Primary**Connections**®

Australian Academy of Science

Feathers, fur or leaves?

Year 3

Biological sciences

About this unit   Feathers, fur or leaves?

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, such 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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Contents

Foreword

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

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

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

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

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

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

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

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

The Primary**Connections** teaching and learning approach

Primary**Connections** units embed inquiry-based learning into a modified 5Es instructional model. The relationship between the 5Es phases, investigations, literacy products and assessment is illustrated below:

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

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

More information on Primary**Connections** 5Es teaching and learning model can be found at:

www.primaryconnections.org.au

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

Developing students' scientific literacy

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

- scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues

- understanding of the characteristic features of science as a form of human knowledge and enquiry

- awareness of how science and technology shape our material, intellectual and cultural environments

- willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen

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

Linking science with literacy

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

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

Assessment

Science is ongoing and embedded in Primary**Connections** units. Assessment is linked to the development of literacy practices and products. Relevant understandings and skills are highlighted at the beginning of each lesson. Different types of assessment are emphasised in different phases:

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

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

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

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

Safety

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

- Be aware of the school's policy on safety in the classroom and for excursions.

- Check students' health records for allergies or other health issues.

- Be aware of potential dangers by trying out activities before students do them.

- Caution students about potential dangers before they begin an activity.

- Clean up spills immediately as slippery floors are dangerous.

- Instruct students never to smell, taste or eat anything unless they are given permission.

- Discuss and display a list of safe practices for science activities.

Teaching to the Australian Curriculum: Science

The Australian Curriculum: Science has three interrelated strands—Science Understanding, Science as a Human Endeavour and Science Inquiry Skills—that together 'provide students with understanding, knowledge and skills through which they can develop a scientific view of the world' (ACARA, 2020).

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

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

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

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

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
EXPLORE	**Lesson 2** Sorting out life	To provide students with hands-on, shared experiences of how to distinguish between living and non-living things
	Lesson 3 Animal sort	To provide students with hands-on, shared experiences of how to distinguish between plants and animals using observable features
	Lesson 4 What am I?	To provide students with hands-on, shared experiences of different ways of grouping animals based on observable features
EXPLAIN	**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 view
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.

Feathers, fur or leaves?— Alignment with the Australian Curriculum

Feathers, fur or leaves? is written to align to the Year 3 level of the Australian Curriculum: Science.

The Science Understanding, Science Inquiry Skills, and Science as a Human Endeavour strands are interrelated and embedded throughout the unit (see page xii for further details). This unit focuses on the Biological sciences sub-strand.

Year 3 Science Understanding for the Biological Sciences:	Living things can be grouped on the basis of observable features and can be distinguished from non-living things (ACSSU044)
Incorporation 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.

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

Year 3 Achievement Standard

The Australian Curriculum: Science Year 3 achievement standard indicates the quality of learning that students should demonstrate by the end of Year 3.

By the end of Year 3, students use their understanding of the movement of Earth, materials and the behaviour of heat to suggest explanations for everyday observations. They **group living things based on observable features and distinguish them from non-living things. They describe how they can use science investigations to respond to questions.**

Students use their experiences to identify questions and make predictions about scientific investigations. They follow procedures to collect and record observations and suggest possible reasons for their findings, based on patterns in their data. They describe how safety and fairness were considered and they use diagrams and other representations to communicate their ideas.

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

Feathers, fur or leaves?—Australian Curriculum Key ideas

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

Overarching idea	Incorporation in *Feathers, fur or leaves?*
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

Feathers, fur or leaves?—Australian Curriculum: Science

Feathers, fur or leaves? embeds all three strands of the Australian Curriculum: Science. For ease of reference, the table below outlines the sub-strands covered in *Feathers, fur or leaves?*, the content descriptions for Year 3 and their aligned lessons.

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	1–7
Science Inquiry Skills	**Questioning and predicting**	ACSIS053	With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge	6
	Planning and conducting	ACSIS054	With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment	6
		ACSIS055	Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately	4–6
	Processing and analysing data and information	ACSIS057	Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends	2–4, 6, 7
		ACSIS215	Compare results with predictions, suggesting possible reasons for findings	6
	Evaluating	ACSIS058	Reflect on investigations, including whether a test was fair or not	6
	Communicating	ACSIS060	Represent and communicate observations, ideas and findings using formal and informal representations	1–4, 6, 7

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

General capabilities

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

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

Feathers, fur or leaves?—Australian Curriculum general capabilities

General capabilities	Australian Curriculum description	*Feathers, fur or leaves?* examples
Literacy	Literacy knowledge specific to the study of science develops along with scientific understanding and skills. Primary**Connections** learning activities explicitly introduce literacy focuses and provide students with the opportunity to use them as they think about, reason and represent their understanding of science.	In *Feathers, fur or leaves?* the literacy focuses are: • science chat-boards • science journals • word walls • labelled diagrams • tables • T-charts • branching keys • procedural texts • line drawings • graphs.
Numeracy	Elements of numeracy are particularly evident in Science Inquiry Skills. These include practical measurement and the collection, representation and interpretation of data.	Students: • 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 is particularly evident in Science Inquiry Skills. Students use digital technologies to investigate, create, communicate, and share ideas and results.	Students are given optional opportunities to: • use digital cameras to record 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.
Critical and creative thinking	Students develop critical and creative thinking as they speculate and solve problems through investigations, make evidence-based decisions, and analyse and evaluate information sources to draw conclusions. They develop creative questions and suggest novel solutions.	Students: • use reasoning to develop questions for inquiry • use a beliefs continuum • formulate, pose and respond to questions • consider different ways of thinking about classificatio and definition • develop evidence-based claims.
Ethical behaviour	Students develop ethical behaviour as they explore principles and guidelines in gathering evidence and consider the implications of their investigations on others and the environment.	Students: • 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 work effectively in teams, develop collaborative methods of inquiry, work safely, and use their scientific knowledge to make informed choices.	Students: • work collaboratively in teams • follow a procedural text for working safely • participate in discussions.
Intercultural understanding	Intercultural understanding is particularly evident in Science as a Human Endeavour. Students learn about the influence of people from a variety of cultures on the development of scientific understanding	• 'Cultural perspectives' opportunities are highlighted where relevant • Important contributions made to science by people from a range of cultures are highlighted where relevant.

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

Alignment with the Australian Curriculum: English and Mathematics

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, 4, 5
	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	1–7
	Text structure and organisation	ACELA1478	Understand how different types of texts vary in use of language choices, depending on their purpose (for example, tense and types of sentences)	1, 5, 6
	Expressing and developing ideas	ACELA1484	Learn extended and technical vocabulary and ways of expressing opinion including modal verbs and adverbs	1–7
English–Literacy	**Interacting 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 and evaluating	ACELY1680	Use comprehension strategies to build literal and inferred meaning and begin to evaluate texts by drawing on a growing knowledge of context, text structures and language features	1, 5
Mathematics–Number and Algebra	**Number and place value**	ACMNA052	Recognise, model, represent and order numbers to at least 10 000	6
Mathematics–Measurement and Geometry	**Using units of measurement**	ACMMG061	Measure, order and compare objects using familiar metric units of length, mass and capacity	3, 6
Mathematics–Statistics and Probability	**Data representation and interpretation**	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	2–4, 6
		ACMSP070	Interpret and compare data displays	2, 3, 6

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

Cross-curriculum priorities

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

• Aboriginal and Torres Strait Islander histories and cultures

• Asia and Australia's engagement with Asia

• Sustainability.

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

Aboriginal and Torres Strait Islander histories and cultures

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

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.

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

Sustainability

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 upon them.

Teacher background information

Introduction to scientific classification

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, the kingdom of plants and the kingdom of animals. 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, for example, leaves, and structures to capture water and nutrients from the environment, for example, 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, such as 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 might attribute their own meanings to the terms 'alive' or 'living'. For example, they might 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; Stepans, 1985). They might 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 might 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; Stepans,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 and that it is not an insect (Driver et al., 1994. However, scientists denote ants are part of a group called insects, and insects are 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.

References

Bell, B. (1985 'Student's ideas about plant nutrition: What are they?' *Journal of Biological Education,* 19 (3, pp. 213–18.

Carey, S. (1985. *Conceptual Change in Childhood,* Cambridge, MA: MIT Press.

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.

Stepans, J. (1985. 'Biology in elementary school: children's conceptions of life' *American Biology Teacher,* 47, pp. 222–225.

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

www.primaryconnections.org. au

Note: 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 a labelled diagram.

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.

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

ENGAGE

Key lesson outcomes

Science

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

- identify the observable features of specimens and how to classify them
- identify living and non-living things in their home
- identify possible questions for investigation.

Literacy

Students will be able to:

- contribute to class discussions about specimens, their observable features and how to classify them
- identify the purpose and features of a class science journal
- 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 xii.

Teacher background information

In this lesson, 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, rather than a raindrop falling on it. The trap closes using a complex mechanism, which is very different from using muscles like animals do. If the prey has escaped, or if it was a false alert, the traps open again after 12 hours. Otherwise, the prey takes 10 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 least) at one stage in its life, 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 classifie 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.

In this lesson, 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, and can bite or sting when their habitat is disturbed.
- Handle small animals carefully. Use spoons and damp brushes, not fingers, as animal 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 other information, for example, the 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.

Session 1 Discovered journal

Equipment

FOR THE CLASS

- class science journal
- 2 large sheets of paper for class science chat-board (see 'Preparation')
- 1 enlarged copy of 'Explorer's journal' (Resource sheet 1)
- 4 large sheets of paper (see 'Preparation')
- 7 A4 sheets of paper for signs (see 'Preparation')
- tape or glue (see 'Preparation')
- 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, such as a polished rock and a rough rock
    - two plants, including a Venus flytra
    - two small animals, including a millipede.

    Note: Photos are available by emailing pc@science.org.au 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

- Prepare an enlarged copy of '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:* Display the science chat-board, 'Explorer's journal' (Resource sheet 1) and the word wall in a digital format.

- *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 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 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.

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

ENGAGE

4   Introduce the 'Explorer's journal' (Resource sheet 1). 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 the 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** includes dates and times. It might include written text, drawings, measurements, labelled diagrams, photographs, tables and graphs.

Compare and discuss the similarities and difference between the 'Explorer's journal' (Resource sheet 1) 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 1' of the 'Explorer's journal' (Resource sheet 1) and ask students to consider the claim 'It is living'. Place the signs 'Agree', 'Disagree' and 'Unsure' 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: In the *Engage* phase, do not provide any formal definitions or correct students' answers as the purpose is to elicit students' prior knowledge.

10   Go to 'Specimen 2' and repeat Lesson steps 8 and 9 with the claim 'It is a plant'.

11   Go to 'Specimen 3' 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 science 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** includes a topic title or picture and words that 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.

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.
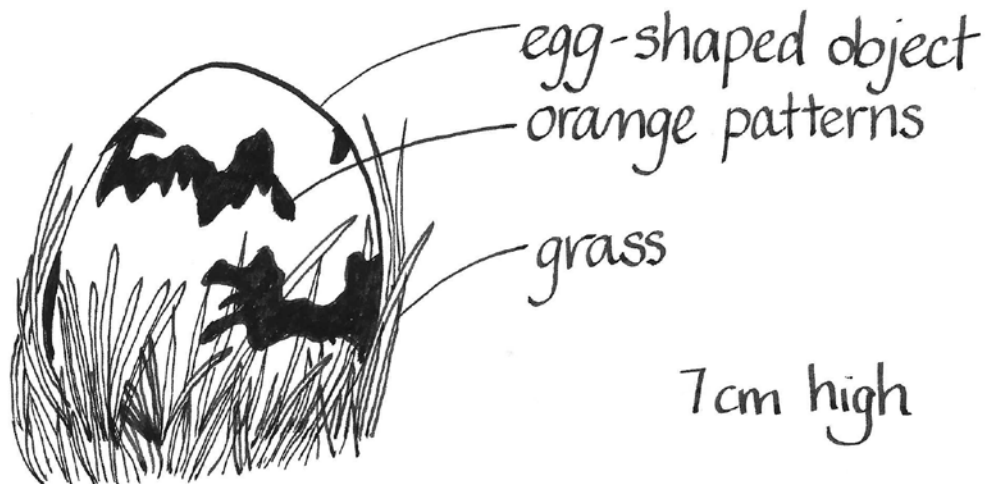
Explorer's journal

Name: _____   **Date:** _____

1.04.2011
Wallaman waterfall,
Australia

Specimen 1

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

egg-shaped object
orange patterns

grass

7cm high

It looks like an egg but it is hard, cold and heavy. I wonder if it is alive or not?
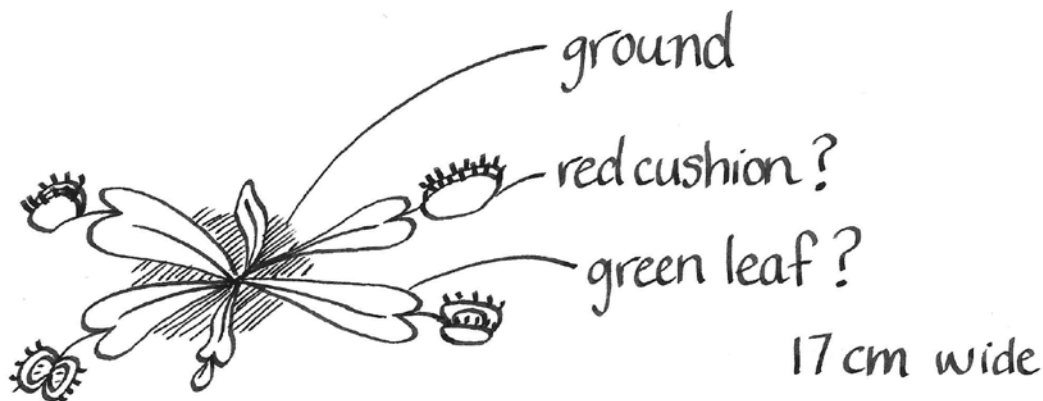
Resource sheet 1

Explorer's journal

Name: _____ **Date:** _____

11.05.2011
Green Swamp,
North America

Specimen 2
This is what I found on my walk today:

ground

red cushion?

green leaf?

17 cm wide

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

before:

after:

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?

Resource sheet 1

Primary**Connections**®
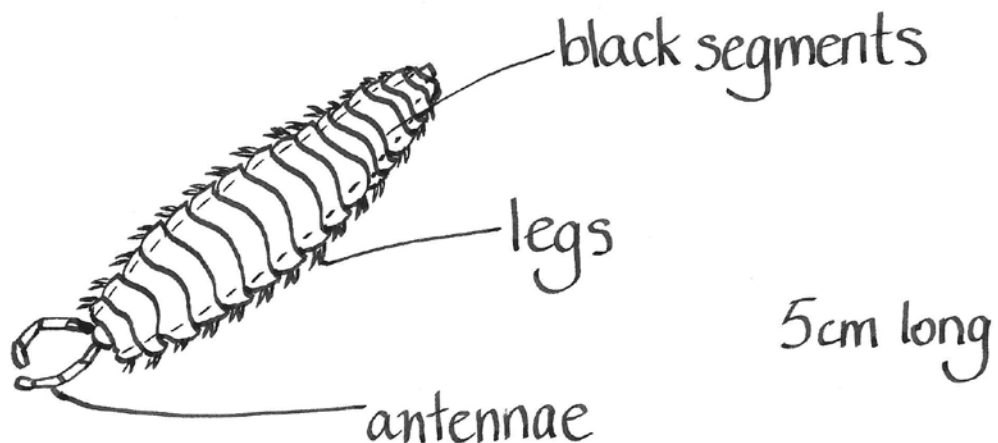Linking science with literacy

Explorer's journal

Name: _____ **Date:** _____

21.05.2011
Amazon Forest
South America

Specimen 3

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

black segments

legs

5cm long

antennae

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

Resource sheet 1

Session 2 Home explorers

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' (Resource sheet 2)

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)

ENGAGE

Preparation

- In the next lesson students will be presenting the information they collect at home. Write the appropriate 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 families' and 'Home explorer's journal' (Resource sheet 2), and the 'Code for caring' poster in a digital format.

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 them. 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').

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).
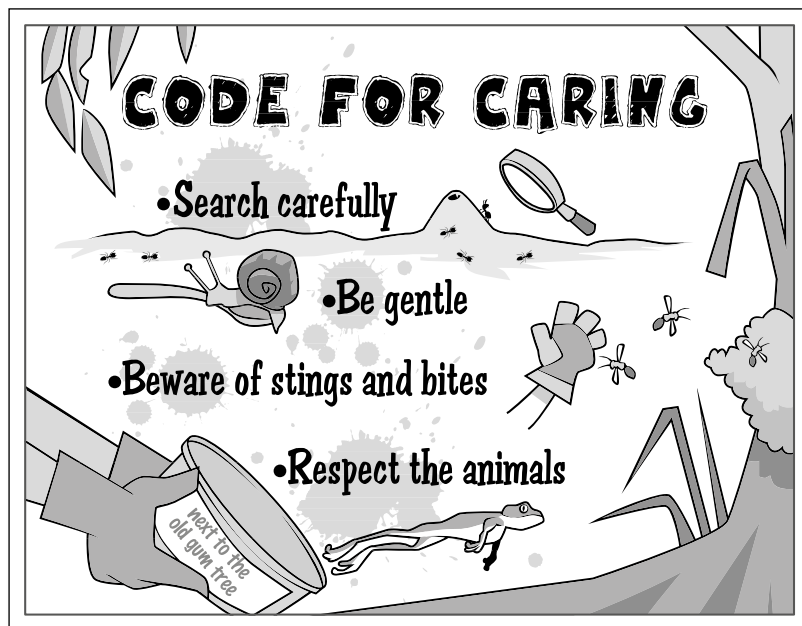
Sample 'Code for caring' poster

5   Introduce an enlarged copy of 'Home explorer's journal' (Resource sheet 2).
    Discuss how students will complete the 'Home explorer's journal' (Resource sheet 2)
    to record information.

6   Ask students to find living and non-living things in the class oom. 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 or?

    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.
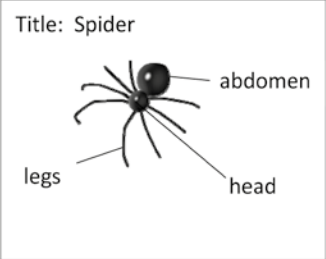
What does a labelled diagram include?

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

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).
    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.

Name: Veronica   Date: 9 June

Location: On the tree in my backyard

Specimen 1

Title: Spider

abdomen

legs

head

I think this specimen is living because:

it can run and it can eat.

Work sample of 'Home explorer's journal'

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.

ENGAGE

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.

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
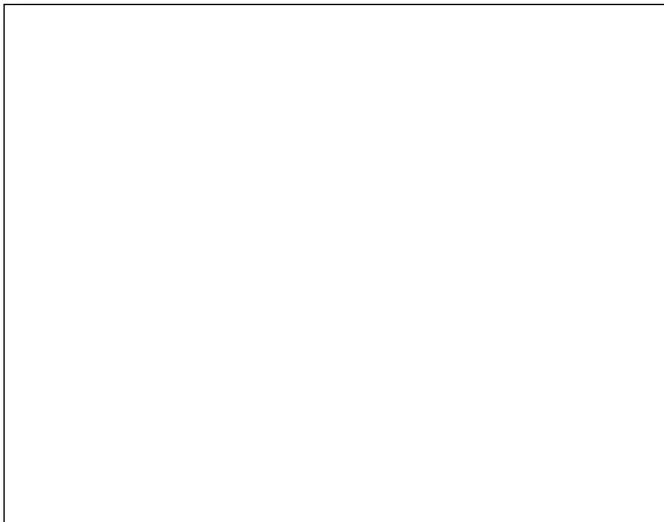
I think this specimen is <u>living</u> because:

✂ -
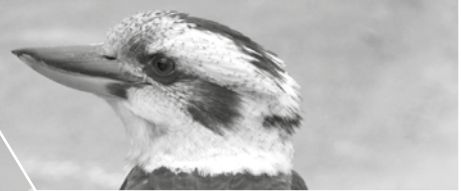
Name: _____ **Date:** _____

Location: _____

Specimen 2

I think this specimen is <u>non-living</u> because:

Lesson ② Sorting out life

AT A GLANCE

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

Assessment focus

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

- how living things can be distinguished from non-living things.

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

Key lesson outcomes

Science

Students will be able to:

- discuss the observable features of specimens and how to classify them
- identify living and non-living things from shared specimens
- consider claims about living specimens and identify patterns in data
- identify what makes something living.

Literacy

Students will be able to:

- contribute to class discussions about specimens, their observable features and how to classify them
- share responses and opinions with others
- 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 xii).

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 in their lives. Some plants can open and close their leaves, and sunflowers orient their flower 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, for example, 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, for example, 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, for example, 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, for example, 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, such as 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, such as flowers, branches and fruit, they still have cells using energy, producing energy and are 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.

EXPLORE

Equipment

FOR THE CLASS	FOR EACH STUDENT
• 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)	• 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) in a digital format.

Lesson steps

1 Review the previous session using the class science journal, Natural Science table and science chat-board. Review 'Specimen 1', sheet 1 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 or?

Record students' answers in the class science journal.

3 Introduce the 'Non-living', 'Living' and 'Unsure' wall sections.
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, for example, 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:

https://www.pbslearningmedia.org/resource/tdc02.sci.life.colt.plantsgrow/from-seed-to-flower/

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 1' 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.

Primary**Connections** *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 <u>all</u> living things have? Circle them.

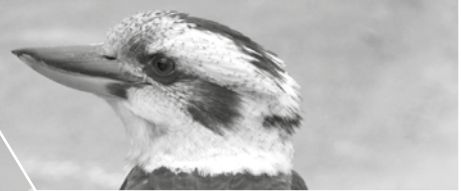Resource sheet 3

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 <u>all</u> living things have? Circle them.

Lesson 3 Animal sort

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

Assessment focus

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

- how to distinguish plants from animals based on their features. You

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

Key lesson outcomes

Science

Students will be able to:

- identify the observable features of specimens and how to classify them
- 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.

Literacy

Students will be able to:

- contribute to class discussions about specimens, their observable features and how to classify them
- share responses and opinions with others
- 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 xiii).

Teacher background information

Something is an animal if…

All animals are able to move themselves from place to place at least at 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, for example, muscles.

The other key difference is that animals have to eat to gain energy as 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, for example, 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 'Living things cards' (Resource sheet 4)
- 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 wristbands or badges for Director, Manager and 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 (Year 3–Year 6)' (Appendix 1). Display an enlarged copy of the team skills chart and the team roles chart in the classroom. Prepare role wristbands or badges for Director, Manager and Speaker.

- Prepare an enlarged copy of 'Living things cards' (Resource sheet 4) and cut it out to make a set of living things cards. 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) in a digital format.

Lesson steps

1   Review the previous session using the class science journal, Natural Science table and science chat-board. Review 'Specimen 2' 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 a set of living things cards into three groups: '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?' (Resource sheet 5) 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 cl ims on 'What is an animal?' (Resource sheet 5) are true for all the animal cards.

12 Revisit the 'Specimen 2' 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.

PrimaryConnections® *Feathers, fur or leaves?*

What is an animal?

Name: _____ Date: _____

Other members of your team: _____

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.)	✓	✓	✓	✓	✓

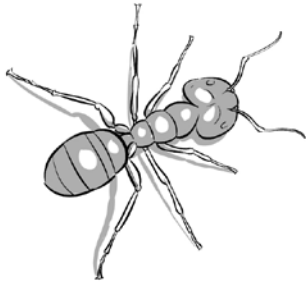Which of these claims do you think all animals have? Circle them.

Resource sheet 5

Work sample of 'What is an animal?'

Curriculum links

Mathematics

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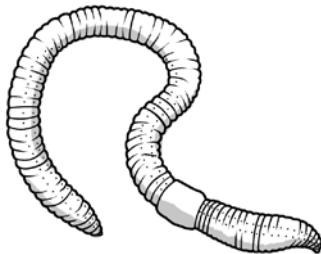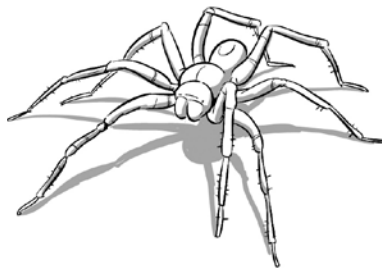
Living things cards

ant 3 mm long	**crab** 20 cm across	**snake** 1 m long
earthworm 7 cm long	**spider** 5 cm long	**eagle** 2 m across
octopus 1 m long	**goldfish** 20 cm across	**kangaroo** 1 m high
millipede 5 cm long	**frog** 8 cm long / 3 mm long	**dragonfly** 5 cm long
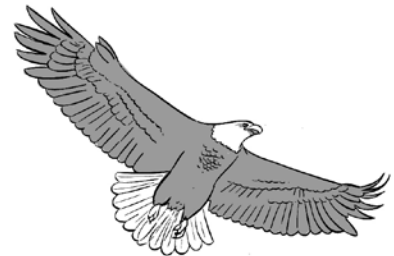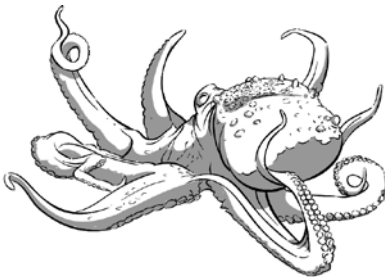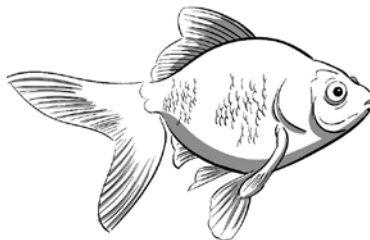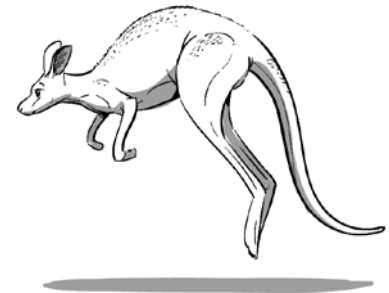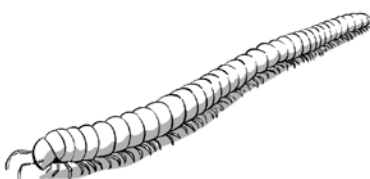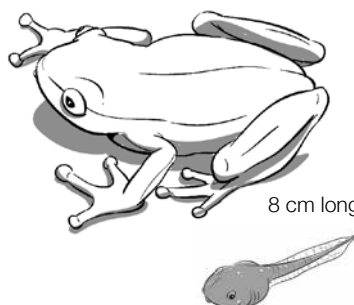
Living things cards
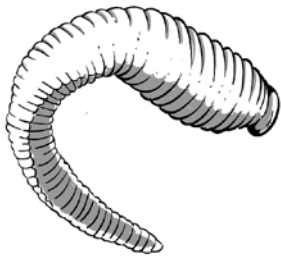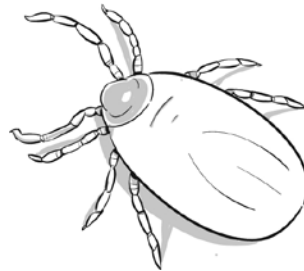
leech 4 cm long	**tick** 6 mm long	**human** 180 cm high
snail 4 cm long	**axolotl** 20 cm long	**shark** 4 m long
centipede 6 cm long	**lizard** 12 cm long	**rice grass** 80 cm high
slater 1 cm long	**chicken** 40 cm high	**tree** 8 m high
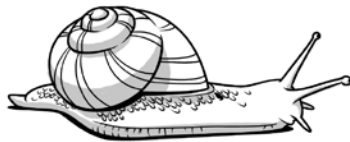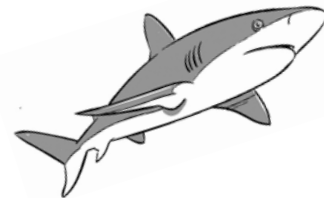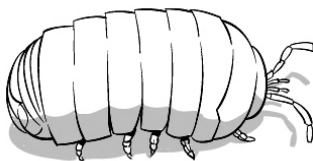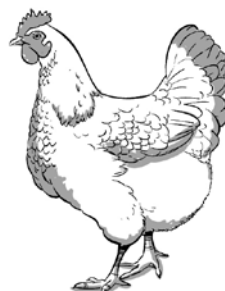
Primary**Connections**®
Linking science with literacy

What is an animal?

Name: _____ **Date:** _____

Other members of your team: _____

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 <u>all</u> animals have? Circle them.

Lesson ④ What am I?

AT A GLANCE

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

Students:

- identify different features that might 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.

Lesson focus

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

Assessment focus

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

- different features that can be used to group animals scientifically. You will

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

Key lesson outcomes

Science

Students will be able to:

- identify common observable features of animals
- group animals according to observable features.

Literacy

Students will be able to:

- contribute to class discussions about specimens, their observable features and how to classify them
- share responses and opinions with others
- use a T-chart to organise animals into categories.

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

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 who is from a different time and place.

Equipment

FOR THE CLASS	FOR EACH TEAM
• class science journal	• role wristbands or badges for Director, Manager and Speaker
• class science chat-board	• each team member's science journal
• Natural Science table	• animal cards from the 'Living things cards' (Resource sheet 4) (from Lesson 3)
• class set of 'Living things cards' (from Lesson 3)	• 1 A4 piece of paper for a T-chart
• 1 A3 piece of paper (see 'Preparation')	

Preparation

- Assemble the animal cards from the 'Living things cards' (Resource sheet 4) 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 in a digital format.

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, such as 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, for example, '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', for example, 'only lives on land'.

EXPLORE

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.

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.

Indigenous perspectives

- This lesson focuses on identified features of animals. If you have contact with local Indigenous community members and/or Indigenous Education Officers (see page 6) invite them to discuss what they know about the observable features of Australian animals.

EXPLORE

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

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

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

Key lesson outcomes

Science

Students will be able to:

- discuss the observable features of specimens and how to classify them
- classify animals into scientific groups using a branching key.

Literacy

Students will be able to:

- contribute to class discussions about the observable features of specimens and how to classify them
- use a branching key through reading a series of questions.

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

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 term 'mammal' has specific biological meaning in classifi tion 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 classification for humans (*Homo sapiens*) is therefore:

Kingdom—Animalia
Phylum—Chordata
Class—Mammalia
Family—Hominidae
Genus—*Homo*
Species—*sapiens*

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, such as '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.

- **Sharks 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, such as 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 inte nal 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 Arthopoda.

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, such as:

- **Cnidaria such as anemones, jellyfish and corals**; their common distinguishing feature is to have a special type of cell, a cnidocyte (stinging cells).
- **Platyhelminthes (flatworms), such as tapeworms and flukes**; they have very fla 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 5 cm 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, a some stage of their life.

EXPLAIN

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 TEAM

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

Preparation

- Assemble the animal cards from the 'Living things cards' (Resource sheet 4) 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).
- Prepare an enlarged copy of 'Branching key' (Resource sheet 6).
- *Optional:* Display the 'Branching key' (Resource sheet 6) in a digital format.

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 3' 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.

EXPLAIN

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 have a lot of features in common.

Optional: Show students an interview with a taxomist. See: **https://www.abc.net.au/radionational/programs/offtrack/a-day-in-the-life-of-a-taxonomist/6694996**

4 Ask students to consider the pictures of the dragonfl , 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. 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 11 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.

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

11 Using the 'Branching key' (Resource sheet 6) as a visual aid, discuss how all insects are also animals but not all animals are insects.

12 Revisit the 'Explorer's journal' (Resource sheet 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'.

EXPLAIN

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 like 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 (ICT)

- 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.

Indigenous perspectives

- The dichotomous system of identifying animals based on observable features is one way to organise the world. Indigenous people might have their own way of understanding the relationships around them (see page 6).
- Primary**Connections** recommends working with Aboriginal and Torres Strait Islander community members to access local and relevant cultural perspectives. Protocols for engaging with Aboriginal and Torres Strait Islander community members are provided in state and territory education guidelines. Links to these are provided on the Primary**Connections** website**:** www.primaryconnections.org.au

EXPLAIN

Branching key

ANIMALS

Does it have bones inside its body?

Yes → Does it ever have gills?

Yes → Does it have legs? → **Yes** → Amphibians

Does it have legs? → **No** → Fish

Does it ever have gills? → **No** → Does it have feathers?

Does it have feathers? → **Yes** → Birds

Does it have feathers? → **No** → Does it have scales?

Does it have scales? → **Yes** → Reptiles

Does it have scales? → **No** → Mammals

Does it have bones inside its body? → **No** → Does it ever have legs?

Does it ever have legs? → **Yes** → Does it have antennae?

Does it have antennae? → **Yes** → Does it have more than two antennae?

Does it have more than two antennae? → **Yes** → Crustaceans

Does it have more than two antennae? → **No** → Does it have more than six legs?

Does it have more than six legs? → **Yes** → Myriapods

Does it have more than six legs? → **No** → Insects

Does it have antennae? → **No** → Arachnids

Does it ever have legs? → **No** → Does it have lots of body segments?

Does it have lots of body segments? → **Yes** → Annelids

Does it have lots of body segments? → **No** → Molluscs

Disclaimer: This branching key has been developed for the purpose of this unit of work only.

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 fin
- 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.

ELABORATE

Lesson focus

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

Assessment focus

Summative assessment of the Science Inquiry Skills is an important focus of the *Elaborate* phase (see page xi).

Key lesson outcomes

Science

Students will be able to:

- predict what animal groups might be found in the school's leaf litter

- identify animal specimens

- make claims based on evidence about animals groups present in the school's leaf litter.

Literacy

Students will be able to:

- contribute to class discussions about the observable features of specimens and how to classify them

- record observations and drawings of animal specimens

- discuss and compare results to form common understandings.

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

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, for example, 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 affect 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, for example, 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.

ELABORATE

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 wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- 1 copy of 'Animal groups investigation planner' (Resource sheet 7)
- gloves (gardening, plastic)
- safety glasses for each team member
- magnifying glass
- large container (500 mL)
- large resealable plastic bags (35 cm x 27 cm)
- self-adhesive label
- marker pen
- *optional:* additional large resealable plastic bag (35 cm x 27 cm) 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 might 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 classif , such as:
  - the soil from the school compost heap
  - the soil from the school vegetable garden
  - water from a nearby river.

- ⚠ SAFETY 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 might harm the animals and/or experience bites or stings.

- Prepare an enlarged copy of 'Animal groups investigation planner' (Resource sheet 7).

- *Optional:* Display the 'Animal groups investigation planner' (Resource sheet 7) in a digital format.

ELABORATE

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 describe how something is done. We can read a **procedural text** to find out how to do things
>
> **What does a procedural text include?**
>
> A **procedural text** includes a list of materials needed to do the task and a description of the sequence of steps used. It might include annotated diagrams.

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 journals. Model how to complete an entry about an animal. Discuss the purpose and features of a line drawing.
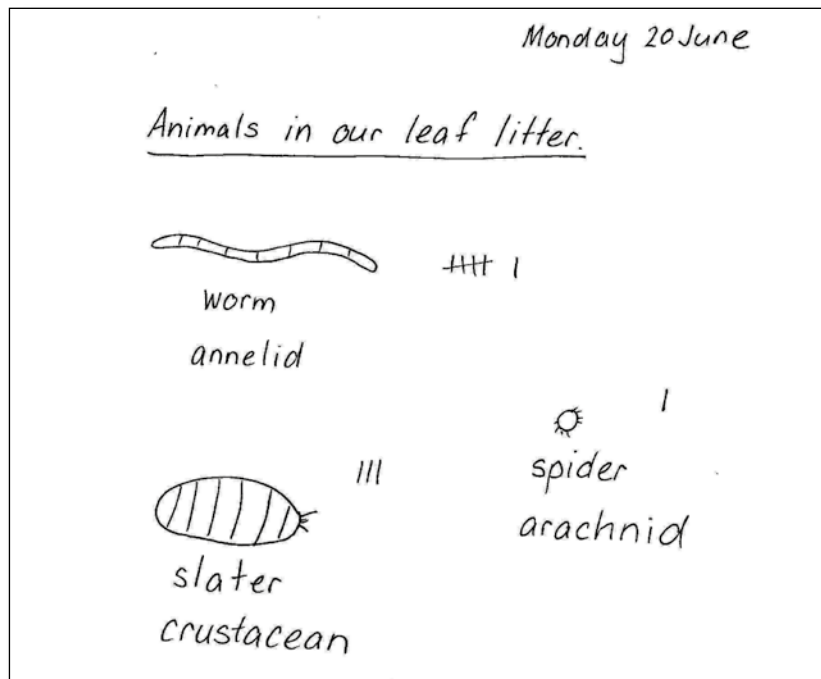
ELABORATE

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 resealable plastic bags for about a day. After a day the bags need to be opened to aerate the contents again.

Optional: Give each student a resealable plastic bag to collect their own samples from home or another location outside 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:** _____

Other members of your team: _____

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.

Resource sheet 7

Session 2 Looking at 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)
- 1 enlarged copy of 'Animal groups investigation results' (Resource sheet 8)
- 1 enlarged copy of 'Branching key' (Resource sheet 6)

FOR EACH TEAM

- role wristbands or badges for Director, Manager and Speaker
- each team member's science journal
- collected leaf litter in a resealable plastic 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).
- Prepare an enlarged copy of 'Animal groups investigation results' (Resource sheet 8).
- *Optional:* Display the 'Animal groups investigation results' (Resource sheet 8) in a digital format.
- ⚠ SAFETY Students are asked to examine the contents of the bags without opening them 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 copy 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.

ELABORATE

> **Why do we use a graph?**
>
> We use a **graph** to organise information so we can look for patterns. We use different types of **graphs**, such as picture, column or line graphs, for different situations.
>
> **What does a graph include?**
>
> A **graph** includes a title, axes with labels on them and the units of measurement.

3 Form teams and allocate roles. Allow teams time to complete their graphs. Explain that students will need to use their line drawings, tallies and branching keys to complete the graph. Model how to complete the graph.

4 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.)

5 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.

6 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.

ELABORATE

7 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.

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

9 Return the leaf litter, soil and animals to the area that they were found in.
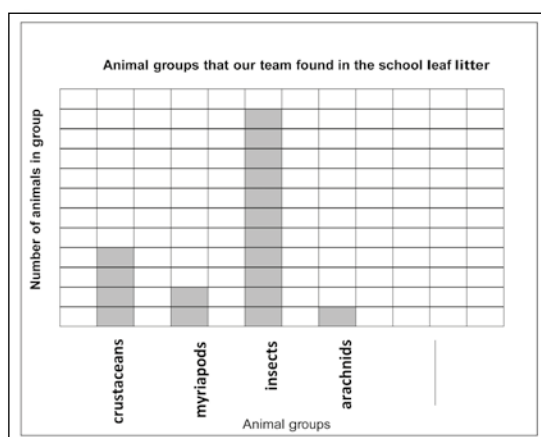
Work sample of animal groups graph

Animal groups investigation results

PrimaryConnections®
Linking science with literacy

Name: _____ **Date:** _____

Other members of your team: _____

Animal groups that our team found in the school leaf litter
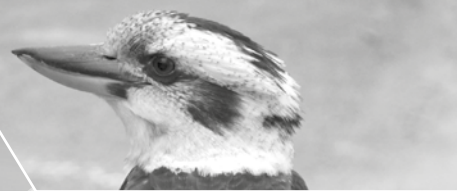
Number of animals in group

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

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 re-represent their conceptual understanding.

Assessment focus

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

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

Key lesson outcomes

Science

Students will be able to:

- organise things into groups based on their observable features.

Literacy

Students will be able to:

- 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 xii).

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.
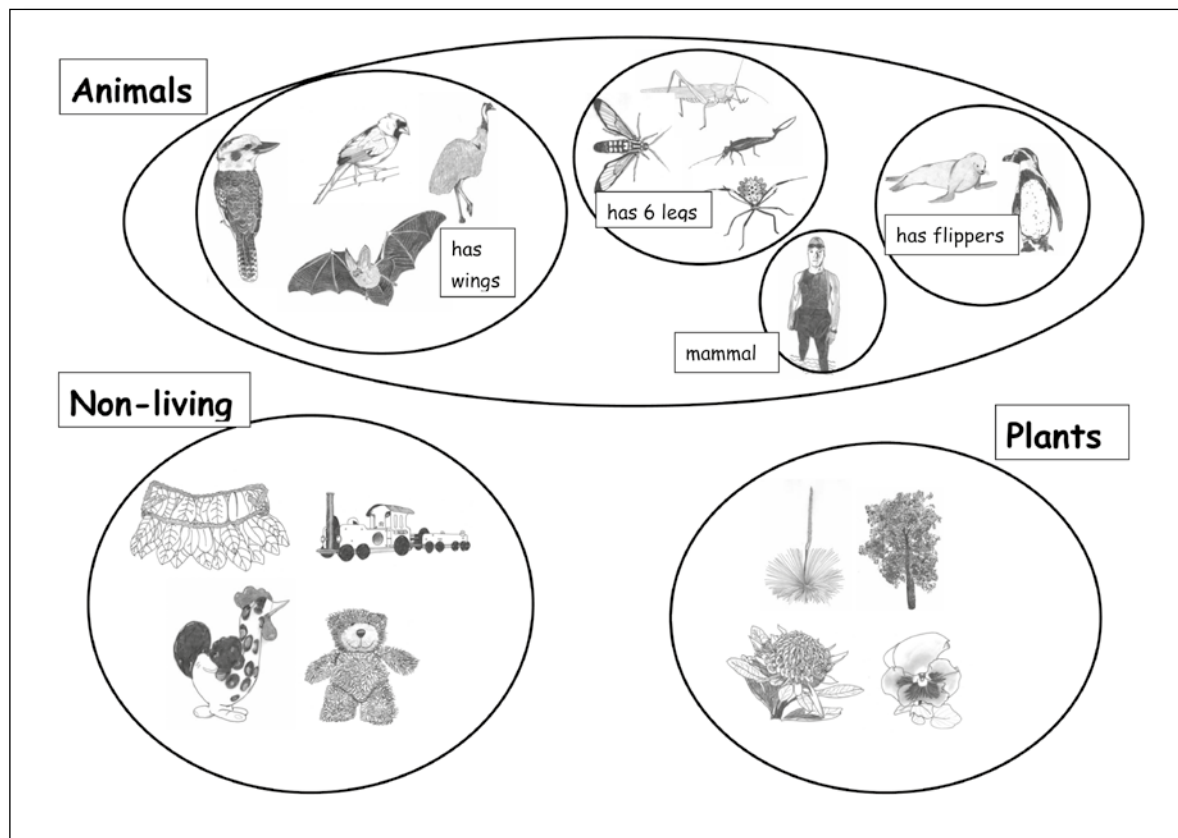
Work sample of drawings in groups

Equipment

FOR THE CLASS	FOR EACH STUDENT
• class science journal • class science chat-board • Natural Science table • 1 enlarged copy of 'Lots of drawings' (Resource sheet 9)	• science journal • 1 copy of 'Lots of drawings' (Resource sheet 9) • scissors • tape or glue

Preparation

• Prepare an enlarged copy of 'Lots of drawings' (Resource sheet 9).
• *Optional:* Display the photos from 'Lots of drawings' (Resource sheet 9) in a digital format.

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' (Resource sheet 1), 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?

EVALUATE

Lots of drawings

moth	**swimmer**	**teddy bear**
coreid bug	**pansy**	**leaf skirt**
emu	**grass tree**	**penguin**
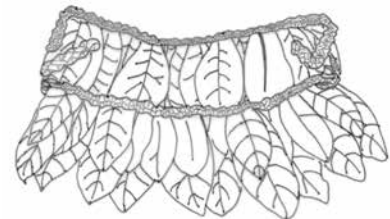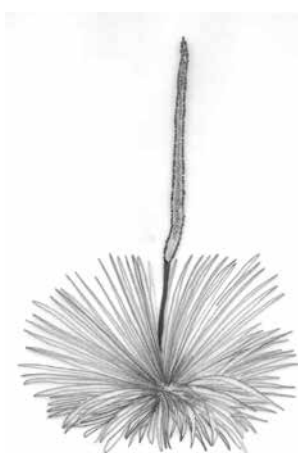
Lots of drawings
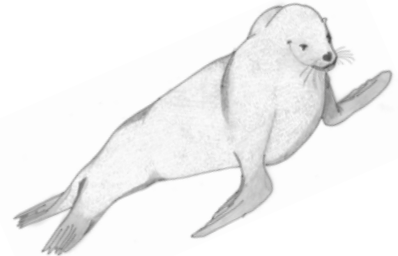
cardinal	**waratah**	**seal**
katydid	**glass chicken**	**train**
bat	**tree**	**earwig**
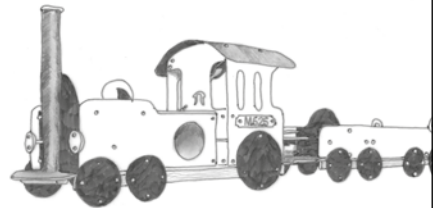
Appendix 1
How to organise collaborative learning teams
(Year 3–Year 6)

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 xiv.

Team structure

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

• Assign students to teams rather than allowing them to choose partners.

• Vary the composition of each team. Give students opportunities to work with others who might be of a different ability level, gender or cultural background.

• Keep teams together for two or more lessons so that students have enough time to learn to work together successfully.

• If you cannot divide the students in your class into teams of three, form two teams of two students rather than one team of four. It is difficult for students to work together effectively in larger groups.

• Keep a record of the students who have worked together as a team so that by the end of the year each student has worked with as many others as possible.

Team roles

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

For Year 3–Year 6, the teams consist of three students—Director, Manager and Speaker. (For Foundation–Year 2, teams consist of two students—Manager and Speaker.)

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

Manager

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

Speaker

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

Director (Year 3–Year 6)

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

Team skills

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

Students will practise the following team skills throughout the year:

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

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

Supporting equity

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

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

TEAM ROLES

Manager
Collects and returns all materials the team needs

Speaker
Asks the teacher and other team speakers for help

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

TEAM SKILLS

1 Move into your teams quickly and quietly

2 Speak softly

3 Stay with your team

4 Take turns

5 Perform your role

Appendix 2
How to use a science journal

Introduction

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

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

Monitoring students' journals allows you to identify students' alternative conceptions, find evidence of students' learning and plan future learning activities in science and literacy.
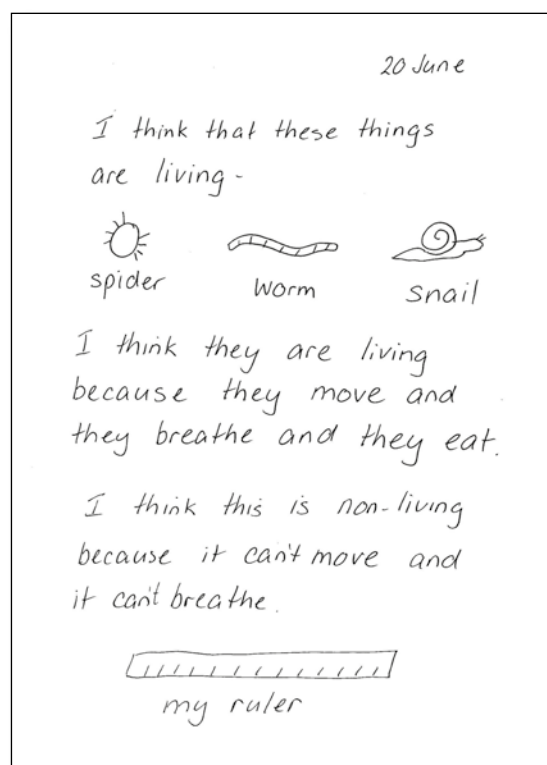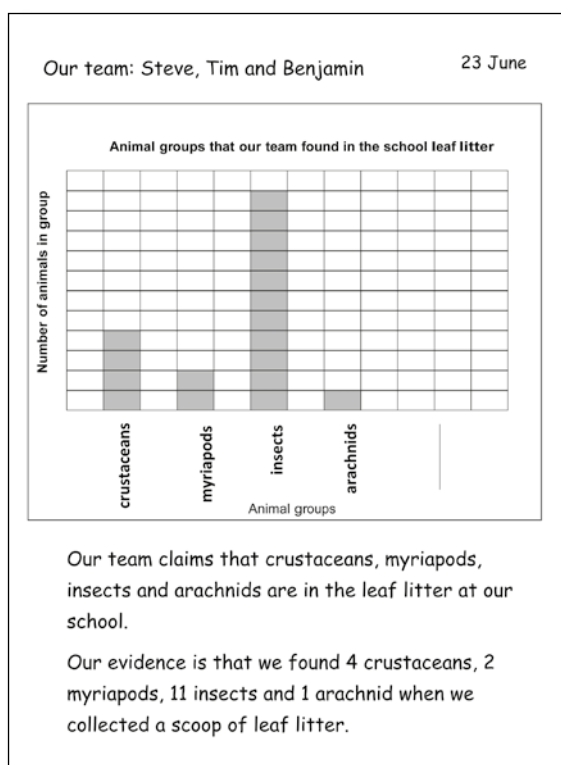
Keeping a science journal aligns to descriptions in the Australian Curriculum: Science and English. See pages xi and xiii.

Using a science journal

1   At the start of the year, or before starting a science unit, provide each student with a notebook or exercise book for their science journal or use an electronic format. Tailor the type of journal to fit the needs of your classroom. Explain to students that they will use their journals to keep a record of their observations, ideas and thoughts about science activities. Emphasise the importance of including pictorial representations as well as written entries.

2   Use a large project book or A3 paper to make a class science journal. This can be used at all year levels to model journal entries. With younger students, the class science journal can be used more frequently than individual journals and can take the place of individual journals.

3   Make time to use the science journal. Provide opportunities for students to plan procedures and record predictions, and their reasons for predictions, before an activity. Use the journal to record observations during an activity and reflect afterwards, including comparing ideas and findings with initial predictions and reasons. It is important to encourage students to provide evidence that supports their ideas, reasons and reflections.

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

5   Science journal entries can include narrative, poetry and prose as students represent their ideas in a range of styles and forms.

6 In science journal work, you can refer students to display charts, pictures, diagrams, word walls and phrases about the topic displayed around the classroom. Revisit and revise this material during the unit. Explore the vocabulary, visual texts and ideas that have developed from the science unit, and encourage students to use them in their science journals.

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

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

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

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

Number of animals in group

crustaceans   myriapods   insects   arachnids
Animal groups

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.

The use of a word wall, including words from regional dialects and other languages, aligns to descriptions in the Australian Curriculum: English. See page xiii.

Goals in using a word wall

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

Organisation

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

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

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

Plants in action word wall

Material world word wall

Using a word wall

1   Limit the number of words to those needed to support the science and literacy experiences in the classroom.

2   Add words gradually, and include images where possible, such as drawings, diagrams or photographs. Build up the number of words on the word wall as students are introduced to the scientific vocabulary of the unit

3   Encourage students to interact with the word wall. Practise using the words with students by reading them and playing word games. Refer to the words during science and literacy experiences and direct students to the wall when they need a word for writing. Encourage students to use the word wall to spell words correctly.

4   Use the word wall with the whole class, small groups and individual students during literacy experiences. Organise multi-level activities to cater for the individual needs of students.

Feathers, fur or leaves? word wall

Appendix 4
How to use a TWLH chart

Introduction

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

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

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

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

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

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

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

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 others' reasoning
- reflecting on how their ideas have changed

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

Establish norms

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

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

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

Science question starters

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

DISCUSSION SKILLS

- Listen when others speak

- Ask questions of each other

- Criticise ideas, not people

- Listen to and discuss all ideas before selecting one

Appendix 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?

What type of graph?

The Australian Curriculum: Mathematics describes 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.

Picture graph

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

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

Table A: Number of small animals near the play equipment

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

**Graph A: Number of small animals near the play equipment**
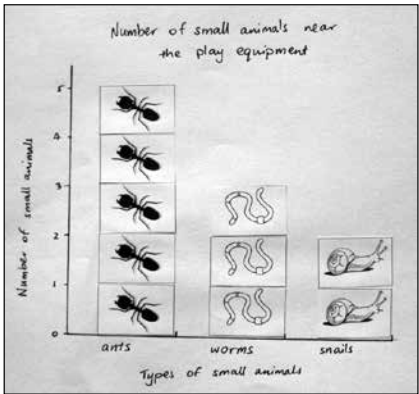
Column graph

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

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

Table B: 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 B: The effect of material on the amount of light that passes through
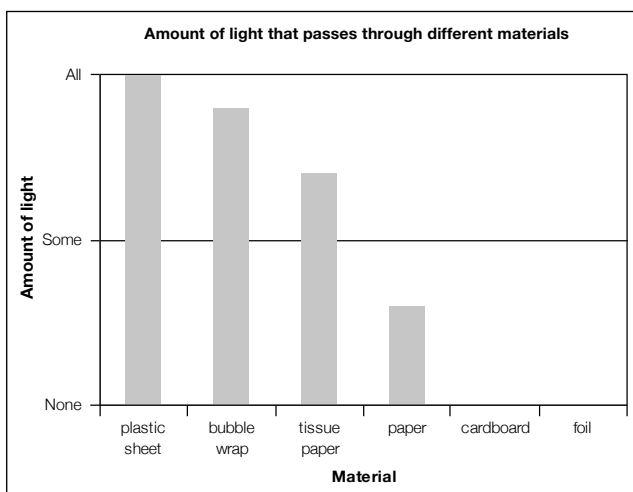
Which variable goes on each axis?

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

Graph titles and labels

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

Steps in analysing and interpreting data

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

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

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

Questioning for analysis

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

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

Analysis

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

Appendix 7
Feathers, fur or leaves? equipment list

EQUIPMENT ITEM	QUANTITIES	LESSON 1	1	2	3	4	5	6	6	7
		SESSION 1	2					1	2	
Equipment and materials										
A3 paper	1 piece per class									●
A4 paper	7 sheets per class	●				●				
A4 paper	1 per student		●							
A4 paper	1 per team					●				
blank Poster paper (Code for caring)	1 per class	●	●							
card or paper for labels	ongoing	●	●	●	●	●	●	●	●	●
gloves (gardening, plastic)	1 pair per student							●		
container, large (500 ml)	1 per team							●		
self-adhesive label	1 per team							●		
large resealable plastic bag (35 cm x 27 cm)	1 per team							●		
large resealable plastic bag (35 cm x 27 cm) *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 team						●	●		
self-adhesive notes	2 per student		●	●	●	●	●	●		
self-adhesive notes	ongoing							●	●	●
specimens or photos of specimens	1 set per class	●								
table, large for specimen display	1 per class							●	●	●

EQUIPMENT ITEM	QUANTITIES	LESSON 7	LESSON 6	LESSON 6	LESSON 5	LESSON 4	LESSON 3	LESSON 2	LESSON 1	LESSON 1
			SESSION 2	SESSION 1					SESSION 2	SESSION 1
Equipment and materials (continued)										
table labels	3 per class									
tape or glue	1 per class	●								
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 living?' (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 groups investigation planner' (RS7), enlarged	1 per class		●	●						
'Animal groups investigation planner' (RS7)	1 per team		●	●						
'Animal groups 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	●	●	●	●	●	●	●	●	●
role badges or wristbands for Director, Manager and Speaker	1 set per team	●	●	●	●	●	●	●	●	●
team roles chart	1 per class	●	●	●	●	●	●	●		
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

	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
	Students will be able to represent their current understandings as they:	Students will be able to:	Students:	
ENGAGE **Lesson 1** Wondering about the world *Session 1* Discovered journal *Session 2* Home explorer	• identify the observable features of specimens and how to classify them • identify living and non-living things in their home • identify possible questions for investigation.	• contribute to class discussions about specimens, their observable features and how to classify them • identify the purpose and features of a class science journal • create a labelled diagram and journal entry to represent and communicate their findings	***Session 1*** Discovered journal • describe different ways to groups specimens • share observations of features of specimens • make claims about whether specimens are non-living, plants or animals. ***Session 2*** Home explorer • identify a living and non-living specimen at home • write a journal entry, including a labelled diagram.	**Diagnostic assessment** of the Science Understanding • Science journal entries • Class discussions • Science chat-board and word wall contributions • Labelled diagrams
EXPLORE **Lesson 2** Sorting out life	• discuss the observable features of specimens and how to classify them • identify living and non-living things from shared specimens • consider claims about living specimens and identify patterns in data • identify what makes something living.	• contribute to class discussions about specimens, their observable features and how to classify them • share responses and opinions with others • create a shared description of what makes something living.	• 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.	**Formative assessment** • 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 lesson outcomes are aligned to relevant descriptions of the Australian Curriculum. See page xi for Science and page xiii for English and Mathematics.

		SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
		Students will be able to:	Students will be able to:	Students:	
EXPLORE	**Lesson 3** Animal sort	• identify the observable features of specimens and how to classify them • 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.	• contribute to class discussions about specimens, their observable features and how to classify them • share responses and opinions with others • create a shared description of what makes something an animal.	• 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.	**Formative assessment** • Science journal entries • Class discussions • Science chat-board and word wall contributions • 'Living things cards' (Resource sheet 4) • 'What is an animal?' (Resource sheet 5)
EXPLORE	**Lesson 4** What am I?	• identify common observable features of animals • group animals according to observable features.	• contribute to class discussions about specimens, their observable features and how to classify them • share responses and opinions with others • use a T-chart to organise animals into categories.	• identify different features that might 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.	**Formative assessment** • Science journal entries • Class discussions • Science chat-board and word wall contributions • Natural science table sort • T-chart responses

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

	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
	Students will be able to:	Students will be able to:	Students:	
EXPLAIN — **Lesson 5** Animal assemblies	• discuss the observable features of specimens and how to classify them • classify animals into scientific groups using a branching key.	• contribute to class discussions about the observable features of specimens and how to classify them • use a branching key through reading a series of questions.	• 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.	**Formative assessment** • Science journal entries • Class discussions • Science chat-board and word wall contributions • Animal card match-up responses • 'Branching key' (Resource sheet 5)
ELABORATE — **Lesson 6** Taxonomists in training *Session 1* Scooping up leaf litter *Session 2* Looking at leaf litter	• predict what animal groups might be found in the school's leaf litter • identify animal specimens • make claims based on evidence about animals groups present in the school's leaf litter.	• contribute to class discussions about the observable features of specimens and how to classify them • record observations and drawings of animal specimens • discuss and compare results to form common understandings.	*Session 1* **Scooping up leaf litter** • discuss how to determine what animal groups are present in the leaf litter and predict what they might fin • work in teams to collect leaf litter specimens in accurately labelled bags. *Session 2* **Looking at leaf litter** • observe, draw, identify and tally the animals found • present investigation results in a graph column • make claims about the animal groups present in the leaf litter using collected evidence.	**Summative assessment** of Science Understanding • 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 7)

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

	SCIENCE OUTCOMES*	LITERACY OUTCOMES*	LESSON SUMMARY	ASSESSMENT OPPORTUNITIES
	Students will be able to:	Students will be able to:	Students:	
EVALUATE **Lesson 7** Classifying collections	• organise things into groups based on their observable features.	• share responses and opinions with others • contribute to discussions and express their opinions about their learning journey.	• observe drawings of specimens and organise them into groups based on their observable features • share responses and opinions with others • participate in a class discussion to reflect on their learning during the unit.	**Summative assessment** of Science Inquiry Skills • Science journal entries • Class discussions • Science chat-board and word wall contributions • 'Lots of drawings' (Resource sheet 9)

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

Primary**Connections Units**

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