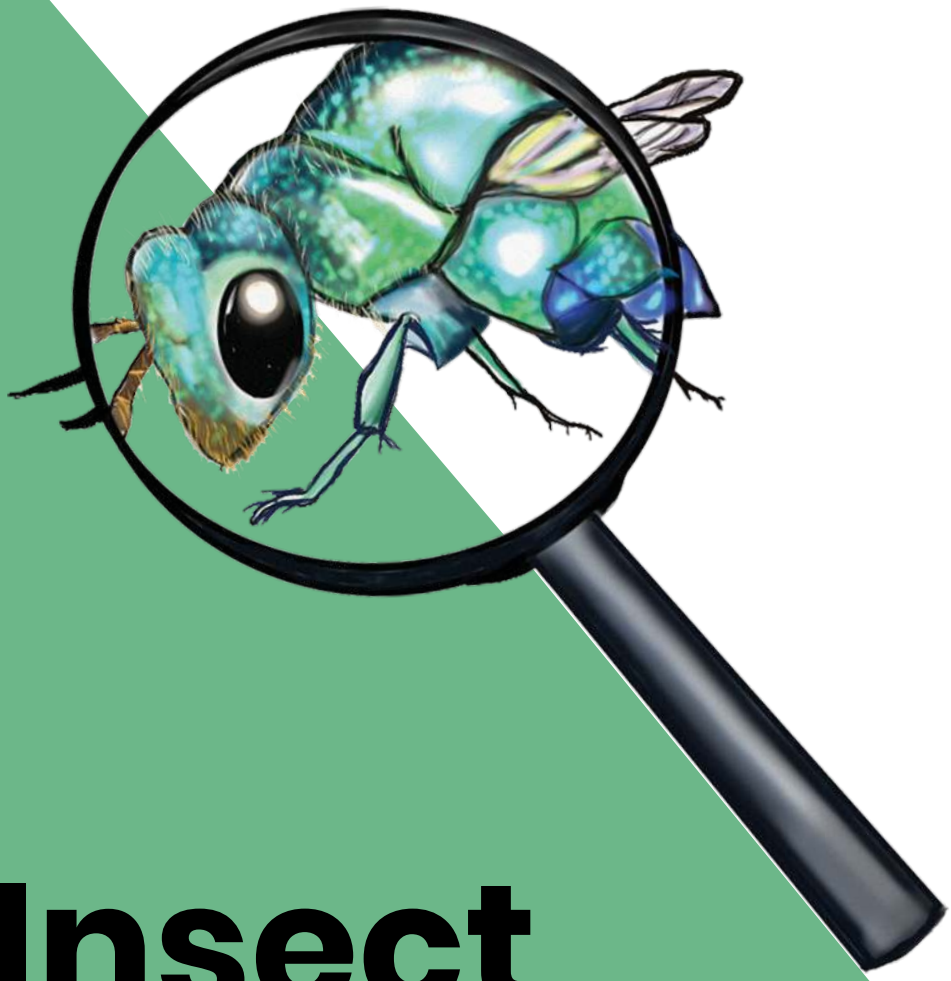


Insect Investigators

A citizen science project

Teacher Resource

Government of South Australia

SAM SOUTH AUSTRALIAN MUSEUM

Contents

Insect Investigators teacher resource

Acknowledgement

We acknowledge the Insect Investigators Project was designed on Kaurna Miyurna Yarta (land) and that our team members and participants from across Australia live, work, teach and learn on the Country of many different Nations.

We encourage teachers and students to respectfully engage with Aboriginal community members in their local area to learn together and share knowledge relating to the project.

The Dreaming is still living for all Aboriginal and Torres Strait Islander peoples from the past, in the present, into the future, forever.

Our team

The Insect Investigators project is led by the South Australian Museum, with the involvement of the Queensland Museum and the Western Australian Museum. This project is also supported by the University of Adelaide and the University of the Sunshine Coast, with support from the Murraylands and Riverland Landscape Board of South Australia and the Western Australian Gould League.

We also have a great team of supporting partners who are helping us to deliver the project across the country. You can find out more about our partners and follow the Insect Investigators team online at www.insectinvestigators.com.au to keep up-to-date with the project and its findings.

The Insect Investigators project

The Insect Investigators project is bringing scientists and schools together to help describe and document Australia's insect diversity. The project is designed to help us discover, recognise and name new insect species as well as document insect diversity in regional areas.

Less than 30% of Australia's estimated 250,000 insect species have names and associated descriptions – that leaves around 180,000 species for us still to discover and describe. We know even less about insect species distribution, or their relationships with other insects and the environment. Without this basic knowledge of insect biodiversity, we can't make good conservation decisions, plan how to keep our ecosystems safe, or quickly detect if our environment is changing.

Insects are often overlooked because of their small size (relative to humans), but for every person on Earth there are around 200 million insects. Insects are the foundation of all terrestrial ecosystems and have a big impact on our lives. They can pollinate plants, disperse seeds, provide food for other species (including humans), cycle nutrients and help maintain soils. Insects also impact human health. Some carry diseases while others have medicinal benefits. Research into insect characteristics also inform high-tech fields like robotics and biomechanics.

We know so little about insects and we're hoping that school students, regional communities and scientists across Australia can come together to help us change that.

In 2022, fifty schools and community groups in regional areas across South Australia, Western Australia and Queensland were selected to embark on this journey of scientific discovery. Each week they will collect local insect fauna using a Malaise trap and send the specimens to the University of Adelaide for sorting. The insect biomass will be measured and specimens from each site will be processed for DNA barcoding (COI gene) by the Centre for Biodiversity Genomics in Canada. DNA barcodes are a short sequence of the genome which illuminate biodiversity by providing an estimate of species diversity and a replicable species-specific barcode for a specimen. These data will be publicly available on the Barcode of Life Database (BOLD) where the Australian fauna currently is significantly under-represented, constituting less than 5% (as of 2021) of the insect sequences. Project taxonomic researchers will receive the specimens for which they have expertise after DNA barcoding, and they will identify potential new species. New species will receive scientific names and formal descriptions. School students and regional communities will be involved in all stages of this process, from collecting to naming, so they can learn about the taxonomic process and engage with their region's insect biodiversity. The insects collected will be added to the state museums' collections so they can inform future research (Western Australian Museum, Queensland Museum, South Australian Museum).

Schools and community groups who are not participating in Insect Investigators 2022 can still help to document insect diversity in their corner of the world. The iNaturalist app (www.inaturalist.org/) allows you to capture encounters with insects in your ecosystem, identify them and share your data with scientists all around the world. This resource aims to allow any school in Australia to build insect biodiversity into the curriculum for many years to come.

Resource overview

Insect Investigators resource overview

This curriculum unit provides a unit plan and lesson outline to help Insect Investigators to engage with insect biodiversity in their local environment. The activities in this unit have been aligned with the content descriptors for Biological Sciences in grades 4–7 and each lesson outline includes the objective and anticipated outcomes broken down into simple statements and checkpoints for knowledge, understanding and skills to help clarify the curriculum requirements.

Grade levels and age appropriateness

Whilst the resources and tasks sheets have been designed with year levels 4-7 in mind, there is scope for teachers to adapt the lesson plans, task sheets and activities for any year level.

Lesson scope and sequence

The Insect Investigators unit has been broken down into six lessons. The lesson plans are for either single or double lessons and the lesson activities have been designed to fit within a 50 or 100 minute time limit.

You can teach the lessons in a sequence or pick any lesson from the unit of work; however lessons do complement each other. The lessons step through conducting an insect biodiversity survey in the order a scientist would undertake the activity (assess the habitat, collect insects using multiple methods, identify the insects, look at conservation actions for the site).

Task sheets and templates

The lesson task sheets and templates suggested in this outline can be used as standalone activities, printed individually for each lesson and stored in student workbooks or folders. They could also be collated to create a 'Scientist's Journal' for students to complete while they're participating in the Insect Investigators program. Adding a fun cover to the front of the workbook would help to engage students with the unit.

Insect Investigators national curriculum alignment

		Lesson					
		1	2	3	4	5	6
Grade 4	**Biological Sciences content descriptor**						
	ACSSU073 Living things depend on each other and the environment to survive	✓		✓		✓	✓
	Science as a Human Endeavour content descriptor						
	ACSHE061 Science involves making predictions and describing patterns and relationships		✓	✓		✓	
	ACSHE062 Science knowledge helps people to understand the effect of their actions patterns and relationships						✓
	Science Inquiry Skills content descriptor						
	ACSI065 With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment			✓			
	ACSIS071 Represent and communicate observations, ideas and findings using formal and informal representations		✓		✓		✓
	Mathematics Measurement and Geometry						
	ACMMG084 Use scaled instruments to measure and compare lengths, masses, capacities and temperatures		✓				
Grade 5	**Biological Sciences content descriptor**						
	ACSSU043 Living things have structural features and adaptations that help them to survive in their environment				✓	✓	
	Science as a Human Endeavour content descriptor						
	ACSHE083 Scientific knowledge is used to solve problems and inform personal and community decisions						✓

Grade 6	**Science Inquiry Skills content descriptor**						
	ACSIS086 Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks			✓			
	ACSIS093 Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts		✓		✓		✓
	Mathematics Measurement and Geometry						
	ACMMG108 Choose appropriate units of measurement for length, area, volume, capacity and mass		✓				
	Biological Sciences content descriptor						
	ACSSU094 The growth and survival of living things are affected by physical conditions of their environment		✓			✓	✓
	Science as a Human Endeavour content descriptor						
	ACSHE100 Scientific knowledge is used to solve problems and inform personal and community decisions						✓
Grade 7	**Science Inquiry Skills content descriptor**						
	ACSIS103 Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks			✓			
	ACSIS110 Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts		✓		✓		✓
	Biological Sciences content descriptor						
	ACSSU111 Classification helps organise the diverse group of organisms			✓	✓		
	ACSSU112 Interactions between organisms, including the effects of human activities can be represented by food chains and food webs	✓		✓			✓

	Science as a Human Endeavour content descriptor						
	ACSHE119 Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available				✓		✓
	Science Inquiry Skills content descriptor						
	ACSIS126 Measure and control variables, select equipment appropriate to the task and collect data with accuracy			✓			
	ACSIS133 Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate		✓		✓		✓

Suggested lesson sequence

Lesson 1	Lesson 2	Lesson 3
What's the big deal	Habitat assessment	Measuring insect
Lesson 4	**Lesson 5**	**Lesson 6**
Who's who and who's new?	Amazing adaptations	Conservation

Lesson 1

Single lesson
(approx. 50 mins)

What's the big deal about biodiversity?

This lesson introduces students to the concept of biodiversity and the Insect Investigators unit.

At the end of this lesson students will:

- **Know** what biodiversity is and why it is important.
- **Understand** why biodiversity should be studied (sustainability and conservation).
- **Be able to** define biodiversity in their own words and identify and describe examples of biodiversity in the environment.

Background information on biodiversity

Biodiversity is the variety of all living things on earth. There are three types of biodiversity:

- Species diversity – vertebrate and invertebrate animals, plants, bacteria, fungi, and viruses.
- Genetic diversity – the diversity of genetic material within each species.
- Ecosystem diversity – the different communities of living things that depend upon each other to survive.

Everything in the natural world is connected. Ecosystems with many connections (high diversity) are healthier and more resilient than those with few connections (low diversity). Diversity is important because it protects against things going wrong.

If one connection is damaged or changed within an ecosystem (or species or genetic code) then the impact will be much greater in a low diversity ecosystem than a higher diversity ecosystem. When biodiversity decreases it not only weakens an ecosystem's ability to survive but it means that the ecosystem can't support many things that humans value.

Lesson 1

Single lesson
(approx. 50 mins)

The book Biodiversity (CSIRO; Morton & Hill 2014), describes 5 core (and interacting) values that humans place on biodiversity:

- Economic—biodiversity provides humans with raw materials for consumption and production. Many livelihoods, such as those of farmers, fishers and timber workers, are dependent on biodiversity.
- Ecological life support—biodiversity provides functioning ecosystems that supply oxygen, clean air and water, pollination of plants, pest control, wastewater treatment and many ecosystem services.
- Recreation—many recreational pursuits rely on our unique biodiversity, such as birdwatching, hiking, camping and fishing. Our tourism industry also depends on biodiversity.
- Cultural—the Australian culture is closely connected to biodiversity through the expression of identity, through spirituality and through aesthetic appreciation. Indigenous Australians have strong connections and obligations to biodiversity arising from spiritual beliefs about animals and plants.
- Scientific—biodiversity represents a wealth of systematic ecological data that help us to understand the natural world and its origins.
- Biodiversity is also considered to have intrinsic value—that is, each species has a value and a right to exist, whether or not it is known to have value to humans.

Lesson outline

- Break down the word biodiversity (biologica and diverse) with quick discussion and definitions on the board.
- Create a mind map or 'biodiversity web' to identify and record the examples in their local area or school yard demonstrating the relationship between humans and other species including insects. Also consider how these relationships change during different stages of an organism's life cycle.
- Ask students to complete the activities in both task sheets for Lesson 1.
- End lesson by clarifying definition for students and asking a few students to provide examples in their own words.
- Discuss why biodiversity is important. Example prompting questions:
    - Do you think the relationship between humans and other species is important? Why?
    - What might change on the web/diagram if one or more species are reduced or become extinct? Can you give an example?
    - Why do humans need to be aware of the biodiversity in our environment?
    - How can we conserve biodiversity?

Lesson 1

Single lesson
(approx. 50 mins)

Alternate activity ideas and topics to explore

What is biodiversity?

Draw/list differences found within species (genetic diversity), between species (species diversity) and between ecosystems (ecosystem diversity). Explore how differences are characterised and how this might change depending on who is characterising diversity (i.e. between people/ cultures/ecosystems).

Then and now – how has the environment changed since colonisation?

Students sketch or record plants/animals/landscape from areas around the school. Discuss what might have been there before the school was built, at colonisation and pre-colonisation. Is the school ecosystem diverse? What impact do you think diversity has in the school landscape? The class could create a master map and add their scientific findings to it as they work through the unit.

Improving biodiversity

Sketch or record plants/animals/landscape around the school (biodiversity audit). Workshop ideas on how to improve biodiversity at the school and implement them at the school. E.g. planting natural/ native habitat at the school to create a butterfly/bird sanctuary.

Living things

Lead discussion on living vs non-living things. Who gets to decide what's classified as living? What has a right to exist? Should rivers be given the same rights as people? How might people treat them differently? Does every species have the right to exist? Or just the ones that help humans? How would you define 'helping humans'?

Extinction

Explore threatened species in the area. You can use local lists or databases or try using the Protected Matters map tool to find species in your area that are listed under the Environment Protection and Biodiversity Conservation Act 1999. When you find a species, you could explore the following questions: Why is it at risk? What could lead it to extinction? How do humans influence (positive and negative)? What animals/insects used to live in the region but now don't? How do we know when something goes extinct? Why are there not many insects listed as threatened?

Further Resources

Atlas of Living Australia
Explore biodiversity in your area and find out what species live near you.

Biodiversity – Australia State of the Environment
Online resource includes background information on biodiversity and ecosystem services and outlines how Australia is performing on different measures of biodiversity (2011, 2016, 2021 to be completed shortly).

Australia's biodiversity at breaking point – a picture essay
Newspaper article The Guardian (2019)

Lesson 2

Double lesson
(approx. 100 mins)

Habitat

This lesson will help students understand what a habitat is and how habitats vary between different insects. It covers some of the reasons why we should protect these habitats as well as how we can do this (leads to conservation lesson).

At the end of this lesson students will:

- **Know** what a habitat is why it is important to insect biodiversity.
- **Understand** that living things depend on each other and the environment for survival.
- **Be able to** identify and describe insect habitats and the factors that can positively or negatively affect insect biodiversity.

Background information on habitats

An ecosystem includes the living and non-living things in a particular location, as well as the interactions among them; it is a complex web of interacting organisms and their environment. The boundaries of an ecosystem are often defined by variables such as rainfall, climate, or geography. Ecosystems can be defined broadly (a 'freshwater ecosystem') or narrowly (the ecosystem of the Murray River).

A habitat is a part of the environment that is suitable for a particular species or group of species. Habitats can be defined broadly (e.g. the Daintree Rainforest is a habitat for lots of different plants and animals) or narrowly (some species of insects need a very specific type of habitat within the Daintree Rainforest, where the amount of moisture/sunshine/leaf litter is all 'just right').

Understanding the different habitats present in the school can help students predict what sort of insects will be found in different areas, and can inspire discussions around improving the habitats available for all sorts of living things, including making the school a better habitat for both humans and insects!

This lesson involves concepts used in ecology, including designating a quadrat in the school and conducting a habitat assessment within them.

Lesson 2

Double lesson
(approx. 100 mins)

Note: A 'quadrat' is a sampling area used in ecological surveys, often a 1m x 1m square (for this lesson, the quadrats are 10m x 10m squares). It is different from a 'quadrant' which is a term used in mathematics to define one quarter of a square.

Lesson outline

- Introduce the concept of habitat.
- Ask students the following prompt questions to generate discussion.
    - Do humans have places or environments where they usually live?
    - What do they look like?
    - How do humans make sure that they are safe and protected from the environment?
    - Do they have environments where they prefer to live?
    - What do they need in order to survive and thrive – shelter, water, food etc?
    - Do animals have homes or environments that they usually live in? Explain your answer and provide examples
    - Scientists call the environment where living things usually live a habitat. Have you heard this word before?
    - Is the whole school only one habitat or is there more than one habitat within the school grounds? Explain your answer and provide examples.
    - What do you think makes a good habitat?
- This lesson uses a set of 4 task sheets. Each task sheet has instructions for small groups of students to complete an activity as part of the overall habitat assessment for a quadrat in the school.
- Extra task cards can be printed to ensure there are enough for each group of students or are available as edited pdfs for use on iPads.
- It is recommended that teachers organise the groups and allocate a task card prior to the lesson to ensure that the task is suitable. Some tasks are harder than others.
- Provide student groups with their task card.

There are videos that accompany most activities that can be watched prior to students completing the activity:

1. Habitat Assessment: Counting dead trees
2. Habitat Assessment: Counting and measuring logs
3. Habitat Assessment: Characterising the understory vegetation
4. Habitat Assessment: Plant species

Lesson 2

Double lesson
(approx. 100 mins)

- As a class, create a quadrat in the school and ensure everyone knows where it is. An extension activity would be to measure out more than one quadrat in the school and compare the habitat assessment results.
- Allow time for students to complete their task within the quadrat.
- Once students have completed their task cards ask them to return to the classroom.
- Conclude the lesson with a class discussion of each group's results.
    - Explain what your task was and share the results.
    - Did you have any challenges?
    - What did you find out about the habitat in the quadrat?
    - What does this tell us about the diversity of habitats available in the school?
    - What sort of insects do you think use the habitats?
    - Do you have a better understanding of what a habitat is and why they're important?
    - What could we do to provide a variety of different habitats in the school?

Lesson 3

Double lesson
(approx. 100 mins)

Measuring insect biodiversity

This lesson will help students explore, collect, and discuss insect samples and evidence of insect biodiversity at their school.

At the end of this lesson students will:

- **Know** that there are various ways to collect samples of and study insects within their school environment.
- **Understand** how insects differ to other small animals (e.g. spiders, snails) and the advantages and disadvantages of different methods of collection.
- **Be able to** use several methods of insect collection and then identify, sort and use scientific methods to record the samples collected.

Background information on insect biodiversity

Living things are classified into the following descending categories: kingdom, phylum, class, order, family, genus, species. Insects are animals in the class Insecta, and all have six legs and three body parts (head, thorax, and abdomen) as adults. They have antennae and can have 0-2 pairs of wings which are attached at the thorax.

Insects are part of the phylum Arthropoda (the arthropods), which also contains animals like arachnids (e.g. spiders, scorpions, mites and ticks). Arachnids have eight legs and two body parts (the head and the thorax are fused into a cephalothorax). The phylum Arthropoda also includes things with more than eight legs such as myriapods (centipedes and millipedes), and crustaceans (e.g. crabs, prawns and slaters). All arthropods have jointed appendages and an exoskeleton. An exoskeleton is a hard outer layer on the arthropod's body made of chitin that provides support and protection.

All arthropods (insects, spiders, millipedes, crustaceans etc.) are invertebrates: animals without a backbone/spinal column. Many different animals are also invertebrates, such as jellyfish, sponges, molluscs like snails and slugs, octopus and starfish, but only the arthropods have an exoskeleton made of chitin and jointed legs.

Lesson 3

Double lesson
(approx. 100 mins)

Entomologists (scientists who study insects) conduct insect biodiversity surveys to work out what insects are living in an area and find new species. We have only named and described an estimated 30% of the insects in Australia.

Most insects are incredibly important for the ecosystem, performing important functions as pollinators and decomposers, as predators and parasites of other pest insects, and as food for other animals. Insects are living things with critical roles in the environment, and therefore we encourage people to not kill insects unnecessarily. However, many insects (particularly the very small ones) are often difficult to collect and identify whilst alive, and some groups may even need dissection to be able to be identified. Entomologists will therefore often collect specimens (kill the insects) so that the insect biodiversity can be accurately measured and the insects can be correctly identified. Collecting a specimen also allows the DNA of the insects to be sequenced, which can be used to help with identification.

We suggest before running lethal collecting activities such as pan traps (which are included in this lesson plan), you discuss with your class the reasons why scientists kill insects when conducting biodiversity surveys.

Ensure that collecting is done thoughtfully and as much data is created from the activity as possible (i.e., by taking photos of any insect specimens in the pan traps and uploading them to iNaturalist). Photos of specimens uploaded to iNaturalist become part of an incredible citizen science dataset that can be used for all sorts of future research, and there is more benefit gained from the collection than if specimens were just thrown away.

If you would prefer not to use a trap like a pan trap (lethal) or a pitfall trap (generally non-lethal, but occasionally arthropods will die or be eaten by others in the trap), you could remove these options and ask students to compare the arthropods they find using only non-lethal methods of collecting.

Examples of non-lethal collecting methods include:

1. Shaking tree or plant branches, or flowers, into a container.
2. Lifting rocks (always place rocks back where you found them).
3. Sifting through leaf litter.
4. Sweep netting.

Always give students a safety briefing before going outside to look for insects. Whilst most insects and other arthropods are harmless, there are some spiders, bees, wasps, ants, scorpions and centipedes which can give nasty bites if threatened. Some students may also be allergic to stings, so having a first aid kit available and quick access to students' prescribed EpiPens (where applicable) is important.

Remember to look for opportunities to respectfully engage with members of your local Aboriginal community in order to share what you are learning and to help you understand more about the relationship Aboriginal people have with their Country and all its parts including the living and non-living things that make up the ecosystem.

Lesson 3

Double lesson
(approx. 100 mins)

Lesson outline

- Quick recap of definition of biodiversity.– 5 mins max.
- Question prompts for lesson introduction – 10 minutes max.
    - Have you been more aware of the insects and animals around you since we learnt about biodiversity and habitats in the last lessons?
    - Define and explain the differences between insects and other arthropods like spiders and millipedes.
    - Have you seen insects or other arthropods around the school? Where? What did they look like? Can you name them?
    - Are there insect and animal habitats within the school?
    - Do you think certain areas of the school would have more insect biodiversity than others? E.g. playground vs the garden beds? Why?
    - How could we collect information about insect and arthropod biodiversity in our school?
    - Who would be interested in this information? Why?
- Provide the Bug Bingo task sheet and allow 10-15 minutes for students to explore anywhere in the school yard and identify as many arthropods as possible. Can they complete a line or even a board black out? Insects can be released after this activity or photographed so that the images can be used for identification activities in a later lesson.
- Discuss the ethics involved in collecting insect specimens for science with the class if you use lethal trapping methods like the pan traps.
- Students work in pairs or groups of three to design, construct and set up their own collection method or trap. View this video to learn how to use pan traps and pitfall traps. If using pitfall traps, ensure to check them regularly and if leaving overnight, check early in the morning so that any animals who have fallen in do not get too hot before you release them.
- Each group should choose a different location and mark this on a school map in the classroom/workbook to allow for recording of insect diversity across the school.
- You may wish to direct students to use the quadrat(s) in which the habitat assessment was carried out, to allow direct comparison between the habitat assessment results and the types of insects that you collect. Otherwise, direct students to collect insects in any suitable location in the school.
- Students work through the task sheets for Lesson 3 while setting up their trap or using their collection method.
- Students can photograph or draw the insects they find and then release them. Photographs can be added to the Bush Blitz Species Discovery Project on iNaturalist. Photos or drawings (if releasing insects) or specimens (if collecting the insects) will be used in the next lesson.

Lesson 3

Double lesson
(Approx. 100 mins)

- If running pan traps or pitfall traps, students will need to leave them for several hours or overnight. Pan traps can be emptied and specimens dried or stored in alcohol (e.g. hand sanitiser). Pitfall traps should be checked early in the morning before animals get too hot, and the arthropods can be photographed and released.
- End lesson with collating and storing task sheets, lists, maps etc in science books or unit booklet.
- Confirm that students have:
    - completed the collection task sheet
    - saved their photos or drawings in an easy to access, sensible location ready for the next lesson
    - where applicable: Set up their collection trap in a safe location properly.

Opportunity for extension

Extend students by testing if different coloured plates attract more or less arthropods or perhaps different kinds, and learn about insect vision and how insects respond to different colours and UV light.

Further Resources

Bush Blitz Backyard Species Discovery Teacher Resources
(includes videos explaining how to make a class account on iNaturalist, and how to upload photos).

Video: how to catch minibeasts using the 'branch shaking' method
(non-lethal)

Video: how to make an insect aspirator

Video: how to make a sweep net

Purchase insect collecting equipment

South Australian Museum Scientific Illustration guide

Lesson 4

Single lesson
(approx. 50 mins)

Who's Who and Who's New? Insect Taxonomy

This lesson will help students develop an understanding of insect taxonomy by studying the specimens or photographs collected in the previous lesson.

At the end of this lesson students will:

- **Know** that insects can be classified based on physical features and that there is a hierarchy.
- **Understand** that it is important for scientists to have a system for classifying and organising insects to understand how they relate and interact with each other.
- **Be able to** use a dichotomous chart to identify the key characteristics of insects and sort them in hierarchical order.

Background information on taxonomy

Taxonomy is the science of classifying living things. Taxonomists research how different species are related to each other and improve the way that we classify life. All living things are classified into the following hierarchical categories: kingdom, phylum, class, order, family, genus, and species. If we know how organisms are related to each other, it can help us predict characteristics of species, and help us understand the process of evolution.

Taxonomists also describe and name new species. All species are given a scientific name, which is made of two parts: the genus and the species name. The scientific name for humans is *Homo sapiens*. Humans are in the genus Homo and the species name is sapiens. Having a name for species allows them to be listed on endangered species lists, studied as potential beneficial insects to control pests, or researched for potential new medicines.

The scientific name for a lion is *Panthera leo* and the scientific name for a tiger is *Panthera tigris*: they are in the same genus and are therefore closely related. Scientific names are normally written in italics. Identifying insects to order level is possible for students to do using a guide that lists the key features, or a dichotomous key. Dichotomous keys use morphological features to split groups of organisms repeatedly until a single identification is possible.

Lesson 4

Single lesson
(approx. 50 mins)

Lesson outline

- Question prompts for lesson introduction – Short discussion or Worksheet entries (short answer)
    - Was your trap still there?
    - What did you notice about the trap before you picked it up? Had it moved? Were there any issues that might have impacted your collection?
    - How do you feel about the size of your sample collection? Did you get as many insects as you anticipated?
    - What would you do differently next time?
    - Which collection method do you think works best? Why?
- Photograph any insects collected in the traps to upload to iNaturalist, if not completed already.
- Teacher introduces the concept of taxonomy and dichotomous keys. Use the identification chart and discuss the features that are on the insects the students have collected.
- Provide Who's Who and Who's New dichotomous key worksheet.
- The first page can be completed as a class to help develop an understanding of how a dichotomous key works.
- Students can then work individually or in the pairs/groups they worked with in the previous lesson to identify at least 5 of the arthropods they caught (live specimens or photos) using the identification sheet or key supplied on the Insect Investigators website.

The worksheet is set up in table format with a system for identifying arthropod features.

For example:

Does your arthropod have	Arthropod 1 Ant	Arthropod 2 Slater	Arthropod 3 Millipede	Arthropod 4 Mosquito
Wings	Yes	No	No	Yes
Eyes	Yes	Yes	Yes	Yes
Antennae	Yes	Yes	Yes	Yes

Students can then create their own dichotomous key from the information in the chart.

- End lesson with collating and storing worksheets, in science books or unit booklet, and upload photos to iNaturalist.

Lesson 4

Single lesson
(approx. 50 mins)

- End the lesson by sharing each group's findings and creating a class checklist of arthropods that are present at the school.
    - How many arthropods have you identified?
    - Were there any you couldn't identify? Tell us about one of them.
    - Did you notice a difference in the arthropods found using the different traps or collection methods in the same part of the school?
    - Did you notice a difference in the arthropods found using the same traps or collection method type in different parts of the school?
    - Did different parts of the school have different numbers of arthropod species?
    - What could we do with the information we gathered? Who might benefit from our findings?

Lesson 5

Single lesson
(approx. 50 mins)

Adaptations

This lesson will give students an understanding of how the physical features and behaviours of insects allow them to adapt to their habitat and how they help them survive.

At the end of this lesson students will:

- **Know** that the physical features and behaviours of insects are adapted to their environment.
- **Understand** that adaptations help insects to survive.
- **Be able to** identify and describe key features and behaviours of insects that reflect adaptations.

Background information on adaptations

All living species have evolved physical and behavioural adaptations to allow them to survive in their natural habitat. One of the reasons that insects are so diverse and numerous is because as a group they have evolved many different adaptations. Different insect species have evolved to survive in every ecosystem and habitat on earth, filling different environmental niches, and different roles in the biodiversity webs.

Lesson 5

Single lesson
(approx. 50 mins)

Lesson outline

Display three examples of plants, animals and insects in three different ecosystems. Ask students to identify the similarities of each living thing within that ecosystem.

- What are their similarities?
- Do the three living things share key features that reflect their environment? Explain your answer
- How are the creatures different between the other ecosystems? Why do you think this is?
- We've just studied the different habitats in our school. Think about the insects and arthropods you collected in those habitats; how did they look?
- Can you identify any key features that are examples of animals adapting to their habitat? Please explain them to us.

- Provide students with the Amazing Adaptations task sheets.
- Allow students time to read the text or read it as a class and answer the questions.
- Students can use their samples and task sheets from previous lessons to complete the second section.
- Early finishers can complete the insect creation activity.
- Conclude the lesson by asking students to share some of the adaptations they have identified with the class.

Lesson 6

Single lesson
(approx. 50 mins)

Conservation

This lesson will allow students to share their new knowledge of insect biodiversity with their peers and school community and develop an awareness of why and how this biodiversity needs to be protected. The tasks can contribute to summative assessment.

At the end of this lesson students will:

- **Know** why it is important to protect insect biodiversity and how this can be done.
- **Understand** that conservation of insect biodiversity is everyone's responsibility.
- **Be able to** recommend conservation ideas and methods and explain their reasoning.

Background information on conservation

There are ongoing threats to the environments we depend on for food, health and clean air. Climate change, deforestation, pollution, pesticides, and the spread of invasive species through globalisation, are all impacting on the health of native and agricultural ecosystems. There is lots of great research and action being taken by scientists and communities to help combat these threats and conserve and repair our native ecosystems.

There is a lot of evidence that the numbers and diversity of insects are declining overseas, with long term studies showing the number of insects caught in Malaise traps have decreased significantly over time. There have not been many long-term studies in Australia, but we can assume similar things are happening here. It can be difficult to create conservation plans for particular insect species when we only have scientific names for 30% of them in Australia. This is part of the reason that the science of taxonomy, and documenting and describing all the species of insects, is important.

However, there is a lot we can do to help promote insect diversity even when we don't know the names of all the species. By planting a range of flowers and trees that are native to the area, reducing the broad-spectrum pesticides used, and protecting remaining native vegetation, we can help increase the diversity of insects in an area. Strong insect biodiversity is beneficial to both other animals and to humans; for example, it can increase pollination to help production of crops, and make waterways cleaner.

Lesson 6

Single lesson
(approx. 50 mins)

Lesson outline

- Start the lesson with a short discussion/brainstorm of what they've learnt during the unit on insect biodiversity.
    - Tell me 3 things you've learnt about insects and insect biodiversity?
    - What was the most interesting thing you learnt?
    - Have you changed your behaviour now that you're more aware of insects in our environment? How do you think we could share our new knowledge about insect biodiversity and encourage others to be more aware of protecting insect biodiversity?
- Provide students with the Insect Biodiversity Brochure OR the persuasive writing brainstorming and planning task sheets. Alternatively, students could share their ideas by making a digital product depending on the technology and software they have access to – see the task sheet for ideas.
- Students can either choose if they would like to make a brochure, make a digital product or write a letter OR the class teacher can decide the most appropriate activity for their class.
- Students work through the task sheets using the question prompts to share their knowledge and understanding about insect biodiversity and conservation ideas.
- If students are completing the brochure, they can use photographs and colour to make them stand out. Alternatively, they could design their brochure using MS Publisher or a similar program during an IT lesson.
- Students can share their products, brochures or letters at the end of the lesson with peers. They could also be shared with parents via platforms such as SeeSaw, Canvas and other online learning tools.

Glossary

Abdomen	The end part of an insect, where all the organs and spiracles (breathing tubes) are.
Antennae	A pair of long thin body parts on the head of insects that are used to sense their environment (like a nose).
Arachnid	A type of animal with eight legs and two body parts (cephalothorax, abdomen) (includes the spiders, scorpions and ticks). All arachnids are arthropods.
Arthropod	All animals with an exoskeleton (their skeleton is on the outside) and includes the insects, arachnids and crustaceans.
Biodiversity	All of the different living things in the environment. Bio = life, diversity = lots of different things.
Biodiversity Web	A network like a food web, that is broader and includes processes such as pollination and seed dispersal.
Cephalothorax	The body part of arachnids that is made of the fused head and thorax.
Chrysalis	Another name given to the pupa of butterflies
Cocoon	The protective covering that some insect larvae make around their pupa. It is often fluffy or hairy.
Crustacean	A type of animal with several pairs of two-parted (biramous) legs. Most crustaceans live in water (but some, like slaters, live on land). All crustaceans are arthropods.

Decomposers	The livings things in a food web or chain that break down dead things to transfer the nutrients back into the soil for plants (the producers). E.g. some fungi and beetles
Ecology	The study of the environment and how living things interact with it.
Ecosystem	All of the living things and the physical environment they interact with.
Elytra	The hardened fore wings of a beetle.
Entomologist	A scientist who studies insects.
Entomology	The scientific study of insects.
Exoskeleton	A hard outer layer that protects the bodies of arthropods like insects and spiders.
Food chain	A sequence of living things that describes how energy is transferred through the ecosystem (who eats who).
Food web	A network that consists of all the food chains in a single ecosystem.
Habitat	The natural home or environment of a living thing like an animal or plant.
Herbivore	An animal that eats plants to gain energy and nutrients.
Insect	A type of animal with six legs and three body parts (head, thorax, abdomen). All insects are arthropods.
Invertebrate	An animal without a backbone/spinal column. This includes the arthropods, but also includes lots of other animals like snails and jellyfish.
Larva	The juvenile stage of some insects that have complete metamorphosis. (Plural: larvae). E.g. a caterpillar is a larva of a butterfly.
Malaise trap	A insect trap that entomologists use to survey for particular flying insects in an environment.
Mandibles	The jaw-like feeding mouthparts of some insects like beetles (the 'chompy' part).
Metamorphosis	The transition an insect undergoes during its lifecycle to turn into an adult insect. Some insects have complete metamorphosis (egg-larva-pupa-adult) whilst others have incomplete metamorphosis (egg-nymph-adult).

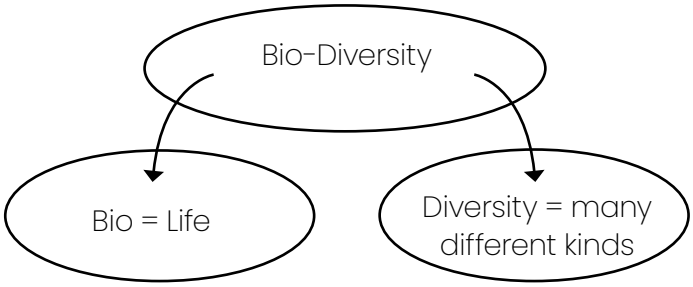
Microscope	A piece of scientific equipment that uses lenses and light to allow you to see small things magnified.
Nectar	A sweet liquid produced by flowers that provides sugar for animals like insects to eat.
Nymph	The juvenile form of insects that have incomplete metamorphosis (e.g. grasshoppers).
Organic matter	Stuff that is made of living things (organisms) or things that were once living, like leaf litter.
Organism	A living-thing, such as a plant, animal, fungi or bacteria.
Pollen	A powder that is made by the male parts of a flower. Insects are important for spreading pollen from flower to flower so that female parts of flowers are able to make seeds for more plants.
Pollinator	An animal (like an insect) that spreads pollen from one flower to another.
Predator	An animal that eats other animals to gain energy and nutrients.
Producers	The livings things in a food web or chain that produce their own energy from the sun (photosynthesis) and don't need to eat other living things to survive, e.g. plants and algae.
Pupa	The stage of an insect lifecycle where a larva changes into an adult. A pupa can be in a cocoon (protective covering) or is sometimes called a chrysalis. (Plural: pupae).
Quadrat	A small section of the larger habitat or area that has been chosen to assess the habitat quality or distribution of plants or animals (e.g. by measuring ecological features like tree height). Quadrats act as representative sections for the larger habitat.
Species	Generally, the lowest classification of living things in taxonomy.
Spiracle	The breathing hole on the abdomen of an insect (insects don't breathe through their mouths).
Taxonomist	A scientist who studies how living things are related to each other, classifies them and gives them scientific names.
Taxonomy	The study of classifying (sorting, naming and describing) living things.
Thorax	The middle part of an insect, between the head and the abdomen, where the wings and legs attach.
Vertebrate	An animal that has a backbone/spinal column. This includes mammals, birds, fish, amphibians and reptiles.

Lesson 1
Task sheets

What is Biodiversity?

Have you ever thought about how many living creatures there are in the world?
Once you start making a list you could go on forever!
Use a timer to see how many living creatures you can list in 30 seconds:

The scientific term for the huge variety of living creatures on earth is BIODIVERSITY.



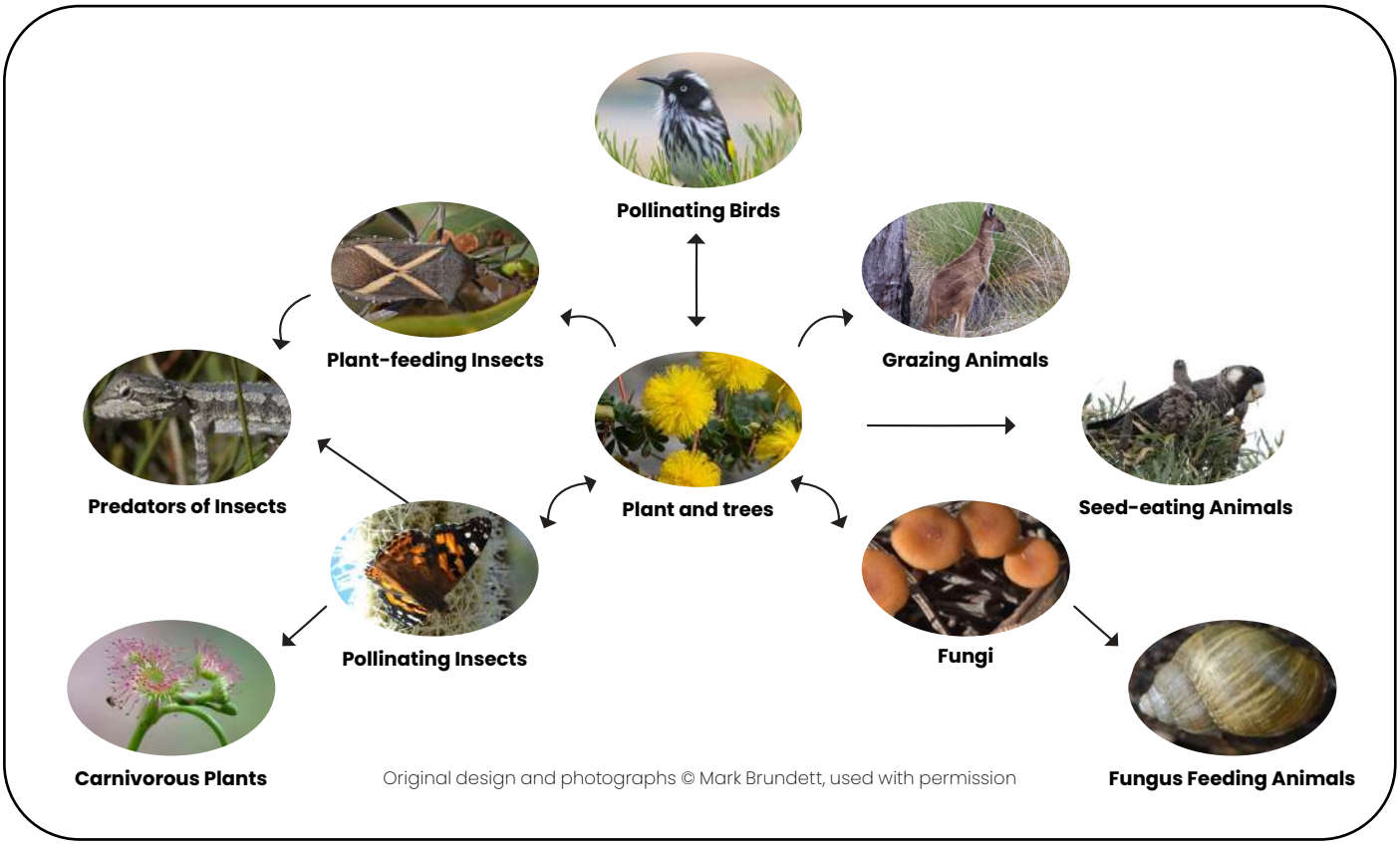
Biodiversity is very important because all of the living things within an ecosystem rely on each other for survival. So, if a plant or animal is affected by changes in the ecosystem all living things are also affected in some way. The health of an ecosystems can be measured by its biodiversity.A strong ecosystem has lots of living things (organisms) in it which means that if one type of organism dies out or gets sick there are things to fall back on. An unhealthy ecosystem is not as bio-diverse and i is harder for living things to survive.

An **ecosystem** is the environment where living things interact with each other and non-living things around them like dead plants, rocks, soil, water and air. Ecosystems can be really small, like a fish tank, or huge, like the ocean.

What is a Biodiversity Web?

A great way to see how an ecosystem works and how living things rely on each other and their environment is to create a Biodiversity Web.

A biodiversity web is a diagram that shows not only how living things support and rely on each other and their environment making connections, like a web, it is also a great way to see how even the smallest changes can cause the web to breakdown or weaken.



1. In your own words explain what a biodiversity web is.

_____

_____

_____

2. What impact would removing one of the living things from this biodiversity web have on the rest of the web?

_____

_____

_____

3. Can you add anymore living things to this biodiversity web? Explain your answer and add them to the graphic above including labels and arrows showing their connections to other living things in the web.

_____

_____

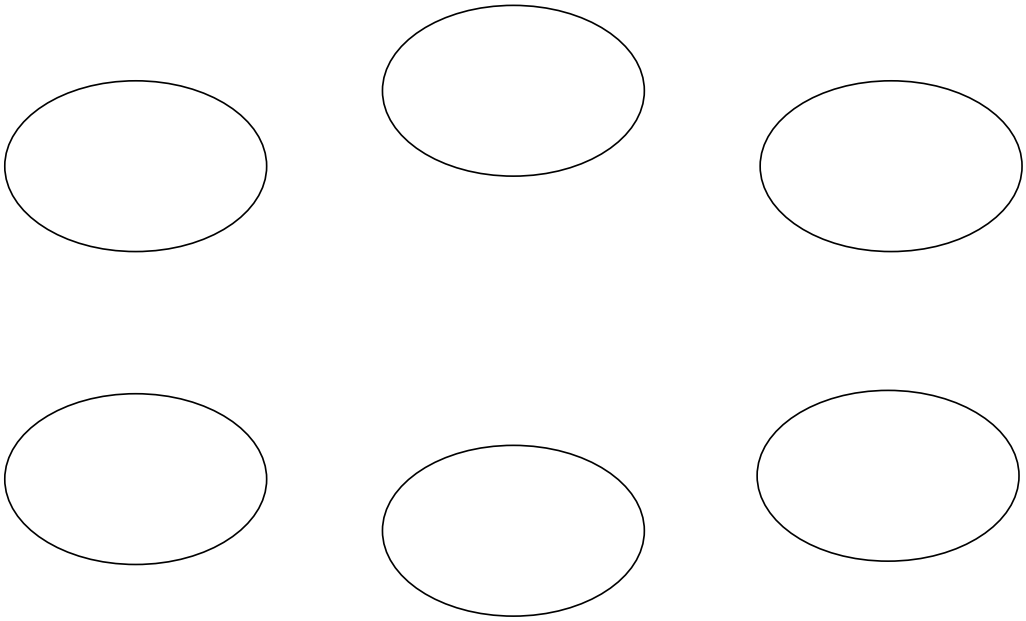
_____

Create Your Own Biodiversity Web?

Did you know that your school has its own ecosystems? Garden beds, ponds, creeks, vegetable gardens and grass areas all contain living things that form ecosystems.

Work with a partner or small group to explore your school yard and the animals and plants that live there. Choose one location and draw your own detailed biodiversity web based on what you find there.

Remember to draw arrows connecting each of the living creatures and explain how they rely on each other.



1. Give a detailed description of the area where your ecosystem is located.

_____

_____

_____

2. Do you think this area shows a high or low level of biodiversity? Explain your answer.

_____

_____

_____

3. List at least 3 factors that might impact the level of biodiversity in this location. Eg. Student traffic, water availability or the weather.

_____

_____

_____

4. How could you improve the level of biodiversity in this area?

_____

_____

Lesson 2
Task sheets

Habitat Assessment: Making Quadrats

When collecting information on insects in your school yard it's important to learn about the habitat that you're working in. This information will be used to try and predict what sort of insects you might find there, and help explain your results from later lessons. A quadrat is a representative area of your school that you can use to assess the habitat available for insects and other animals.

Your Task

As a class, you will need to measure out a square in your school yard in which to assess the habitat available for insects and other animals. This is a representative area of the whole school, which will allow you to carry out the habitat assessment measurements in a reasonable timeframe. Scientists call these representative areas 'quadrats'.

The square can be any size, depending how big your school yard is, and how much time you have to carry out the habitat assessment. For example, you might use a square that has 10m long sides. This would mean the total area inside the quadrat is $10m^2$.

Measure out the quadrat as a class. You can use a tape measure, or take 10 large steps on each side.

You can mark each corner of the quadrat with something like a hat or a cone, or use rope or string to run along the sides.

Make sure everyone in the class knows where the quadrat is in the school.

Take a photo of each of the quadrat and record the locations (you could use google maps or the compass app on a smartphone to find the GPS location if you want).

Habitat Assessment: Trees and Canopy

Counting living trees

A habitat is the natural home, or environment, of living things, it provides food and water, shelter and protection from predators. A habitat can look different for any animal or plant or animal, they can be small or large and species can share the same habitat.

Your task is to focus on the trees in your quadrat and collect data on how many living trees are in the area. Trees are important for providing habitat for insects. Leaves and sticks falling from the canopy also provide much of the material on the ground, such as leaf litter and other organic material. Trees and shrubs of the overstory/understory offer insects structures to live, find food, find mates, and lay eggs. Insects often prefer certain types of trees and shrubs, or plants because they provide exactly what that insect needs, such as sap from tree trunks, hollow branches, or decaying wood.

Your Task

You are required to count the number of living trees in your quadrat. You will need to count both the large (more than 6 metres) and small trees (less than 6 metres). You can use tally marks to count the trees and total them up at the end.

	Tally	Total
Large Trees		
Small Trees		

Habitat Assessment: Trees and Canopy

Counting dead trees and measuring logs

A habitat is the natural home, or environment, of living things, it provides food and water, shelter and protection from predators. A habitat can look different for any animal or plant or animal, they can be small or large and species can share the same habitat.

Your task is to focus on the number of dead trees, both standing and fallen, in your quadrats. Dead and decaying trees are very important for providing habitat for many types of insects. They use the decaying wood and fungi for laying egg and rearing larvae and hunting.

To help with this activity, watch the videos:

Habitat Assessment: Counting dead trees

Habitat Assessment: Counting and measuring logs

Your Task

Your group is responsible for recording the number of dead trees around your insect trap.

1. You must count the standing dead trees and record them in the table below. Look for trees with no leaves and visible signs of decay such as fungi, split trunks or branches.
2. You must also record the number of logs, and choose five to measure their length, the circumference and if any fungi is present. Only count logs that are thicker than an adult's ankle (about 10 cm diameter or 25 cm circumference).

	Tally	Total
Standing dead large trees		
Standing dead small trees		
Logs		

	Length	Circumference	Is fungi present?
Log 1			
Log 2			
Log 3			
Log 4			
Log 5			

Habitat Assessment: Understory

Characterising understory vegetation

A habitat is the natural home, or environment, of living things, it provides food and water, shelter and protection from predators. A habitat can look different for any animal or plant or animal, they can be small or large and species can share the same habitat.

Your task will focus on the trees in the quadrat and on the plants, soil, leaf litter, rocks etc underneath trees. This is called the understory and usually has a great variety of plant species and is a very important source of shelter and food for many animals and fungi (and many other organisms). Different plant species provide different structures and materials for animals to construct nests from, to spin webs between and many insects feed from the many flowering herbs in the low to mid understory.

Insects which decompose organic matter are found in abundance in leaf litter – as too are the predatory insects and spiders which rely on them for nutrition. Furthermore, rocks, bark, branches and twigs are perfect for insects and spiders to forage and hide in. Bare soil is important as a site for seed germination, but also for insects basking in sunlight. Similarly, temporary puddles are used by many organisms, such as birds, dragonflies, bees and flies use puddles for drinking, bathing, but also egg laying.

To help with this activity, watch the video: Habitat Assessment: characterising the understory vegetation

Your Task

Your task is to identify which of the following is present in the understory of the quadrat. Put a tick or a cross in the box to show if you can see each one.

	✓ / x
Tree <6m tall	
Shrub (1 - 5m tall) **Shrubs are smaller than trees and often have more than one woody stem.**	
Small Shrub <1m tall	
Large herb >0.5m tall	
Small herb <0.5m tall	
Fern or bracken	
Moss or lichen **(can be on other plants or rocks)**	
Scrambling/Climbing vine	
Tall Grass >1m (or grass-like)	
Small Grass <0.5m (or grass-like)	
Branches/twigs/sticks on ground	
Patches of bare soil	
Rocks larger than your hand	
Shallow water puddles	
Stream/Creek (note if temporary or permanent)	

Habitat Assessment: Understory

Plant species

A habitat is the natural home, or environment, of living things, it provides food and water, shelter and protection from predators. A habitat can look different for any animal or plant or animal, they can be small or large and species can share the same habitat.

Your task will focus on the trees surrounding your insect trap and on the plants, soil, leaf litter, rocks etc underneath trees. This is called the understory and usually has a great variety of plant species and is a very important source of shelter and food for many animals and fungi (and many other organisms). Different plant species provide different structures and materials for animals to construct nests from, to spin webs between and many insects feed from the many flowering herbs in the low to mid understory.

Many plants and insects rely on each other. Many butterflies (Lepidoptera) and bugs (Hemiptera) use specific plant species or groups of plants. However, other insects are not so picky. Different insects eat different plant parts, e.g., some eat fruits, others leaves, some pollen and nectar, while some eat plant roots. Over half of all insect species are estimated to eat plants.

The number of plant species in your quadrat can help explain the number of insect species.

To help with this activity, watch the video Habitat Assessment: Plant species

Your Task

1. Count the number of different leaf shapes; include overstory, understory and herb layer plants. You might find overstory leaves on the ground. The number of leaf shapes give us an idea of the number of plant species in the quadrat.
2. Count the number of flower types you can collect.
3. You could also draw or photograph the leaves and flowers to keep a record of the different plant species.

How many different leaf shapes?	
Tally	**Total**

How many different flower shapes?	
Tally	**Total**

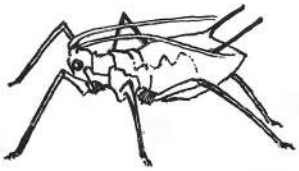
Lesson 3
Task sheets

Insects and their arthropod friends are everywhere! Carefully check around your school grounds and see how many of the arthropods below you can find. Try to complete a row or column to get bingo or even better, find them all!

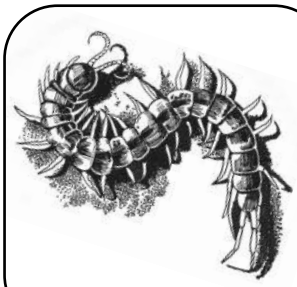
Remember!

Be safe - always be aware of what's around you.
Be careful - don't damage the plants around you.
Be prepared - make sure you're sun safe.

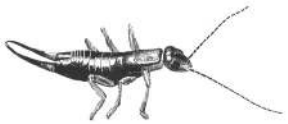

Ant


Aphid

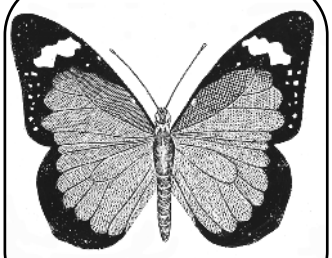

Blow fly
or house fly

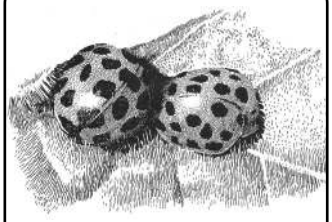

Centipede


Wasp


Earwig


Dragonfly

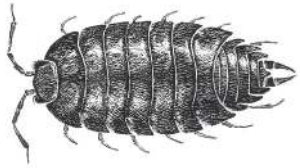

Butterfly

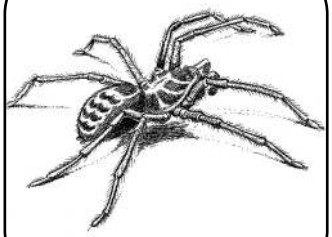

Lady beetle

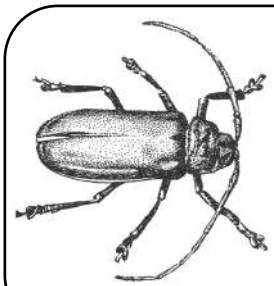

Millipede

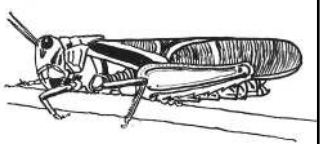

Praying mantis

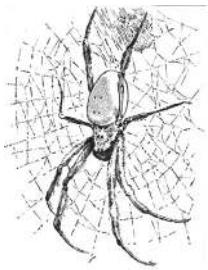

Moth

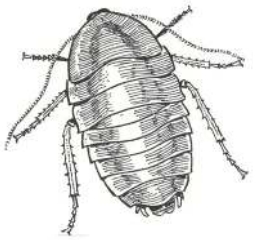

Slater

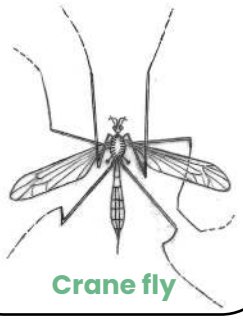

Wolf spider

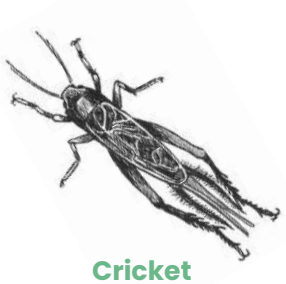

Longhorn beetle


Grasshopper


Orb weaver spider


Cockroach


Crane fly


Cricket

Images courtesy of WA Gould League

Insect Collection Methods

Important reminders:

Be safe - always be aware of what's around you.
Be careful - don't damage the plants around you.
Be informed - don't collect insects in areas where you need a permit.
Be prepared - make sure you're sun safe.

Entomologists (insect scientists) use a lot of different methods to survey for insects when undertaking a biodiversity assessment. A Malaise trap is very good at catching small flying insects like wasps and flies. However, there are a lot of other methods that entomologists use to collect insects.

Some methods keep the insects alive, whilst others (like pan traps) involve killing the insects.

Whilst insects are incredibly important in the environment, sometimes scientists have to collect specimens (kill the insects) to be able to identify them accurately.

Choose one of the methods below to use to survey the insects and other arthropods in your school.

Method #1: Sweep netting

Entomologists (insect scientists) use a net with very small holes to 'sweep' along vegetation like shrubs and leaves. Sweep nets are also useful for sweeping the air just above flowering plants, where insects might be hovering. Once insects fall into the net, you can collect them into vials or containers.

Method #2: Branch shaking

This method is very simple. Take a container or an upside down umbrella and hold it under a branch. Shake the branch over the container, or use a stick to tap the branch and knock any insects that are on the leaves into your container.

Method #3: lifting rocks/search on bare ground

Many insects like ants can be found walking over bare ground. Other arthropods, like spiders, scorpions and slaters, are often found under rocks. Always be careful lifting rocks as snakes also like to hang out there!

Method #4: Sifting leaf litter

Many arthropods live in leaf litter (all of the dried leaves, sticks and flowers on the ground under trees and plants). You can collect leaf litter using gardening gloves or a spade, and spread it over a white piece of paper or a white tray. Watch closely and see what starts to move!

Insect Collection Methods

Important reminders:

Be safe - always be aware of what's around you.
Be careful - don't damage the plants around you.
Be informed - don't collect insects in areas where you need a permit.
Be prepared - make sure you're sun safe.

Method #5: Yellow Pan Traps

Yellow pan traps are quick and easy to set up and are perfect for collecting insects that are attracted to brightly coloured plants such as bees and wasps.

What you'll need:
A yellow plastic party plate

How to use it:
Place the party plate in a sunny spot on the ground where it won't get tipped over. Fill up the plate with clean water and add a drop of dishwashing detergent. The detergent helps to break the surface tension so the insects can fall into the water. Leave the trap for at least a few hours to collect a good sample.

Method #6 Pitfall Trap

Pitfall traps are perfect for collecting insects that crawl along the ground such as beetles and ants.

What you'll need:
A plastic cup

How to use it:
Dig a hole in the ground and place your cup inside. Fill in the dirt around the cup and flatten it down to make sure the top of the cup is level with the ground. Leave the cup for a few hours or even overnight.

You can place some leaf litter or a torn up egg carton in the bottom of the cup to give arthropods a place to hide when they fall in. Always check your trap regularly, and if leaving overnight check it early in the morning before it gets too hot.

Insect Biodiveristy

Date: **Group Members:**

Location Evaluation

Describe the location of your insect collection site.

1. Are there plants in your collection site? List them if you know their names, or describe them.

_____
_____
_____

2. Study the ground in your location. Describe what you see. Is the soil dark or sandy? Is there leaf matter, rocks or sticks?

_____
_____
_____

3. Record any sources of water near your collection location and measure the distance from your site.

_____
_____
_____

4. If your collection area is near mown lawn or grass record the distance from your site to the mown lawn.

_____
_____
_____

5. Is your collection site in a high traffic area? How will it be protected from students walking through the area?

_____
_____
_____

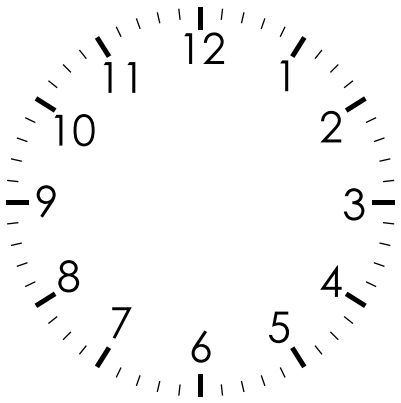
6. What kind of collection method are you using?

- ☐ Sweep netting
- ☐ Branch shaking
- ☐ Lifting rocks/searching on bare ground
- ☐ Sifting through leaf litter
- ☐ Yellow pan trap
- ☐ Pitfall trap
- ☐ Other _____
- ☐

7. Why did you choose to use this type of collection method?

_____
_____
_____
_____
_____

8. Record the time of day you set your trap, or started collecting.



9. How long will you collect for, or leave your trap set up? Why have you chosen this length of time?

_____
_____
_____

Insect Biodiveristy

10. Weather conditions.

Today's temperature: _____

11. Is the weather:

- ☐ Hot
- ☐ Cold
- ☐ Humid
- ☐ Sunny
- ☐ Overcast
- ☐ Raining
- ☐ Windy

12. How do you think the weather conditions will impact the effectiveness of your trap or collecting method?

_____
_____
_____
_____

13. Based on all the information you have about the habitat, predict what sort of insects and other arthropods you think you will find using this collection method? Explain your prediction.

_____
_____
_____
_____

14. Conduct your insect survey using your chosen method. Following the directions of your teacher, either keep specimens until the identification lesson, or draw or photograph the insects, and then release the insects where you found them.

15. What changes would you make to your method or trap design if you were to survey for insects again. Explain your answer.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

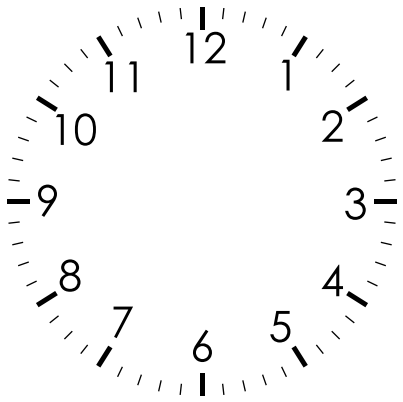
Collection Day

If using pan traps or pitfall traps

1. Was the trap disturbed? This could be by wind or rain, other animals or people. Describe what you see and how you think it was disturbed.

_____
_____
_____
_____
_____
_____
_____
_____

2. Record the time of day you collected your trap.

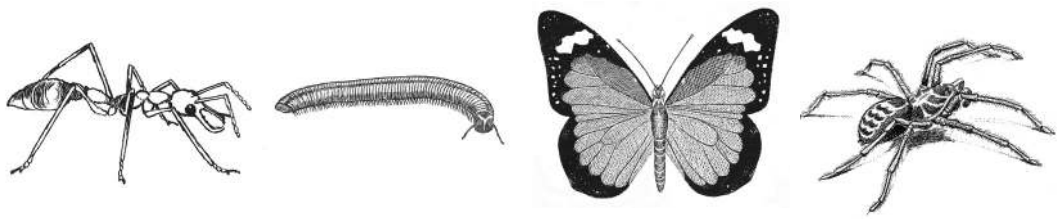


Lesson 4
Task sheets

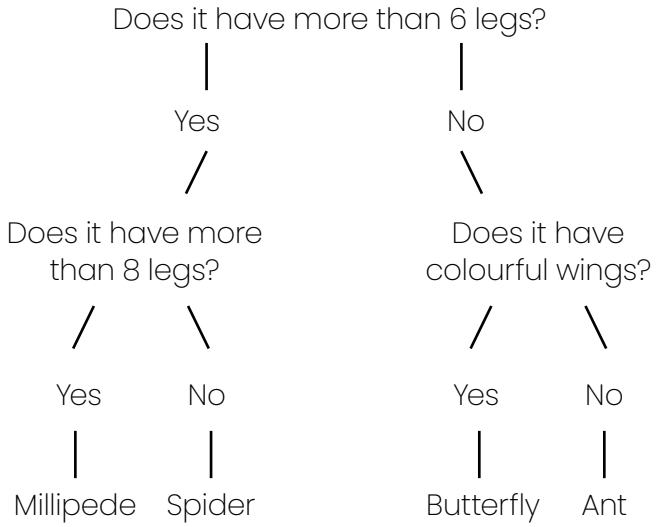
Who's Who and Who's New?

Taxonomy is the scientific process of identifying, classifying and naming objects or living things. Scientists study and compare plants and animals to find similarities. This helps to classify them which means putting them into groups based on the features they share. Once scientists have identified and classified a living thing they can then name it and record it.

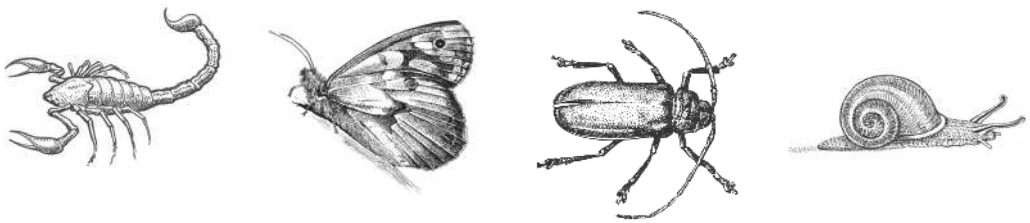
To help classify insects scientists use a special tool called a dichotomous key. A dichotomous key uses a series of steps to narrow down the features and identify each insect. They can be set out in different ways. Let's look at an example.



1. a. Has 6 legs ..... Go to 2
   b. Has more than 6 legs ..... Go to 3
2. a. Does not have wings ..... Ant
   b. Has wings ..... Butterfly
3. a. Has 8 legs ..... Spider
   b. Has more than 8 legs..... Millipede



Now it's your turn. Use the images below to create your own dichotomous key to classify and identify the animals.



1. a. _____
   b. _____
2. a. _____
   b. _____
3. a. _____
   b. _____

Who's Who and Who's New?

Identify the arthropods you collected using the Insect Investigators identification guide or the Insect Investigators dichotomous key to insects. Complete the chart below to compare the key features of up to 5 of the arthropods.

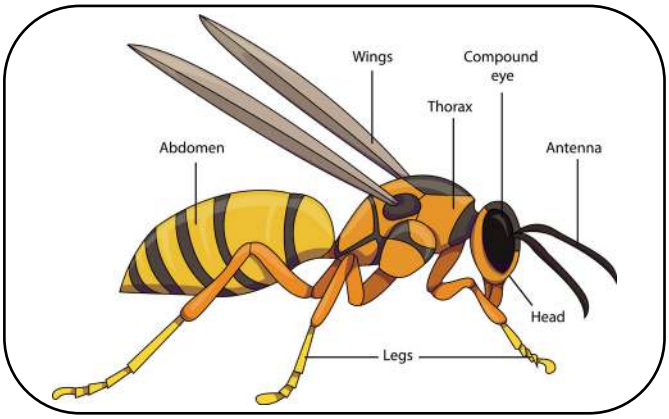
Once you have completed the table create a dichotomous key in the space provided for the 5 arthropods you selected.

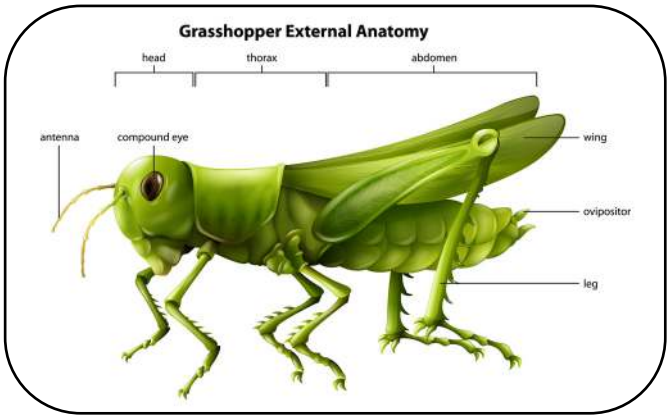
Does your arthropod have:	Arthropod 1	Arthropod 2	Arthropod 3	Arthropod 4	Arthropod 5
Wings					
Antennae					

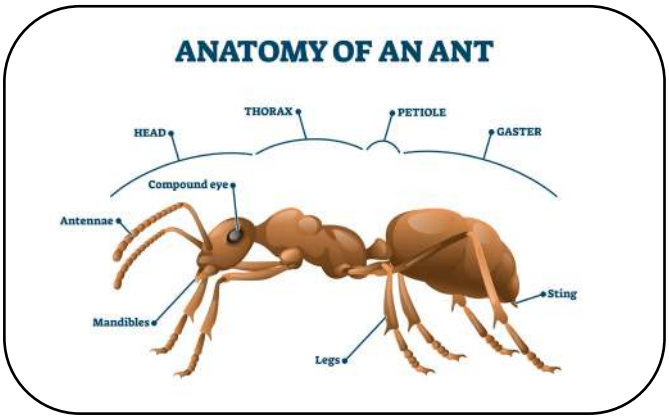
1	a.	
	b.	
2	a.	
	b.	
3	a.	
	b.	
4	a.	
	b.	

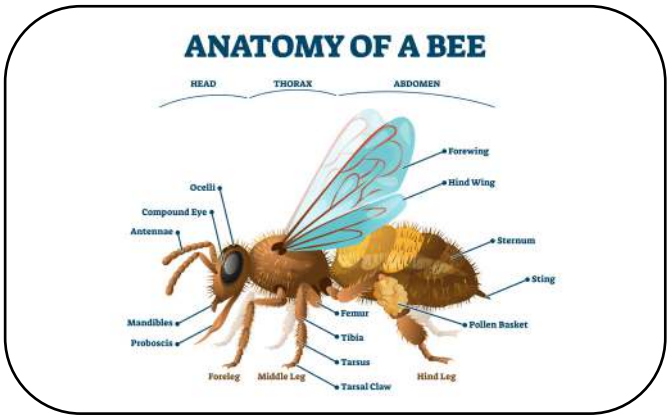
Who's Who and Who's New?

Use the chart below to help you compare your insects and identify their key features.









Lesson 5
Task sheets

Insect Investigation: Desert Ecosystem

Desert Delma *(Delma desmosa)* © tom_brennan, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Military Dragon *(Ctenophorus isolepis)* © Gavin Goodyear, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Spinifex Pigeon *(Geophaps plumifera)* © Gavin Goodyear, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Echidna *(Tachyglossus aculeatus)* © Joe Carmichael, iNaturalist, used under a Creative Commons license (CC0).

Australian Golden Orbweaver *(Trichonephila edulis)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Perentie *(Varanus giganteus)* © Bruce McLennan, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Insect Investigation: Rainforest Ecosystem

Pale Hunter *(Austrogomphus amphiclitus)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Black flying fox large *(Pteropus alecto)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Common Brown Ringlet *(Hypocysta metirius)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Dark Barsided Skink *(Concinnia martini)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Green-Eyed Tree Frog (*Ranoidea serrata)* © RichardReams, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Metallic Starling (Metallic) *(Aplonis metallica ssp. metallica)* © baronsamedi, iNaturalist, used under a Creative Commons license (CC0).

Insect Investigation: Bushland Ecosystem

Sulphur-crested Cockatoo *(Cacatua galerita)* © Stephen Matthews, iNaturalist, used under a Creative Commons license (CC0).

Common Grass-Blue *(Zizina otis)* © Pam Whetnall, iNaturalist, used under a Creative Commons license (CC-BY-NC).

Long-nosed Water Dragon *(Gowidon longirostris)* © Gavin Goodyear iNaturalist, used under a Creative Commons license (CC-BY-NC).

Superb Fairywren *(Malurus cyaneus)* © Claudia Schipp, iNaturalist, used under a Creative Commons license (CC0).

Australian Wood Frog *(Papurana daemeli)* © Richard Fuller, iNaturalist, used under a Creative Commons license (CC0).

Eastern Grey Kangaroo *(Macropus giganteus)* © Claudia Schipp iNaturalist, used under a Creative Commons license (CC0).

Amazing Adaptations

Plants and animals are really amazing. Did you know that many of their physical features are essential to their survival. Also the way they act, or behave, also ensures that they can avoid predators and survive their environment.

These behaviours and physical features are called ***adaptations***. Scientists describe an adaptation as a characteristic that helps living things survive in their environment. An example of an adaptation is the webbed feet of water animals such as ducks, crocodiles and turtles which are designed perfectly for swimming. Another great example is lizards who drop their tale when they're caught by a predator. You can probably think of lots of examples!

Adaptations can help animals survive in several ways. Some adaptations help them to find and eat food. Others help to disguise them from predators or even attract prey. Other adaptations are all about surviving in their environment such as a camel who can go for great lengths of time without water in the desert.

There are 2 kinds of adaptations - *physical* and *behavioural*.

Physical adaptations are parts of a plant or animal that help it survive such as long beaks on birds that suck nectar from flowers or the camouflage skin of lizards to help them blend in with their surroundings to avoid predators.

Behavioural adaptations are the actions and behaviours of plants and animals such as hunting for prey at night or migrating to warmer climates.

The physical and behavioural characteristics of insects are also the result of adapting to their environment. Have you ever seen a moth on a gum tree that blends in so well you could easily miss it if you weren't paying attention? Or a stick insect that looks exactly like part of a tree?

1. In your own words explain what an adaptation is.

2. Describe 2 physical adaptations and how they help animals, or plants, to survive.

3. Describe 2 behavioural adaptations and how they help animals, or plants, to survive.

4. Humans have also adapted to survive. List 3 human adaptations.

Amazing Adaptations

Using the arthropods you collected, and your habitat assessment sheets, complete the chart below to identify key features you think show how they have adapted to their habitat. Include a photograph or a sketch of at least 3 arthropods.

1. Name: _____

(Check the identification chart on the Insect Investigators website)
List 2 features that indicate this arthropod has adapted to their habitat.

_____

_____

How do you think these features help them to live within their habitat and the wider ecosystem? Use what you know about the habitat to justify your answer.

_____

_____

_____

2. Name: _____

(Check the identification chart on the Insect Investigators website)
List 2 features that indicate this arthropod has adapted to their habitat.

_____

_____

How do you think these features help them to live within their habitat and the wider ecosystem? Use what you know about the habitat to justify your answer.

_____

_____

_____

3. Name: _____

(Check the identification chart on the Insect Investigators website)
List 2 features that indicate this arthropod has adapted to their habitat.

_____

_____

How do you think these features help them to live within their habitat and the wider ecosystem? Use what you know about the habitat to justify your answer.

_____

_____

_____

Let's Have Some Fun!

1. Name: _____

Use your new knowledge of arthropods, especially insects, to design a new insect for your habitat.

Draw or sketch your new creation. Give it a scientific name.

List its key features below and explain how these have helped it to survive by adapting to its environment.

1. _____

2. _____

3 _____

4 _____

5. _____

Lesson 6
Task sheets

It's Time to Tell Everyone!

Insects are amazing creatures! They may seem small and insignificant but you now understand their connection to other living things and their important role in keeping ecosystems healthy. It's time to share your new knowledge with others, to convince them of the importance of insects and to encourage them to protect their habitat. You'll need to use your skills of persuasion and present an excellent argument to inspire people to take better care of the environment to protect the biodiversity of insects.

Choose from one of the following options:

Option 1

- Use the template provided to create a brochure informing people of the following:
  - The importance of insect biodiversity
  - What you've learnt about the biodiversity of insects on the school grounds through trapping and habitat assessment
  - Why it's important that we protect insect biodiversity
  - What we can do to support and protect the insect biodiversity within the school grounds.
  - Where people can go to find out more information eg. www.insectinvestigators.com or the iNaturalist app.
- A brochure should be very informative but it should also be colourful, well laid out and easy to read.
- You should include photographs or drawings of insects and could include photographs of you traps and insect collection.
- You can use the template brochure or design your own on the computer but it must be folded in to 3 equal sections.

Option 2

- Create a digital product to communicate the information described in Option 1. Use the tools and technology available at your school, here are some ideas:
  - A short film/ video
  - A slideshow or presentation
  - A website
  - A series of social media posts to share on your class or school site and back to Insect Investigators (with permission)
  - A podcast

Option 3

- Write a persuasive letter to your Principal about the importance of supporting and protecting the in-sect biodiversity within your school. Your letter should include the following:
- An explanation of what biodiversity is and why it is important
- A summary of your findings during the Insect Investigators unit including photographs and diagrams of the insects you found and your assessment of their habitat.
- Suggestions for changes at school that would help to support and protect the insect biodiversity.
- ecommended websites and apps your Principal could look at for more information.
- Use the templates provided to help brainstorm and organise your persuasive letter.

Developing your Argument

Persuasive writing is used to convince or persuade the reader that the writer's ideas or opinion about a topic is right. When writing to persuade someone it's important to provide them with information to back up your argument and support your claim.

Use the prompts below to brainstorm reasons why your Principal should agree that the insect biodiversity of the school needs to be protected and how this could be done.

I know these important facts about insect biodiversity so you should listen to me:

The benefits of insect biodiversity within the school are:

If we don't protect the biodiversity within school grounds this could happen:

My recommendations to protect the insect biodiversity of our school are:

You should support these ideas because:

A Smooth Transition

You're nearly ready to write your letter to your Principal but it can be helpful to have some sentence starters, and transition words and phrases, that help you move smoothly from one point to the next and make your argument even more convincing.

Here are a few suggestions. Feel free to add your own in the space provided.

Sentence starters for your introduction:

Did you know
In my opinion
Without doubt
Everyone knows that

Transition words for providing reasons:

To begin with
It is clear that
Did you know
Another reason why
Most importantly
One last reason

Transition words for providing evidence:

This is supported by
To prove this point
For example
Specifically
This is a fact because
In other words

Sentence starters for your conclusion:

In conclusion
You can see why
To summarise
As you can see

Putting it all Together

To make sure your letter is very persuasive it's important to follow a plan. This helps to make sure you present the most convincing argument. Use the following prompts to plan your persuasive letter.

Introduction - Hook your audience!

Hook your reader's attention with a powerful statement, shocking fact, a quote or rhetorical question (a question that doesn't need an answer). How will you hook your reader?

Reason #1

Write your first reason that backs up your argument and the evidence that supports your reason. Remember to include information, statistics and your own data from your unit on insects.

Reason #2

Write your second reason that backs up your argument and the evidence that supports your reason. Remember to use the sentence starters and transitiitions to move smoothly from one topic to the next.

Reason #3

Write your second reason that backs up your argument and the evidence that supports your reason. Make this the big one! This should be your most important reason.

Convincing Conclusion

Summarise your reasons and evidence and rewrite them in a new way using transitions that let the reader know you are getting to the end of your argument. Try to end with another powerful statement or rhetorical question to convince your Principal.