuss how to identify animals using their features by playing a game of 'What am I?'
- work in teams to identify features shared by at least two animals using a T-chart.



This lesson focuses on identified features of animals. If you have contact with local Indigenous community members and/or Indigenous Education Officers (see page xii) invite them to discuss what they know about the observable features of Australian animals.

EXPLORE

Lesson focus

The *Explore* phase provides students with hands-on experiences of the topic's science phenomenon while building their science inquiry skills. 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. In this lesson you will monitor students' developing understanding of different features that can be used to group animals scientifically.

Key lesson outcomes

Students will be able to:
• identify common observable features of animals
• group animals according to observable features
• contribute to discussions about specimens, their observable features, and how to classify them
• share responses and opinions with others
• use a T-chart to organise data into categories
• consider numbers of animals sharing the same features.

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

Teacher background information

Our brain classifies the world around us in order to make sense of it. However, it is a personal or cultural choice as to the criteria we use to classify the things we see. Historically, scientists focused on characteristics that were integral to the animal and not likely to change, such as whether they have a backbone and their lung structure. Things that looked similar were grouped together.

Today scientists are working to classify things based on shared ancestry. Therefore, DNA is becoming the key characteristic on which animals are grouped. However, DNA is not always readily available so scientists continue to group animals, particularly fossils, based on their understanding of whether the characteristics of the individuals were likely to be variable in the population. For example, the height of humans varies all over the world, whereas all humans have skin.

Students' conceptions

Students might identify living things according to criteria that are not determined by the genes of the animal, such as where they have seen one before, how they feel about them or whether they are rare. Encourage students to think of features scientists might use to communicate about an animal to someone they've never met from a different time and place.

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- class living things cards from Lesson 3
- 1 A3 piece of paper for a T-chart (see 'Preparation')

FOR EACH TEAM

- role badges for Director, Manager, Speaker
- each team member's science journal
- animal cards from the 'Living things cards' (Resource sheet 4) from Lesson 3
- 1 A4 piece of paper for a T-chart

Preparation

- Assemble the animal cards from the living things cards prepared for Lesson 2.
- Prepare a T-chart on an A3 piece of paper with the title 'Yes' in the first column and 'No' in the second column.
- *Optional:* Display the T-chart on an interactive whiteboard or on a computer connected to a projector. See the Primary **Connections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous session using the class science journal, Natural Science table and science chat-board.

Optional: Ask students to present any new specimens they have for the Natural Science table.



- 2 Explain that students are going to sort the animals on their Natural Science table and depicted in the class animal cards (see 'Preparation') according to their features. Ask students what features they might use to describe one of the animals, for example, skin covering, number of legs, colour, if it lays eggs or not. Record students' suggestions in the class science journal.



- 3 Play the game 'What am I?' by listing the features of an animal. For example, 'I live on land, have four legs, eat plants, have fur and a mane, and run really fast. What am I?' (A horse). The student who guesses the animal correctly becomes the next to think about and describe an animal. Encourage the students to use the features brainstormed in Lesson step 2 to help describe the animal.

Note: At this stage do not model using names of groups, such as 'It is an amphibian'.



- 4 Ask students if it is sufficient to describe just one feature, for example 'It has four legs', to guess the animal. Discuss how animals can share the same features, for example, a frog, lizard and kangaroo all have four legs yet they are very different.

- 5 Explain that students are going to work in collaborative learning teams to identify features that are shared by at least two of the animals on the cards.



- 6 Introduce the T-chart and discuss its purpose and features.

Literacy focus













Why do we use a T-chart?

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

What does a T-chart include?

A **T-chart** includes two columns with headings. Information is put into the columns based on the headings.

- 7 Using the T-chart (see 'Preparation'), model how to sort the cards using the feature 'has fur'. Put the cards with animals that have fur (kangaroo and human) in the 'Yes' column and those that don't have fur in the 'No' column (explain that scientists call hair a type of fur).
- 8 Discuss that when they have three or more animals in the 'Yes' column, students will record the feature in their science journals. Ask teams to create their own T-chart on a piece of A4 paper.
- 9 Discuss how for some questions animals can be both 'Yes' and 'No', for example, frogs live on land and in water. Explain to students that for this activity they are to only consider features that are 'Yes' or 'No', such as 'only lives on land'.

Has fur?	
Yes	No
 	 
	 
	 
	 
	 

Work sample of a T-chart



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



11 Allow time for teams to sort the cards into different groups. Ask questions such as:

- Can you think of a different type of feature you could use?
- Why do you think there was only one animal in the 'Yes' column with that feature?, for example, the question was too specific or it is a rare feature.



12 Invite teams to share the features they used with the class. Ask questions such as:

- Is this feature only relevant for one animal?, for example, 'has four legs'
- Are there any non-living things or any plants with this feature?, for example, a table has four legs

Record features and students' answers in the class science journal.

Note: This reminds students that the features they have identified might not be specific to animals. It is not enough to say 'It has four legs' you need to say 'It is an animal (which implies shared characteristics of moving and eating) with four legs'.

13 Review the 'Our questions' section of the class science chat-board and answer any questions that can be answered. Record what students have learned next to the question and how they came to that conclusion.

14 Update the word wall section of the class science chat-board with words and images.

Australian Curriculum links

English



- Explore Aboriginal and Torres Strait Islanders' knowledge of animal features by exploring a range of Dreamtime texts and oral stories.



- Examine stories about living and non-living things from different cultures and times and ask students to draft their own.



Lesson 5 Animal assemblies

AT A GLANCE

To support students to represent and explain their understanding of how to identify living things and animal groups based on observable features, and to introduce current scientific views.

Students

- review how to distinguish non-living things, plants and animals based on their observable features
- discuss how different groups of animals share features
- classify animals as belonging to an identified group using a branching key.

Lesson focus

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

Assessment focus



Formative assessment is an important aspect of the *Explain* phase. It involves monitoring students' developing understanding of how living things can be grouped on the basis of observable features and can be distinguished from non-living things. This allows you to provide feedback to help students further develop their understanding.

Key lesson outcomes

Students will be able to:
• contribute to discussions about specimens, their observable features, and how to classify them
• share responses and opinions with others
• classify animals into scientific groups using a branching key
• listen to and contribute to conversations
• <i>(optional)</i> read informative texts to research information

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

Teacher background information

Levels of classification

The system of classification used by most scientists today is similar to how Carolus Linnaeus organised his classification system in the 1700s. The highest level of classification is the Kingdom, below that is Phylum, Class, Order, Family, Genus and Species (and even sub-species). Each subsequent level subdivides the previous level and is associated with specific characteristics shared by all members (or in rare cases were previously shared by all members).

The classification for humans (*Homo sapiens*) is therefore:

Kingdom – Animalia

Phylum – Chordata

Class – Mammalia

Family – Hominidae

Genus – *Homo*

Species – *sapiens*

The term ‘mammal’ has specific biological meaning in classification as a ‘Class’ of animals; the term ‘insect’ is also a ‘Class’ with characters such as having six legs and three body parts. Both ‘insect’ and ‘mammal’ are small groups of specific living things that are all from the ‘Kingdom’ of animals.

The groups introduced in this lesson are groups that scientists use, albeit from different levels of the classification hierarchy – with the exception of the group ‘fish’ which covers several scientifically distinct groups.

The Branching key

Scientists today use a combination of DNA technology and characteristics to identify how living things are related in order to classify them. However, once classified, it is easier to recognise living things using a branching key. Dichotomous keys are an ordered series of questions with only two possible answers at each point (generally Yes/No). Each question allows the user to disregard some of the possibilities for identification and focus on a group that becomes smaller with each question.

With the exception of ‘fish’, the groups presented in this unit are used in the scientific community, however they are at different levels in the classification system. Animals are initially grouped as vertebrates and invertebrates according to whether or not they have bones inside their body or not. This is a difficult question for students to answer as it is inside the animal. When students are considering this, encourage them to think of occasions where they might have accidentally noticed this, for example ‘bug splats’ on windows or stepping on a snail.

‘Branching key’ answers

Question: Does it have bones inside its body?

Yes – These animals are called **Vertebrates**:

- **Eagles and chickens are birds**; they have lungs, feathers and a beak, and lay eggs with hard shells.
- **Snakes and lizards are reptiles**; they have lungs and dry scales, and lay eggs with leathery shells on land.

- **Kangaroos and people are mammals;** they have lungs and have fur. They feed their babies with milk after birth. Echidnas and platypuses are the only mammals to lay eggs; the others give birth to live young.
- **Shark and goldfish are fish;** they breathe through gills, have fins and live in the water. Many, but not all, have scales and lay eggs.
- **Frogs and axolotls are amphibians;** they have a soft moist skin without scales and breathe through gills at some stage of their life. Tadpoles have gills and then metamorphose into frogs that have lungs. Axolotls are a type of salamander that no longer go through a metamorphosis and therefore keep their gills and aquatic lifestyle. They have similar gills to tadpoles as well as frilly 'external gills' that they use to push water onto their internal gills.

No – These animals are called **Invertebrates:**

- **Earthworms and leeches are annelids;** they are soft bodied and have many repeated body segments without legs. On land they move by elongating and shortening their bodies while anchoring either the front or the back of their body, for example with tiny bristles or suckers.
- **Octopuses and snails are molluscs;** they are always soft bodied although some create a shell outside or inside their bodies. For example, cuttlefish have an internal shell, the cuttlebone, which helps them float.
- **Slaters and crabs are crustaceans;** they have hard bodies with jointed legs and two pairs of antennae. Many live in the sea, but some, like slaters, live on land.
- **Millipedes and centipedes are myriapods;** they have hard bodies, a single pair of antenna and many repeated body segments with legs. The number of legs varies from a few to hundreds.
- **Ticks and spiders are arachnids;** they have hard bodies divided into two main body parts, no antennae and eight legs. Some have fangs.
- **Ants and dragonflies are insects;** they have hard bodies divided into three main body parts, one pair of antennae and six legs. Some have wings.

Note: The last four groups are all sub-groups of the phylum Arthropoda.

Other invertebrates:

The branching key used for this lesson covers the most commonly found animals. However, there are other distinct groups that are not featured, for example:

- **Cnidaria such as anemones, jellyfish and corals;** their common distinguishing feature is to have a special type of cell, as cnidocyte (stinging cells).
- **Platyhelminthes (flatworms) such as tapeworms and flukes;** they have very flat bodies because they have no organs to help transfer gases around the body.
- **Nematodes such as hookworms and root-knot nematode;** small (from microscopic to 5cm long) round worm-like animals.
- **Echinoderms such as sea stars (starfish) and sea cucumbers;** they have tough, spiny skin and a number of 'legs' that is a multiple of five at some stage of their life.

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- class 'Living things cards' from Lesson 3
- 1 enlarged copy of 'Branching key' (Resource sheet 6)
- self-adhesive labels and pens (see 'Preparation')

FOR EACH STUDENT

- science journal
- self-adhesive labels and pens (see 'Preparation')

Preparation

- Assemble the animal cards from the living things cards prepared for Lesson 3. Decide how you will distribute them among students so that each student or collaborative learning team receives one.
- If you have laminated the 'Living things cards' (Resource sheet 4) as per the suggestion in Lesson 3, provide students with self-adhesive labels so they can add the name of the group that the animal belongs to on the back. Find the dragonfly, ant and human cards (see Lesson step 4).
- Enlarge a copy of 'Branching key' (Resource sheet 6)
- *Optional:* Display the 'Branching key' (Resource sheet 6) on an interactive whiteboard or on a computer connected to a projector. See the Primary **Connections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous lessons using the class science journal, Natural Science table and science chat-board.

Optional: Ask students to present any new specimens they have for the Natural Science table.



- 2 Review 'Specimen three' of the 'Explorer's journal' (Resource sheet 1) and students' claims about animals and groups. Ask students questions such as:

- If the explorer concluded it was an animal, why do you think they thought that?
- Do you agree? Why?
- What animal group do you think this specimen belongs to?

Record students' answers on the science chat-board.

- 3** Explain that the class will work as taxonomists to classify the animals of the Natural Science table and the class animal cards. Explain that taxonomists are scientists who study groups of living things. Discuss how taxonomists identify groups of animals that share a lot of features in common.

Optional: Show students an interview with a taxonomist.

See www.abc.net.au/acedayjobs/cooljobs/profiles/s2599749.htm



- 4** Ask students to consider the pictures of the dragonfly, the ant and the human. Discuss which two animals taxonomists might decide to group together as they have the most in common (dragonfly and ant are both insects).

- 5** Distribute the animal cards evenly (see 'Preparation'). Ask students to compare their animals with other students' animals to try to find one that is very similar to their own.



- 6** Allow time for students to compare their animal cards with other students.



- 7** Ask students to stand next to the student with the animal they thought was the most similar to their own. Ask students questions such as:

- What features are similar between the animals?
- How are they different?

- 8** Explain that scientists use just a few key features to distinguish the animals in the room into eleven different groups. Introduce the enlarged copy of 'Branching key' (Resource sheet 6) and discuss the features and purpose of a branching key.

Literacy focus

What is a branching key?

A **branching key** is a tool to help identify and classify objects.

What does a branching key include?

A **branching key** includes questions to answer and arrows to follow until the object is classified.

Discuss how taxonomists organised the key as a series of simple questions to help them classify new things quickly. Model how to find the group of a cat and write 'cat' under mammals.



- 9** Explain that scientists have decided that snakes and lizards are in the same group. Discuss how to classify the animals using the questions of the branching key with the students who have those cards. Record the names of the animals under the relevant group (reptiles). Ask the two students to record the animal's group (reptiles) on the back of its card, for example using a self-adhesive label (see 'Preparation').



- 10** Repeat Lesson step 9 for each group (see 'Teacher background information' for full list).

- 11** Using the branching key as a visual aid, discuss how all insects are also animals but not all animals are insects.



- 12** Revisit the 'Explorer's journal' (Resource 1) on the class science chat-board. As a class record what students have learned, for example, 'We now know that the millipede is not an insect but it is an animal,' and how they came to that conclusion, for example, because it has the features of a myriapod which is a different type of animal from an insect.

- 13** Review the 'Our questions' section of the class science chat-board and answer any questions that can be answered. Record what students have learned next to the question and how they came to that conclusion.

Optional: For each unanswered question on the class science chat-board, discuss with students whether the question is relevant to the topic. If it is, discuss a plan of action for how to find the information, for example through secondary sources such as a textbook, a website or asking someone such as a scientist. Remind students that not all sources of information are credible and to record where their information comes from.

Organise when students will collect information on relevant questions and when they will present this information to the class.

- 14** Update the word wall section of the class science chat-board with words and images.

Curriculum links

Information and communication technology

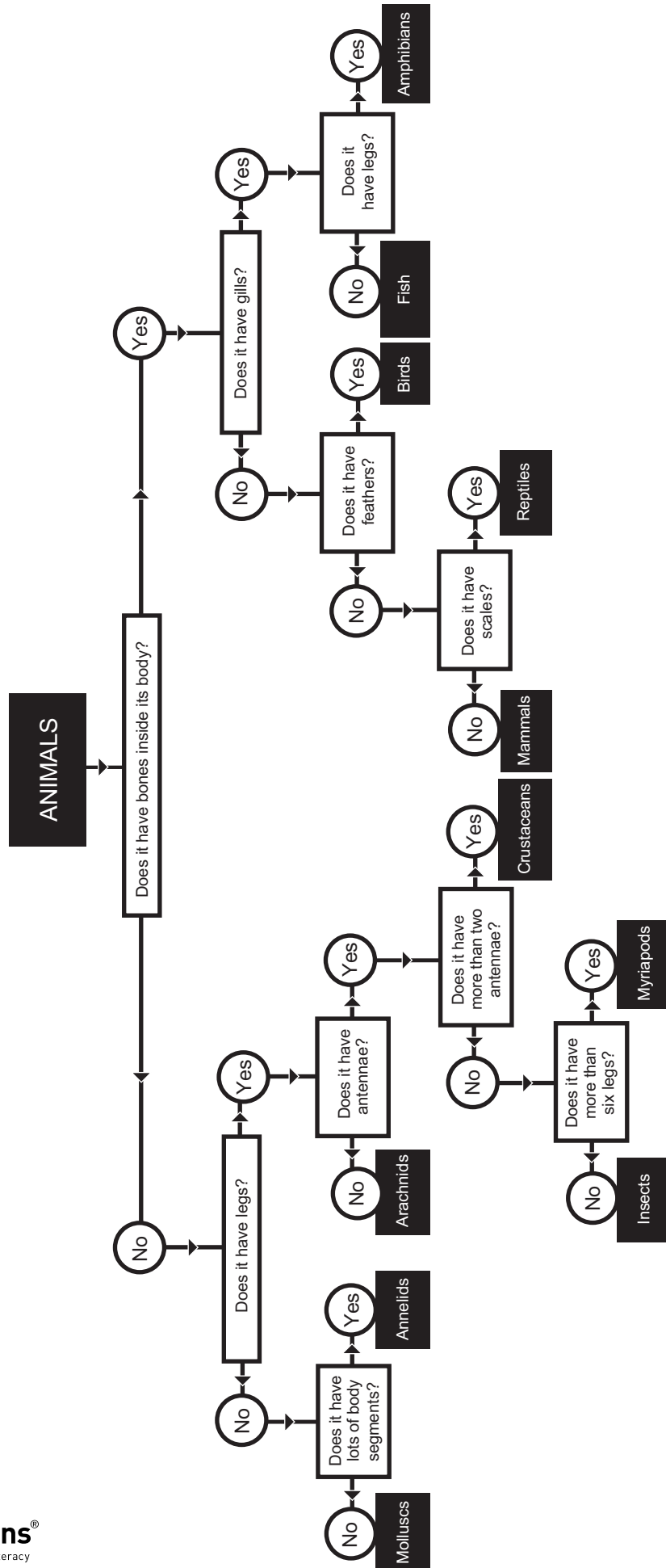
- Play Buzz Bumble by answering yes/no questions to identify small animals using a branching key. See www.rspb.org.uk/youth/play/buzz.aspx
- The Learning Federation (www.thelearningfederation.edu.au) Learning object L1134 Animal search: Sort animals into groups based on their physical features.
- View the web-based Encyclopedia of Life (EoL). The project aims to catalogue every species on Earth in a single, easy-to-use reference guide. See www.eol.org
- Practise sorting key games and activities. See www.woodlands-junior.kent.sch.uk/revision/Science/living/keys.html



Indigenous perspectives

- The dichotomous system of identifying animals based on observable features is one way to organise the world. Indigenous people may have their own way of understanding the relationships around them (see page xii). Contact local Indigenous community members and/or Indigenous Education Officers to access relevant, local Indigenous knowledge. Protocols are available on the website: www.science.org.au/primaryconnections/indigenous

Branching key





Lesson **6** Taxonomists in training

AT A GLANCE

To support students to plan and conduct an investigation of the animal groups present in the leaf litter in the school grounds.

Session 1 Scooping up leaf litter

Students

- discuss how to determine what animal groups are present in the leaf litter and predict what they might find
- work in teams to collect leaf litter specimens in accurately labelled bags.

Session 2 Looking at leaf litter

Students

- observe, draw, identify and tally the animals found
- present investigation results in a column graph
- make claims about the animal groups present in the leaf litter using collected evidence.

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. This phase is designed to challenge and extend students' understanding and skills.

Assessment focus



Summative assessment of the Science Inquiry Skills is an important focus of the *Elaborate* phase. Rubrics are available on the Primary**Connections** website to help you monitor students' science inquiry skills.

Key lesson outcomes

Students will be able to:
<ul style="list-style-type: none"> • predict what animal groups might be found in the school's leaf litter
<ul style="list-style-type: none"> • work in teams to safely use appropriate equipment to collect leaf litter specimens
<ul style="list-style-type: none"> • identify animal specimens and record observations and drawings
<ul style="list-style-type: none"> • display the animal tally results in a column graph
<ul style="list-style-type: none"> • make claims based on evidence about animal groups present in the school's leaf litter
<ul style="list-style-type: none"> • discuss and compare results to form common understandings
<ul style="list-style-type: none"> • reflect on the investigation

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

Teacher background information

The topsoil and leaf litter support a whole ecosystem of animals. Some animals (detritivores) eat the dead animal and plant (organic) matter and the fungi that grow in it. These include: millipedes (myriapods), woodlice such as slaters (crustaceans), earthworms (annelids) and slugs (molluscs). These animals not only chew up organic material to release nutrients, they can also transport bacteria and fungal spores that break down the material even further. The detritivores (centipedes [myriapods], spiders [arachnids] and various insect larvae) are the prey of various predators of the soil and litter system.

The size and diversity of the soil community can vary depending on:

- the amount of compost and organic materials present which depends on the surrounding vegetation and/or animal activity.
- the climate and time of year since the amount of water and the temperature affects fungal and bacterial growth that in turn determines which detritivores are present - too much water drowns them and too little makes the organic matter inedible.
- the place and time of day of sampling, for example if it was in direct sunlight immediately prior to sampling, many animals may have left the area to seek cooler, moister places. However, places that receive sunlight during the day generally have more fungi and bacteria than those that do not receive sunlight and so have more diverse communities if sampled at certain times, such as at dawn.

In order to determine the animal life of the litter and soil of a particular region, scientists might need to sample many different sections, using various methods, and repeat the tests frequently throughout the yearly cycle.

Information adapted with permission from: Kinnear, A. (1994) *Teachers guide to animals of the soil and leaf litter*. Perth: Edith Cowan University.

Session 1 Scooping up leaf litter

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- 1 enlarged copy of 'Animal groups investigation planner' (Resource sheet 7)
- *Optional:* map of the school grounds

FOR EACH TEAM

- role badges for Director, Manager, Speaker
- each team member's science journal
- copy of 'Animal groups investigation planner' (Resource sheet 7)
- gloves
- safety glasses
- magnifying glass
- large container (500mL)
- large zip-lock bags
- self-adhesive label
- pencil
- *Optional:* additional zip-lock bag for home collection

Preparation

- Identify a number of locations around the school that contain a good collection of leaf litter (beneath shrubs, in local bush land). Areas where a variety of leaves have collected may contain more animals. The closer the site to a native environment the greater the diversity of animals that might be observed or collected.

Optional: Find a map of the school grounds to discuss areas to collect specimens.

- If leaf litter is not available in the school grounds, consider other options to help students find animals to classify such as:
 - the soil from the school compost heap
 - the soil from the school vegetable garden
 - water from a nearby river.
- Provide gloves and safety glasses for all students. Advise students to avoid touching their mouth or their eyes during this session. Be aware of students' allergies. Ask students not to handle small animals as they may harm the animals and/or experience bites or stings.
- Enlarge a copy of 'Animal groups investigation planner' (Resource sheet 7).
- *Optional:* Display the 'Animal groups investigation planner' (Resource sheet 7) on an interactive whiteboard or on a computer connected to a projector. See the Primary**Connections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections



Lesson steps

- 1 Review the previous lessons using the class science journal, Natural Science table and science chat-board. Discuss the different animal groups students have identified and their features. Ask questions such as:

- What animal groups might you find in your backyard?
- What animal groups might you find on a farm?
- What animal groups might you find under the ground?
- What animal groups might you find in the leaf litter?

Explain that leaf litter is the word to describe the leaves and other things that have dropped off trees and formed a layer on the ground. Add the word and image to the word wall.



- 2 Explain that students will work in collaborative learning teams to work like taxonomists and explore what animal groups can be found in leaf litter.
- 3 Introduce the enlarged copy of 'Animal groups investigation planner' (Resource sheet 7). Read through with students and model how to complete each step.
- 4 Discuss the features and purpose of a procedural text.

Literacy focus

Why do we use a procedural text?

We use a **procedural text** to find out how something is done.

What does a procedural text include?

A **procedural text** includes a list of materials that we need to do a task and a sequence of steps to follow. It might include labelled diagrams.



- 5 As a class, predict what animal groups they might find in leaf litter and provide reasons for their prediction. Record responses in the 'What do we predict we will find?' section of the enlarged copy of 'Animal groups investigation planner' (Resource sheet 7).
- 6 Discuss with students how they will know if they have found an animal, rather than a non-living thing or a plant. Review the agreed descriptions of living things and animals in the class science chat-board.
- 7 Model how to use a magnifying glass to examine the contents of the bag.
- 8 Review the 'Code for caring' poster from Lesson 1.
- 9 Explain that teams will record their observations and identifications of animal groups in their science journal. Model how to complete an entry about an animal. Discuss the purpose and features of a line drawing.

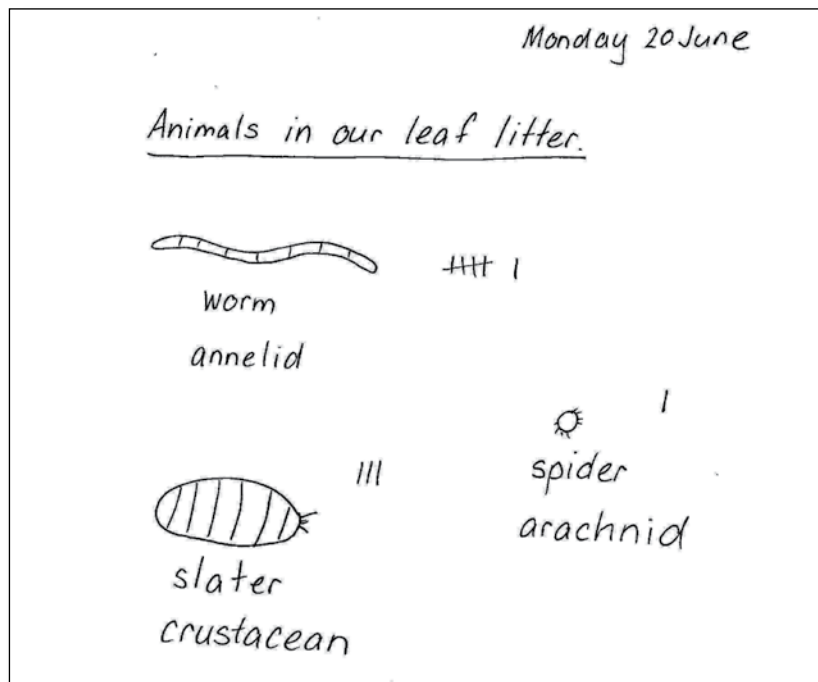
Literacy focus

Why do we use a line drawing?

We use a **line drawing** to show what an object looks like without lots of detail.

What does a line drawing include?

A **line drawing** includes simple lines usually using a pencil.



Work sample of line drawings with tallies

Optional: Ask students to capture results using relevant ICT programs.



10

Form teams and allocate roles. Ask Managers to collect team equipment. Allow teams time to collect and examine the leaf litter, and complete their line drawings and tallies.

Note: There is only enough air in the zip lock bags for a day or more. After a day the bags need to be opened to aerate the contents again.

Optional: Give each student a zip lock bag to collect their own samples from home or another location outside of school. These samples can then be used to compare animal groups found at school with animal groups found elsewhere.

Animal groups investigation planner

Name: _____ Date: _____

1. What do we want to find out?

What animal groups can we find in the leaf litter of our school?

2. What do we predict we will find?

3. What do we need?

- science journal
- gloves
- safety glasses
- magnifying glass
- large plastic container
- large zip-lock bag
- label
- pen

4. What will we do?

1. Find some leaf litter.
2. Print your name, the date and the location on the label.
3. Scoop up two large scoops of the leaf litter and some of the soil too.
4. Zip the bag closed with air inside it.
5. Spread out the leaf litter inside the bag.
6. Draw and tally the animals that you can see.
7. Place the bag flat on a table and leave.



Session 2 Looking at leaf litter

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- enlarged copy of 'Animal groups investigation planner' (Resource sheet 7)
- enlarged copy of 'Animal groups investigation results' (Resource sheet 8)
- 1 enlarged copy of 'Branching key' (Resource sheet 6)

FOR EACH TEAM


- role badges for Director, Manager, Speaker
- each team member's science journal
- collected leaf litter in a zip-lock bag from Session 1
- 1 of copy of 'Animal groups investigation results' (Resource sheet 8)

Preparation

- Read 'How to facilitate evidence-based discussions' (Appendix 5)
- Read 'How to construct and use a graph' (Appendix 6)
- Enlarge a copy of 'Animal groups investigation results' (Resource sheet 8)
- *Optional:* Display the 'Animal groups investigation results' (Resource sheet 8) on an interactive whiteboard or on a computer connected to a projector. See the Primary**Connections** *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections
- Students are asked to examine the contents of the bags without opening for safety reasons including possible allergies, stings and bites.



Lesson steps

- 1 Review the previous session using the class science journal, Natural Science table, science chat-board and the enlarged copies of 'Animal groups investigation planner' (Resource sheet 7). Remind students that they collected evidence by observing their collections of leaf litter and identifying what animal groups were present.
- 2  Introduce the enlarged copy of 'Animal groups investigation results' (Resource sheet 8), and explain that this is where each team will complete a column graph of what they found. Discuss the purpose and features of a graph.
- 3 Form teams and allocate roles. Allow teams time to complete their graphs.

Why do we use a graph?

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

What does a graph include?

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

Explain that students will need to use their line drawings, tallies and branching keys to complete the graph. Model how to complete the graph.



- Invite each team to share the animal groups that they identified using their science journals and 'Animal groups investigation results' (Resource sheet 8) with the class. For each team ask:

- What is your claim? (We claim that insects live in the leaf litter).
- What is your evidence? (We found animals with three body parts and six legs).



- Ask students in the audience to use the 'Science Question starters' (see Appendix 5) to ask each team about their investigation.

Record in the class science journal the names and tallies of the different animal groups that the class agrees were found.



- Introduce the 'Discussing results' section of the 'Animal groups investigation results' (Resource sheet 8). Ask students questions such as:

- Why do you think some teams found other animals?
- What variables might affect what we collect when we scoop the leaf litter? (the time of year, the weather, the location of the collection).

Record students' answers in the class science journal.



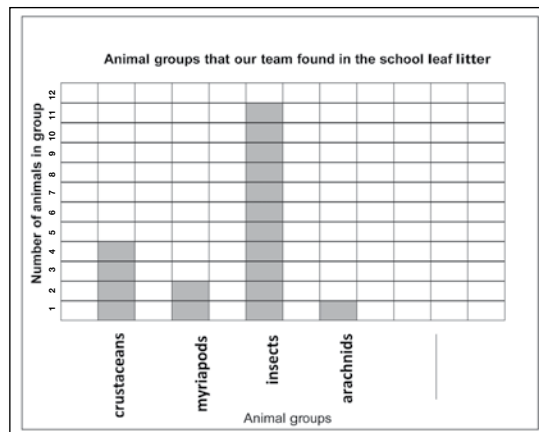
- Review the investigation as a class, asking questions such as:

- What went well with our investigation?
- What didn't go well? How could we have done it better?
- What ideas do you have for another investigation about animal groups in our school?

Record students' ideas in the class science journal.

- Update the word wall section of the class science chat-board with words and images.

- Return the leaf litter, soil and animals to the area that they were found in.



Work sample of animal groups graph

Animal groups investigation results

Name: _____ Date: _____

What did your team find?

Animal groups that our team found in the school leaf litter

Number of animals in group												

Animal groups

Discussing results – What did our whole class find?

Question:

What animal groups are in the leaf litter of our school?

Claim:

Our class claims that the animal groups that are in the leaf litter of our school are:



Lesson 7 Classifying collections

AT A GLANCE

To provide opportunities for students to represent what they know about how living things can be grouped on the basis of observable features and can be distinguished from non-living things, and to reflect on their learning during the unit.

Students

- observe drawings of specimens and organise them into groups based on observable features
- participate in a class discussion to 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 represent their conceptual understanding.

Assessment focus



Summative assessment of the Science Understanding descriptions is an important aspect of the *Evaluate* phase. In this lesson you will be looking for evidence of the extent to which students understand how living things can be grouped on the basis of observable features and can be distinguished from non-living things. Literacy products in this lesson provide useful work samples for assessment using the rubrics provided on the PrimaryConnections website.

Key lesson outcomes

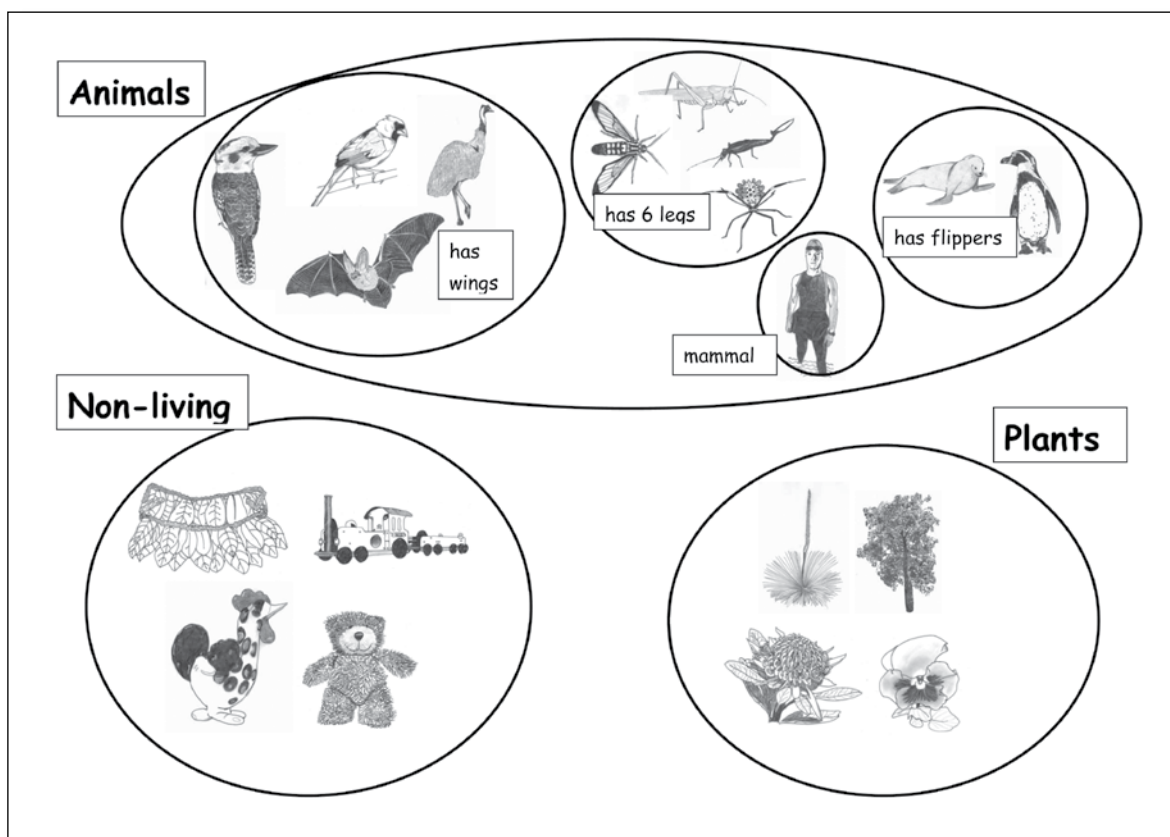
Students will be able to:

- identify groups of things based on their observable features
- share responses and opinions with others
- contribute to discussions and express their opinions about their learning journey

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

Teacher background information

In this lesson, students will be grouping things based on their observable features. One way that scientists might group the drawings is shown below.



Work sample of drawings in groups

Equipment

FOR THE CLASS

- class science journal
- class science chat-board
- Natural Science table
- 1 enlarged copy of 'Lots of drawings' (Resource sheet 9)

FOR EACH STUDENT

- science journal
- 1 copy of 'Lots of drawings' (Resource sheet 9)
- scissors
- glue

Preparation

- Enlarge a copy of 'Lots of drawings' (Resource sheet 9)
- *Optional:* Display the photos from 'Lots of drawings' (Resource sheet 9) on an interactive whiteboard or on a computer connected to a projector. See the PrimaryConnections *Feathers, fur or leaves?* Interactive Resource available at www.science.org.au/primaryconnections

Lesson steps

- 1 Review the previous lessons using the class science journal, Natural Science table and word wall.
- 2 Play the game, 'What am I?' using the animal cards and/or things inside or outside the classroom. The student who works out the answer then becomes the leader and chooses the clues for others to work out. Encourage students to use features that they have been learning throughout the unit.
- 3 Explain that you have a jumble of drawings made by an explorer that need to be grouped.



- 4 Introduce the enlarged copy of 'Lots of drawings' (Resource sheet 9). Explain that students will organise the drawings into groups that they think scientists might find useful.
- 5 Ask students to look at the drawings and think about what groups they might put them into. Ask students to cut the drawings out and then paste them into their science journals into those groups. Model circling the group and labelling it with its name and features.



- 6 Allow time for students to complete the activity.



- 7 Ask students to share the groups that they have made and why they made those groups. Ask questions such as:
 - What groups have you made that scientists might find useful? (I claim the groups that can be made are...)
 - Why did you choose those groups? What is your evidence or thinking for making those groups?



- 8 Ask students to reflect on their learning during the unit using the Explorer's journal, the class science journal, science chat-board and completed resource sheets. Ask questions such as:
 - What did you think about ... at the start of the unit? (for example, non-living things, plants, animals, animal groups)
 - What did we want to find out about...?
 - What have you learned about...? Why do you think that now?
 - How did you find about about...?
 - What activity did you enjoy most of all? Why?
 - What activity did you find the most challenging? Why?
 - What are you still wondering about?

Curriculum links

Information and Communication Technology

- Classifying animals (www.csiro.au/helix/sciencemail/activities/ClassifyingAnimals.html) – students design, draw and classify an animal based on a series of criteria, such as what it eats, whether or not it has a backbone and whether it is cold or warm-blooded.

Lots of drawings



moth



swimmer



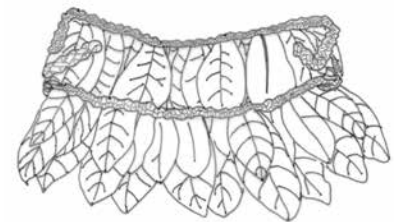
teddy bear



coreid bug



pansy



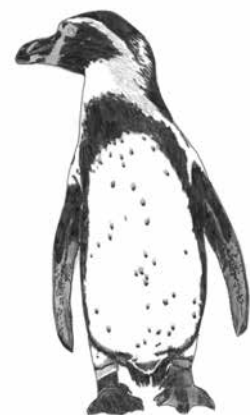
leaf skirt



emu



grass tree



penguin

Lots of drawings



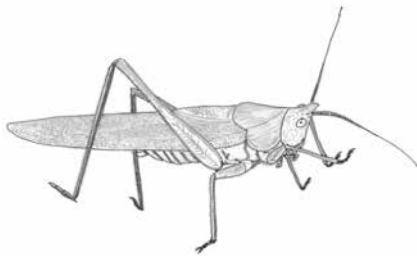
cardinal



waratah



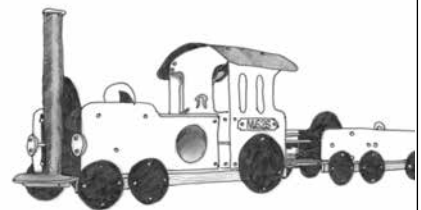
seal



katydid



glass chicken



train



bat



tree



earwig

Appendix 1

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

Introduction

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

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

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

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

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

Team structure

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

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

Team roles

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

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

a colour-coded peg, badge or wristband. 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 members should be doing.

Manager

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

Speaker

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

Director

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

PrimaryConnections 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.

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



Supporting equity

In science lessons, there can be a tendency for boys to manipulate materials and girls to record results. PrimaryConnections 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 SKILLS

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

TEAM ROLES

Manager

Collects and returns all materials the team needs

Speaker

Asks the teacher and other team speakers for help

Director

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

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.

Representing their ideas in a science journal gives students a purposeful task for writing and reading in English. For additional information on how to help students who are learners of English as an additional language or dialect, please see the Australian Curriculum resources.

Keeping 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 Stages 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, for example, 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.

Feathers, fur or leaves? science journal entries

Our team: Steve, Tim and Benjamin 23 June

Animal groups that our team found in the school leaf litter


Animal group	Number of animals in group
crustaceans	4
myriapods	2
insects	11
arachnids	1

Our team claims that crustaceans, myriapods, insects and arachnids are in the leaf litter at our school.


Our evidence is that we found 4 crustaceans, 2 myriapods, 11 insects and 1 arachnid when we collected a scoop of leaf litter.

20 June


I think that these things are living -



spider



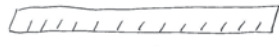
worm



snail

I think they are living because they move and they breathe and they eat.

I think this is non-living because it can't move and it can't breathe.



my ruler

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 regional 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

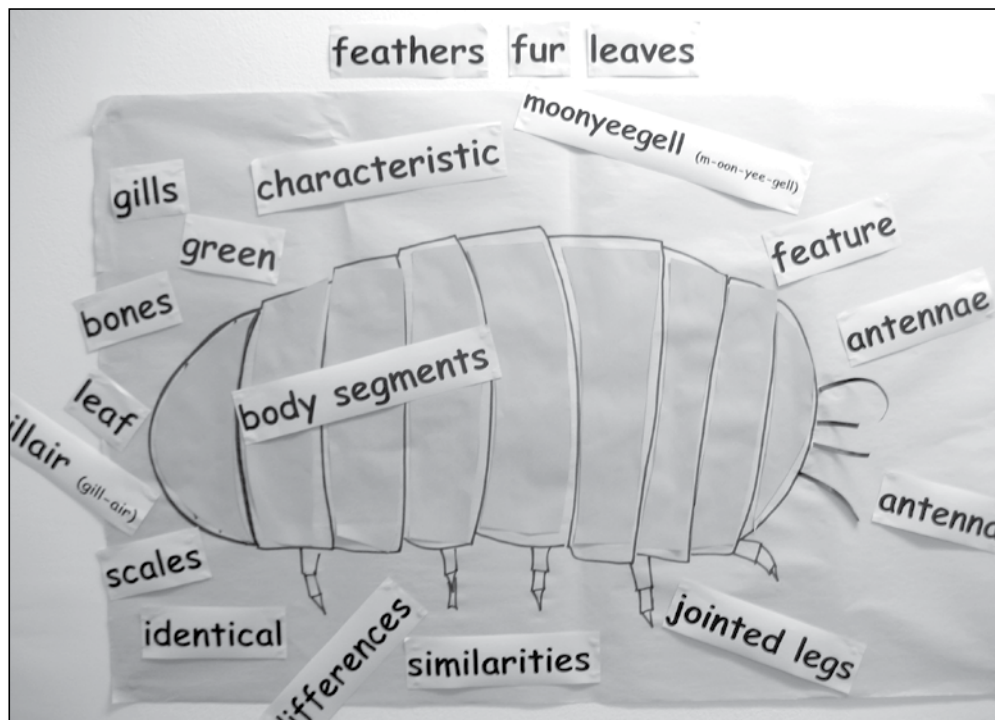
Position the word wall so that students have easy access to the words. They need to be able to see, remove and return word cards to the wall. A classroom could have one main word wall and two or three smaller ones, each with a different focus, for example, high-frequency words.

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

Organise the words on the wall in a variety of ways. Place them alphabetically, or put them in word groups or groups suggested by the unit topic, for example, words for a *Feathers, fur or leaves?* unit might be organised using headings, such as 'Animal types', 'Animal characteristics' and 'Animal names'.

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



Feathers, fur or leaves? word wall

Using a word wall

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

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**C**onnections 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.

Feathers, fur or leaves? 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?)
We think bugs, worms and insects are in our school's leaf litter. →	What animal groups are in the leaf litter in our school? →	The animals in our school leaf litter are: insects, annelids and crustaceans. →	We found five animals: three were insects because they had 6 legs and 3 body parts and two were annelids because they had soft bodies and no legs.

Science chat-board

One way of recording students' learning journey throughout the unit is to use a science chat-board as a TWLH chart. This is a space where students record thoughts, ideas, questions, claims, evidence and reasoning as the unit progresses.

A separate 'Our questions' section is created on the science chat-board to ensure all students' questions are captured and a 'Word wall' section is provided for students to record relevant words and associated images.



Feathers, fur or leaves? science chat-board

Appendix 5

How to facilitate evidence-based discussions

Introduction

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

In the primary science classroom, argumentation is about students:

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

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

Establish norms

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

- Listen when others speak
- Ask questions of each other
- Criticise ideas, not people
- Discuss all ideas before selecting one.

Claim, Evidence and Reasoning

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

Q – What **question** are you trying to answer? For example, 'What animal groups are in the leaf litter?'

C – The **claim**. For example, 'Annelids live in the leaf litter'.

E – The **evidence**. For example, 'I found an animal that is an annelid because it does not have bones, has a soft body and has lots of segments'.

R – The **reasoning**. How the evidence supports the claim. In this unit, students are required to make claims and collect evidence only.

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

Science question starters

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

Science question starters

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

DISCUSSION SKILLS

- 1 Listen when others speak**
- 2 Ask questions of each other**
- 3 Criticise ideas, not people**
- 4 Discuss all ideas before selecting one**

Appendix 6

How to construct and use a graph

Introduction

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

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

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

What type of graph? and

Which variable goes on each axis of the graph?

The Australian Curriculum: Mathematics describe data representation and interpretation for Year 3 as follows:

- Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies
- Interpret and compare data displays.

What type of graph?

The type of graph used depends on the type of data to be represented. Many investigations explore the effect of changing one variable while another is measured or observed.

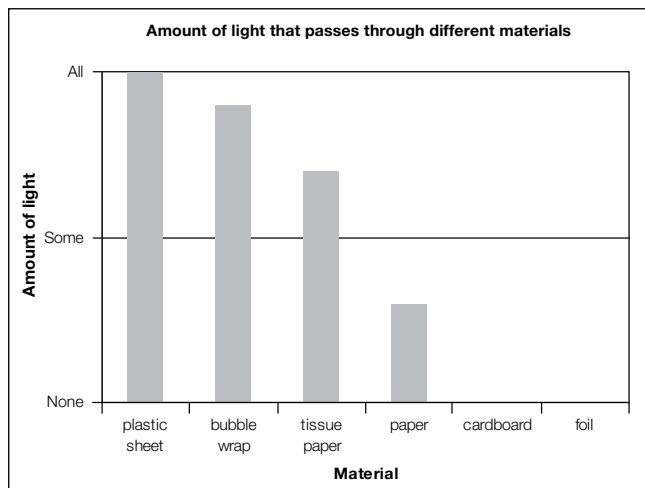
Column graph

Where data for one of the variables are in **categories** (that is, we use **words** to describe it, for example, material) a **column graph** is used. Graph A below shows how the results for an investigation of the effect of material type on the amount of light that passes through it (**data in categories**) have been constructed as a **column graph**.

Table A: The effect of material on the amount of light that passes through

Material	Amount of light
plastic sheet	all
bubble wrap	almost all
tissue paper	most
paper	not much
cardboard	none
foil	none

Graph A: The effect of material on the amount of light that passes through



Line graph

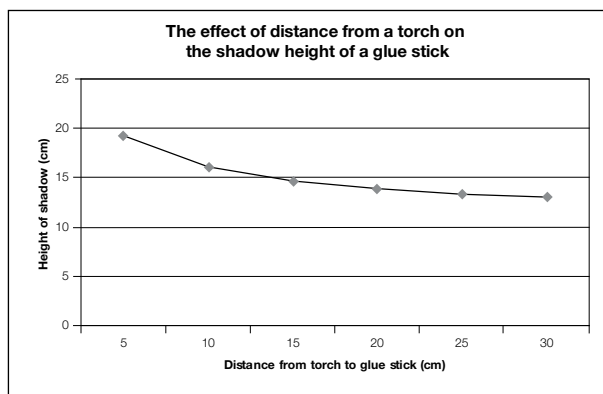
Where the data for both variables are **continuous** (that is, we use **numbers** that can be recorded on a measurement scale, such as length in centimetres or mass in grams), a **line graph** is usually constructed. Graph B below shows how the results from an investigation of the effect of distance from a light source (**continuous data**) on the shadow height of an object (**continuous data**) have been constructed as a **line graph**.

Note: For the ‘Big shadow, little shadow’ lesson in this unit, a line graph would be the conventional method to represent findings from this investigation as the data for both variables are continuous. It is suggested, however, that students construct a column graph as this is appropriate for Stage 2 students. You might produce a column and a line graph and discuss with students why a line graph would normally be used to represent the data.

Table B: The effect of distance from a torch on the shadow height of a glue stick

Distance from torch to glue stick (cm)	Height of shadow (cm)
5	19.3
10	16.1
15	14.7
20	13.9
25	13.3
30	13

Graph B: The effect of distance from a torch on the shadow height of a glue stick



Which variable goes on each axis?

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

Graph titles and labels

Graphs have a title and each variable is labelled on the graph axes, including the units of measurement. The title of the graph is usually in the form of ‘The effect of one variable on the other variable’. For example, ‘The effect of distance from a torch on the shadow height of a glue stick’ (Graph B).

Steps in analysing and interpreting data

- Step 1** Organise the data (for example, construct a graph) so you can see the pattern in data or the relationship between data for the variables (things that we change, measure/observe, or keep the same).
- Step 2** Identify and describe the pattern or relationship in the data.
- Step 3** Explain the pattern or relationship using science concepts.

Questioning for analysis

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

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

Analysis

For example, analysis of Graph B shows that further the distance from the torch the shorter the height of the glue stick's shadow. This is because as light travels in straight lines, the closer the object to a light source the more light it blocks out and therefore the bigger the shadow.

Appendix 7 Feathers, fur or leaves? equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON		1	2	3	4	5	6	6	7
		1	SESSION								
Equipment and materials											
A3 paper	1 per class						•				
A4 paper	7 per class	•									
A4 paper	1 per student		•				•				
blank Poster paper (Code for caring)	1 per class		•								
card or paper for labels	ongoing		•	•	•	•	•	•	•	•	•
'Explorer's journal' specimens or photos	1 set per class	•									
gloves (gardening, plastic)	1 pair per student								•		
container (500ml)	1 per team								•		
self-adhesive label	1 per team								•		
large zip-lock bag (35cmx27cm)	1 per team								•		
large zip-lock bag (35cmx27cm) optional	1 per student								•		
magnifying glass	1 per team								•		
manila folder (Home explorer's folder)	1 per student			•							
map of the school grounds optional	1 per class								•		
marker pen	1 per student							•			
marker pen	1 per team								•		
paper, large sheets	4 per class		•								
safety glasses	1 per student								•		
scissors	1 per student										•
self-adhesive labels	1 per student							•			
self-adhesive notes	2 per student		•								
self-adhesive notes	ongoing		•	•	•	•	•	•	•	•	•
table, large for specimen display	1 per class		•								•

EQUIPMENT ITEM	QUANTITIES	LESSON		1	1	2	3	4	5	6	6	7
		SESSION	1	2						1	2	
Equipment and materials (continued)												
table labels	3 per class						•	•				
tape or glue	1 per student		•									•
tape or glue	1 per class					•						
wall labels	3 per class			•								
Resource sheets												
'Explorer's journal' (RS1)	1 per student											
'Explorer's journal' (RS1), enlarged	1 per class	•		•								
'Information note for families' (RS2)	1 per student			•								
'Home explorer's journal' (RS2)	1 per student			•								
'Home explorer's journal', enlarged (RS2)	1 per class			•								
'What makes it alive' (RS3), enlarged	1 per class					•	•					
'Living things cards' (RS4)	1 per team						•	•				
'Living things cards' (RS4), enlarged	1 per class						•	•				
'What is an animal' (RS5)	1 per team						•					
'What is an animal' (RS5), enlarged	1 per class						•					
'A branching key' (RS6), enlarged	1 per class							•				
'Animal group investigation planner' (RS7), enlarged	1 per class								•	•		
'Animal group investigation planner' (RS7)	1 per team									•		
'Animal group investigation results' (RS8), enlarged	1 per class									•	•	
'Lots of drawings' (RS9)	1 per student											•
'Lots of drawings' (RS9), enlarged	1 per class											•
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						•	•				•
science chat board	1 per class						•	•				•
student science journal	1 per student	•		•								•
word wall	1 per class	•		•								•

Appendix 8 Feathers, fur or leaves? unit overview

LESSON SUMMARY		LESSON OUTCOMES*	ASSESSMENT OPPORTUNITIES
ENGAGE	<p>Lesson 1 Wandering about the world</p> <p>Students</p> <ul style="list-style-type: none"> describe different ways to group specimens share observations of features of specimens make claims about whether specimens are non-living, plants or animals identify a living and a non-living specimen at home write a journal entry, including a labelled diagram. 	<p>Students will be able to</p> <ul style="list-style-type: none"> contribute to discussions about specimens and their observable features identify the purpose and features of a science journal identify possible questions for investigation identify living and non-living things in their home create a labelled diagram and journal entry to represent and communicate their findings. 	<p>Diagnostic assessment</p> <ul style="list-style-type: none"> Science journal entries Class discussions Science chat-board and word wall contributions
	<p>Lesson 2 Sorting out life</p> <ul style="list-style-type: none"> discuss the specimens and journal entries from their home exploration identify the features of living things and describe how they differ from non-living things. 	<ul style="list-style-type: none"> contribute to discussions about specimens, their observable features and how to classify them share responses and opinions with others identify living and non-living things from shared specimens consider claims about living specimens and identify patterns in data create a shared description of what makes something living. 	<p>Formative assessment</p> <ul style="list-style-type: none"> Science journal entries Class discussions Science chat-board and word wall contributions 'Home explorer's journal' (Resource sheet 2) 'What makes it living?' (Resource sheet 3)

* These outcomes are aligned to relevant descriptions of the Australian Curriculum: Science and are provided at the beginning of each lesson.

LESSON SUMMARY		LESSON OUTCOMES*		ASSESSMENT OPPORTUNITIES	
<p>Students</p> <ul style="list-style-type: none"> • classify picture cards as 'Animals', 'Plants' or 'Unsure' and discuss their choice • work in teams to identify the defining features of animals • distinguish the features of plants. 	<p>Students will be able to</p> <ul style="list-style-type: none"> • contribute to discussions about specimens, their observable features and how to classify them • identify and group plants using picture cards • share responses and opinions with others • determine the size of a plant or animal • identify claims about what makes something an animal by identifying patterns in data • create a shared description of what makes something an animal. 	<p>Lesson 3 Animal sort</p>	<p>Formative assessment</p> <ul style="list-style-type: none"> • Science journal entries • Class discussions • Science chat-board and word wall contributions • 'Living things cards' (Resource sheet 4) card sort • 'What is an animal?' (Resource sheet 5) 		
<ul style="list-style-type: none"> • identify different features that may be useful for identifying animals • discuss how to identify animals using their features by playing a game of 'What am I?' • work in teams to identify features shared by at least two animals using a T-chart. 	<ul style="list-style-type: none"> • identify common features of animals • group animals according to observable features • contribute to discussions about specimens, their observable features and how to classify them • share responses and opinions with others • use a T-chart to organise data into categories • consider numbers of animals sharing the same features. 	<p>Lesson 4 What am I?</p>	<p>Formative assessment</p> <ul style="list-style-type: none"> • Science journal entries • Class discussions • Science chat-board and word wall contributions • Natural science table sort • T-chart responses 		

* These outcomes are aligned to relevant descriptions of the Australian Curriculum: Science and are provided at the beginning of each lesson.

LESSON SUMMARY		LESSON OUTCOMES*		ASSESSMENT OPPORTUNITIES	
EXPLAIN	Lesson 5 Animal assemblies	Students	Students will be able to		
		<ul style="list-style-type: none"> review how to distinguish non-living things, plants and animals based on their observable features discuss how different groups of animals share features classify animals as belonging to an identified group using a branching key. 	<ul style="list-style-type: none"> contribute to discussions about specimens, their observable features and how to classify them share responses and opinions with others classify animals into scientific groups using a branching key listen to and contribute to conversations (optional) read informative texts to research information. 	<p>Formative assessment</p> <ul style="list-style-type: none"> Science journal entries Class discussions Science chat-board and word wall contributions Animal card match-up responses Branching key (Resource sheet 6) responses 	

* These outcomes are aligned to relevant descriptions of the Australian Curriculum: Science and are provided at the beginning of each lesson.

		LESSON SUMMARY	LESSON OUTCOMES*	ASSESSMENT OPPORTUNITIES
FLABORATE	Lesson 6 Taxonomists in training	<p>Students</p> <ul style="list-style-type: none"> discuss how to determine what animal groups are present in the leaf litter and predict what they might find work in teams to collect leaf litter specimens in accurately labelled bags observe, draw, identify and tally the animals found present investigation results in a column graph make claims about the animal groups present in the leaf litter using collected evidence. 	<p>Students will be able to</p> <ul style="list-style-type: none"> predict what animal groups might be found in the school's leaf litter work in teams to safely use appropriate equipment to collect leaf litter specimens identify animal specimens and record observations and drawings make claims based on evidence about animal groups present in the school's leaf litter discuss and compare results to form common understandings reflect on the investigation. 	<p>Summative assessment of the Science Inquiry Skills</p> <ul style="list-style-type: none"> Science journal entries Class discussions Science chat-board and word wall contributions 'Animal groups investigation planner' (Resource sheet 7) 'Animal groups investigation results' (Resource sheet 8)
	EVALUATE	<p>Lesson 7 Classifying collections</p> <ul style="list-style-type: none"> observe drawings of specimens and organise them into groups based on observable features participate in a class discussion to reflect on their learning during the unit. 	<ul style="list-style-type: none"> identify groups of things based on their observable features share responses and opinions with others contribute to discussions and express their opinions about their learning journey. 	<p>Summative assessment of the Science Understanding</p> <ul style="list-style-type: none"> Science journal entries Class discussions Science chat-board and word wall contributions 'Lots of drawings' (Resource sheet 9)

* These outcomes are aligned to relevant descriptions of the Australian Curriculum: Science and are provided at the beginning of each lesson.



Professional learning

PrimaryConnections: linking science with literacy is an innovative program linking the teaching of science with the teaching of literacy in primary schools. The program includes a professional learning component and curriculum units aligned to the Australian Curriculum: Science.

Research has shown that the professional learning component of the **PrimaryConnections** program significantly enhances the implementation of the curriculum units. Professional Learning Facilitators are available throughout Australia to conduct a variety of workshops. At the heart of the professional learning program is the Curriculum Leader Training Program.

PrimaryConnections Curriculum Leader Training Program

Held annually, this two-day workshop develops a comprehensive understanding of the **PrimaryConnections** program. Participants receive professional learning resources that can be used to train others in **PrimaryConnections**.

PrimaryConnections one-day Introduction to PrimaryConnections Program

This workshop develops knowledge and understanding of **PrimaryConnections**, and the benefits to enhance the teaching and learning of science and literacy.

The professional learning calendar, other workshops and booking forms can be found on the website: www.science.org.au/primaryconnections

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

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

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

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

PrimaryConnections features an inquiry-based approach, embedded assessment and incorporates Indigenous perspectives.

The PrimaryConnections curriculum resources span Years F–6 of primary school.

www.science.org.au/primaryconnections

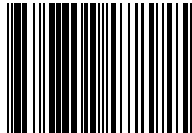


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