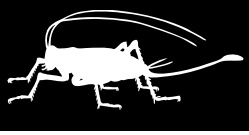
EXPERIENCING INVERTEBRATES IN YOUR GREEN SPACE

Education resource

Verran School student holding a slater. Photo: Shan Walker

Department of Conservation
Te Papa Atawhai

Contents



Appendix

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A. Introduction

New Zealand invertebrates

About 97% of all known animals are invertebrates.

Invertebrates are animals without a backbone/spine. There are invertebrates everywhere if you look closely: in our homes, gardens, schools, forests, streams, oceans and green spaces. Invertebrates are extremely diverse.

Most invertebrates found in New Zealand are found nowhere else in the world! Like our birds, our native invertebrates evolved over time with few predators around, therefore many became large and flightless (for example the giant wētā and giant weevil).

Big Picture

You are connected to insects in your local environment.

You, the birds, trees and insects, your school and neighbourhood are all part of a bigger ecosystem.

Why are invertebrates important?

Invertebrates are an important part of ecosystems in green spaces and help to keep the balance in nature in numerous ways. They are responsible for pollinating plants, recycling nutrients and keeping populations of other living things stable. Some break down pollutants, provide food for other animals, build and maintain soils and deal with natural waste. Invertebrates are an important food source for many animals. Without invertebrates ecosystems could not survive: they are essential for a healthy environment. See: **doc.govt.nz**

In Te Ao Māori, invertebrates are part of whakapapa links (connections and ancestry) and enhance the mauri (life-force) in an area.

Male Auckland tree wēta. Photo: Maureen Robertson

Why find out about invertebrates in your green space?

Finding out about which invertebrates are living in your environment can tell you how healthy it is, which other animals and plants live in the area and which issues may be present. This resource (and the associated resources on page 5) provide guidance around facilitating experiences and learning around local invertebrates, invoking respect and appreciation for them and encouraging action to enhance their habitats.

Key concepts

Using the Investigating invertebrates in your green space resource students can:

- Connect with and learn about invertebrates and begin to group/classify them
- Gather and interpret data about native and introduced invertebrates living in a local green space
- Begin to understand how invertebrates are part of a wider ecosystem

NB: This resource is about land invertebrates, for information about aquatic invertebrates see: **doc.govt.nz**

Key vocabulary

• invertebrate • vertebrate • arthropod • insect • molluscs • worms • arachnids • crustaceans • classification • segmented • ecosystem • exoskeleton • species

Symbols used in this resource

This symbol represents New Zealand Curriculum links included in the resource.

This symbol represents a hands-on, outdoor learning experience. These experiences encourage student connection to the natural world.

This symbol represents student activities to learn about invertebrates and reflect on their hands-on, outdoor learning experiences.

This symbol represents inquiry-based learning experiences.

This symbol represents learning experiences around Matauranga Maori (Maori knowledge and perspectives).

Curriculum links

Major link:

Science: Living World: Evolution

Levels 1-2: Recognise that there are lots of different living things in the world and that they can be grouped in different ways.

Levels 3-4: Begin to group plants and animals into science- based classifications.

NB: Year 1-4 will focus on worms, snails, insects and spiders.

Year 5-8 will focus on worms, molluscs (including snails), and arthropods: (insects, crustaceans, spiders (arachnids) and myriapods (centipedes and millipedes).

Science capabilities: Gather and interpret data, use evidence, critique evidence, interpret representations and engage with science

Minor links:

Science: Planet Earth and Beyond: Earth systems

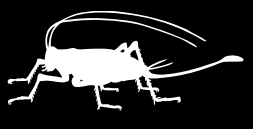
Science: Nature of Science: Investigating in science, Communication in science, Understanding about science, Participating and contributing

English: Listening, reading and viewing, Speaking, writing and presenting, Ideas

The Arts: Music, visual arts

Mathematics: Statistics

B. Suggested learning sequence



1. IDENTIFY A LOCAL GREEN SPACE in your school or community

Explore a local green space using the **Exploring your local environment resource**

2. EXPERIENCE BIRDS IN YOUR GREEN SPACE

Explore and investigate birds living in your green space using the **Experiencing birds in your green space resource**

YOU ARE HERE

3. EXPERIENCE INVERTEBRATES IN YOUR GREEN SPACE

Explore and investigate invertebrates in your green space using this resource:

Experience and connect with invertebrates in your green space through the introductory activities (p.8) Individual students have personal experiences with invertebrates to spark their interest and empathy for them and encourage a sense of connection.

Planning your investigation and learning about New Zealand invertebrates

Start or continue your learning inquiry. Students reflect on knowledge and then ask questions about invertebrates. They make predictions about invertebrates in their green space and plan an investigation to learn more about them.

Gathering and reflecting on data about invertebrates in your green space

Survey the invertebrates in a local area.

Students add to their knowledge, reflect on predictions, and use and critique their evidence/ data about invertebrates.

Extending thinking about invertebrates

Continue the learning inquiry: students investigate patterns and themes and form new ideas about invertebrates. Explore Maori perspectives. Add to big picture knowledge about the green space.

Sharing knowledge and taking the next step

Students share their findings with the community and then take the next steps in exploring their green spaces.

4. EXPERIENCE NATIVE TREES IN YOUR GREEN SPACE

Explore and investigate plants and trees in your green space using the **Experiencing native trees in your green space resource**

5. INVESTIGATE ANIMAL PESTS IN YOUR GREEN SPACE

Explore and investigate animal pests in your green space using the **Investigating animal pests in your green space resource**

6. INVESTIGATE PLANT PESTS IN YOUR GREEN SPACE

Explore and investigate plant pests in your green space using the **Investigating plant pests in your green space resource**

7. COME TO CONCLUSIONS AND LEARN HOW TO ENHANCE BIODIVERSITY

In your green space with the **Enhancing biodiversity in your green space resource**

8. FORM AN ACTION PLAN

For your green space using the **Tools for action resource**

Introduce the following vocabulary before starting your learning about invertebrates:

Years 1-4

Invertebrates: animals without a spine/backbone

Vertebrates: animals with a spine/backbone

Classification: grouping and naming living things

Species: animals that are very similar to each other and have the same name to identify them

Ecosystem: an ecosystem is all the plants, animals and other living and non-living things which interact with each other in a particular place

Native, introduced, endemic: for detailed explanations of these terms see **Experiencing birds in your green space resource**

Years 5-8

Arthropods: Arthropods include insects, spiders, crustaceans and centipedes. They have a skeleton on the outside of their body (called an exoskeleton), jointed legs, and a segmented body. Arthropods include: slaters, beetles, insects, spiders and centipedes.

Exoskeleton: The hard coating on an animal's body which protects it like a skeleton

For definitions of other group names (e.g. crustaceans, myriapods, molluscs) see: the **Invertebrate grouping slideshow** and glossary (page 29).

C. Background notes for teachers about invertebrates

Invertebrates are diverse

There are all sorts of invertebrates living in New Zealand. Invertebrates are the most varied group of animals on the planet. Both a worm and a fly are invertebrates, though they have very little in common.

Keeping it simple for primary students

The study of invertebrates can be complicated and extremely detailed. For the purposes of this resource, the grouping, classification and identification of invertebrates have been simplified. In real-life, scientists classifying at species level will be more specific in their identification of an invertebrate. But for students of Year 1-8, we will leave the detail for the experts: for example, there are many species of slug found in New Zealand but in this resource we have referred to a slug as any slug (leaf-veined, tiger or garden slug). Also we have referred to all worms as 'worms' though there are many different types (such as flat worms, round worms and nematodes). For more information on specific species of invertebrates see: **www.soilbugs.massey.ac.nz**

Many invertebrates have life cycles and look and behave extremely differently at each stage of their life cycles. For example, a butterfly has a body and structure designed for reproduction, whereas the body and structure of the caterpillar is adapted for growth and development. For simplicity, we have referred to invertebrates in this resource in their adult form in most cases.

The goals of this resource

This resource aims to ignite students' interest in invertebrates and encourage them to want to learn more about these fascinating New Zealand creatures. It also aims to enable teachers to easily facilitate learning about invertebrates both outdoors and in the classroom.

D. Experiencing invertebrates outdoors

Introductory activities

Try one or several of these integrated curriculum activities to identify students' prior knowledge and experiences.

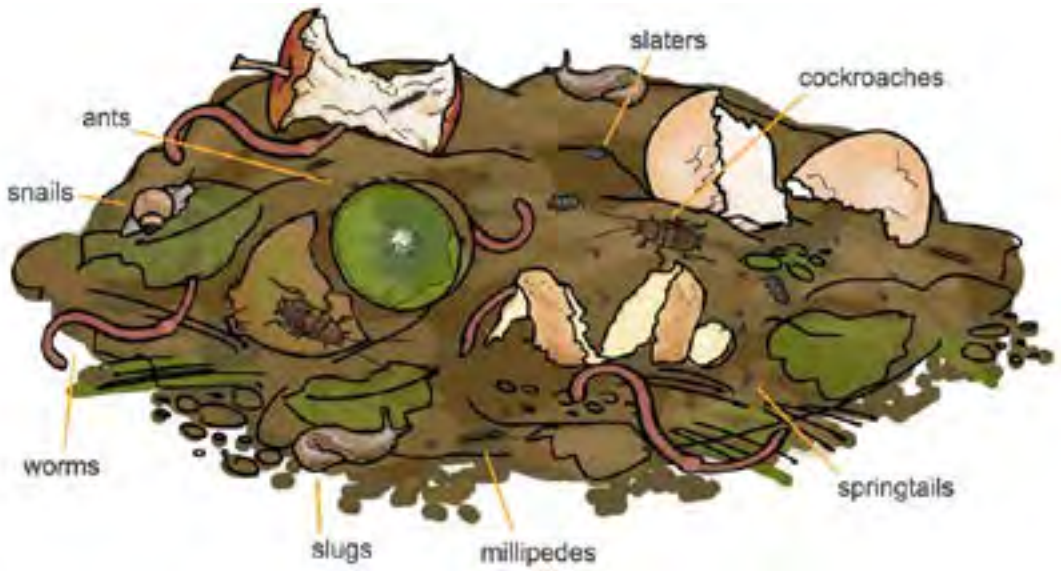
Invertebrate scavenger hunt

Invertebrates are all around us!

- Find objects that show signs of invertebrate life. These may include: leaves that have been eaten by invertebrates, sticks with bugs living in them, old nests, webs, snail shells, exoskeletons, butterfly wings and other objects.

Inside a compost bin/worm farm

- View 'Yucky bugs' **youtube.com**. In this clip Ruud Kleinpaste (AKA 'The Bug-man'), investigates what is in a compost bin and finds the 'recycling squad' inside.
- After viewing, dig up your own compost bins, gardens or worm farms to investigate the invertebrates that make up your recycling squads. These amazing animals recycle the remains of living things into compost and soil! Can you find worms, slugs, springtails, ants, cockroaches and beetles like Ruud did?



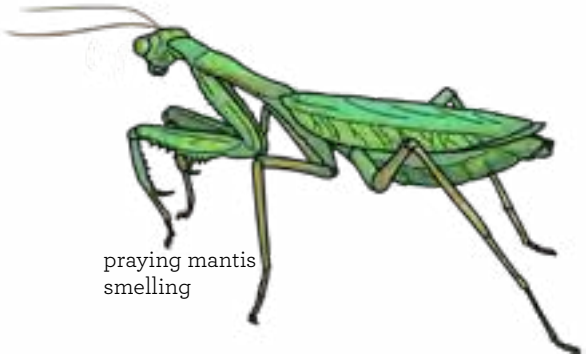
Insect senses

Insects see the world differently to people. Arthropods have compound eyes, which means they have many lenses in their eyes which allow them to see images repeated in their vision. This type of seeing is good for sensing movement. Some insects also see different colours than we do.

- Make models of insects- see example at: **freekidscrafts.com**
- Identify insect's sense organs: compound eyes/antennae (feelers)/hairs/legs/bodies. Use the models to imagine and act out how an insect might experience the world.

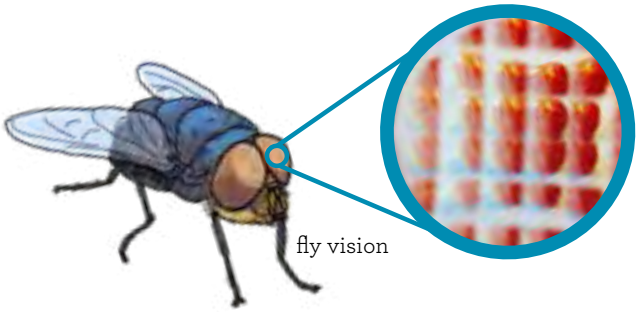
Here are some ideas to get you started seeing/feeling/smelling and tasting like an insect:

- Feelers/antennae – are used to **SMELL** and detect chemicals



praying mantis smelling

- Insects have compound eyes: they can **SEE** multiple images at once

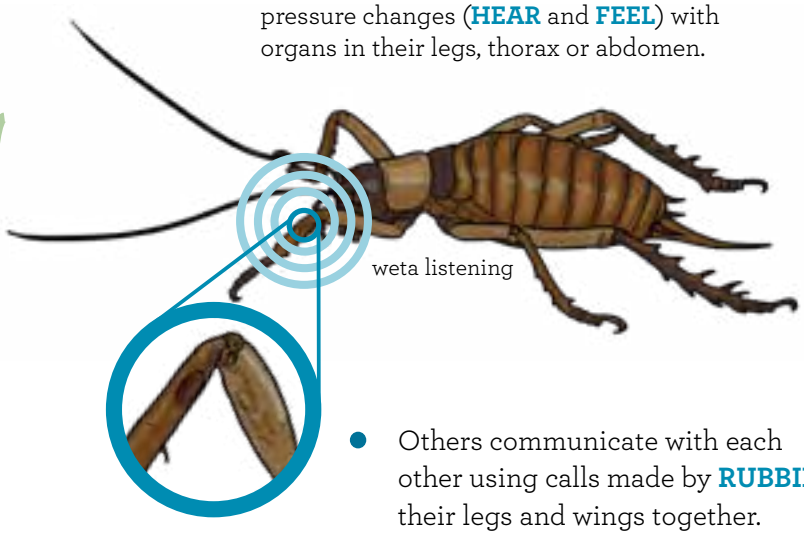


fly vision

- Some insects can **SENSE** direction e.g. bees

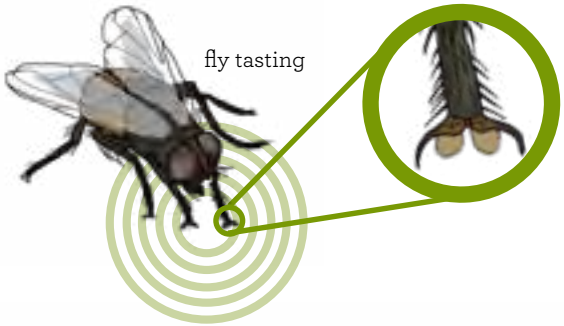
bee sensing

- Some insects can sense vibration and pressure changes (**HEAR** and **FEEL**) with organs in their legs, thorax or abdomen.



weta listening

- Flies have special hairs on their feet to **TASTE** food!



fly tasting

- Others communicate with each other using calls made by **RUBBING** their legs and wings together.

cricket calling

E. Planning your investigation & learning about NZ invertebrates

Starting or continuing a learning inquiry

Before beginning to learn about invertebrates, take time to find out what students already know and what they would like to find out next.

Let this information guide your teaching and learning. Form or continue students' learning inquiries about your green space. Let students take the lead in their learning and decide where their individual or group inquiries will go.

Ask students to make predictions about which invertebrates might live in their green space, based on what they have experienced there already. Record predictions and reasoning for later reference.

Grouping and classifying invertebrates

Curriculum links

Science: Nature of science: Investigating in science, communicating in science

Living world: Evolution

Minor curriculum links: English: Speaking, Writing

Science capabilities: Gather and interpret data, Interpret representations

Learning outcome

Students are learning to:

- Group invertebrates by comparing their body parts

Success criteria

Students can:

- Group invertebrate cards according to their features and body parts and explain reasons for their decisions

The animal kingdom is divided into **vertebrates** (animals with backbones/spine) and **invertebrates** (animals without backbones/spine). Invertebrates can be divided into many different scientific groups. Scientists use different methods to classify invertebrates and identify which group they belong to. Body parts and the number of legs of an invertebrate are useful cues to aid grouping.

These activities are designed to help students observe and look closely at invertebrate body parts in order to identify what type of animal they are and to group them into appropriate groups.

Real scientists will take many other factors into account when grouping animals.

Grouping invertebrates

- Use the table below and the images of invertebrates on **Grouping invertebrates** to help develop students' observational skills for when they are identifying invertebrates in their green space.
- Year 1-4 students could group the images according to how many legs they have or make their own categories based on features. They could then stick the images on paper or in a workbook and label them with names and groups.
- Year 5-8 students can learn more about classifying and grouping invertebrates in the **Invertebrate Grouping** slideshow.
- After viewing the slideshow, students can attempt to group or classify the pictures of New Zealand invertebrates in **Grouping invertebrates**. More able students can use the table above to aid grouping (remove the examples given on bottom row of table (shaded) first) Scientific classification groups for the invertebrates is given in table 'Groups of common New Zealand invertebrates' on page 13.

	INVERTEBRATES WITHOUT LEGS		INVERTEBRATES WITH 6 LEGS	INVERTEBRATES WITH 8 LEGS	INVERTE-BRATES WITH MORE THAN 8 LEGS
GROUP NAME	**Worms**	**Snails and slugs**	**Insects**	**Spiders and other arachnids**	**Crustaceans**
FEATURES OF THIS GROUP	• No legs • No bones or shell • Long thin body	• No legs • Slimy body • Some have shells	• 6 legs • 2 antennae/ feelers • 3 part body (head-thorax- abdomen)	• 8 legs	• More than 8 legs
EXAMPLES IN THIS GROUP	Earthworm Other worms	Snails Slugs	Butterfly, cicada, beetle, ant, wētā, stick insect, cockroach	Spiders Harvestmen	Slaters Hoppers

Land invertebrates fit mostly into the 3 categories/groups of worms, molluscs and arthropods.

LAND INVERTEBRATES		
Arthropods	**Molluscs**	**Worms**
Arthropods have: • a skeleton on the outside of their body (called an exoskeleton) • jointed legs • a body that is divided into segments	Molluscs have: • soft bodies • no bones or exoskeleton, but some molluscs have shells covering their bodies • a muscular foot or tentacles- most molluscs have a head-foot: a head that is on their foot! • a toothed tongue called a radula • not segmented bodies – it's hard to see any parts to their bodies	Worms have: • no legs • no skeleton • Long, thin body • In earthworms/ segmented worms- the body is divided into segments • Other worms: Flatworms: flat, solid soft bodies or round worms- round bodies (nematodes)
 *Photo: Ruud Kleinpaste*		
Arthropod examples: Insects (Butterfly, cicada, beetle, ant, wētā, stick insect, cockroach) Arachnids: (spiders, harvestmen, mites and ticks) Myriapods: (millipedes and centipedes) and crustaceans (slaters and hoppers)	Mollusc examples: Snails, slugs	Worm examples: Earthworms, flatworms, round worms

We will focus on the three categories above (arthropods, molluscs and worms) in this resource. These groups of invertebrates are called 'phyla'. These three phyla are found on land: worms (flatworms, segmented worms and round worms), molluscs (snails, slugs, shellfish), arthropods (insects, spiders and crustaceans). Porifera (sponges), echinoderms (starfish/ sea urchins) and cnidarians (jellyfish, coral and anemones) are other phyla/ groups found only in the ocean, not on land.

Detailed outline of invertebrate groups

This table is for teacher reference/extra information for invertebrate experts.

	NUMBER OF LEGS	GROUPS OF ANIMALS	EXAMPLES
INVERTEBRATE GROUPS	0	Phylum: Molluscs	Slugs
		Phylum: Molluscs	Snails
		Phylum: Annelids	Worms (segmented)
		Phylum: Platyhelminthes	Flatworms
		Phylum: Nematoda	Roundworms
	6	Phylum: Arthropoda Class: Insecta - Insects	Wētā Beetle Grasshopper Stick insect Cockroaches Bees, wasps Ants Fleas Flies Moths Butterflies
	8	Phylum: Arachnids	Spiders
		Phylum: Arachnids	Harvestmen
		Phylum: Arachnids	Mites and ticks
	More than eight	Phylum: Arthropoda (myriapods) Class: Chilopoda	Centipedes
		Phylum: Arthropoda (myriapods) Class: Diplopoda	Millipedes
		Phylum: Arthropoda Class: Crustacea	Slaters (4-8 pairs of legs)
		Phylum: Arthropoda Class: Crustacea	Landhopper (3-7 pairs of legs)

NB: There are many different species of each invertebrate listed, for example in New Zealand there are about 1,100 named native spider species. For more detailed information on invertebrates see: **landcareresearch.co.nz**

Life cycles of invertebrates

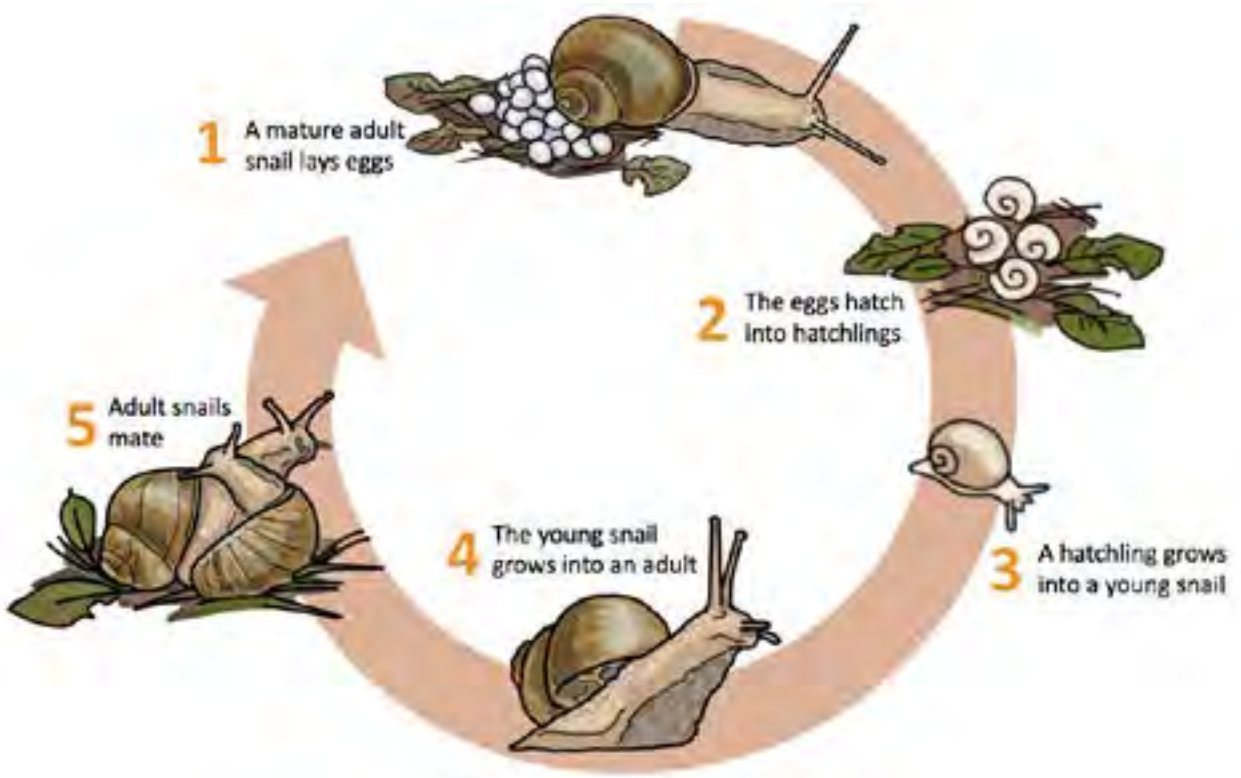
Many insects go through changes in their body structure during their lives: a process called metamorphosis. Invertebrates look different at different stages of their life cycle. As young they often start life as an egg and then hatch out to become a larva or caterpillar. The larva/caterpillar eats and grows quickly to become an adult.

Metamorphosis

- A butterfly has 4 separate main stages of the life cycle (egg, caterpillar, pupa and adult). This is called complete metamorphosis. See **teara.govt.nz** for a detailed description of the stages of the red admiral butterfly's life cycle. The red admiral is native to New Zealand.

- To further investigate butterfly life cycles see **Connected Journal 2013 L2- I Spy**. The article 'Look out for Monarchs' describes the life cycle of the monarch butterfly: **scienceonline.tki.org.nz.** Introduce students to the process of complete metamorphosis through the diagram on page 2 of the article and then record any questions they have about the process.

- Some insects have fewer stages in their life cycle (incomplete metamorphosis). The example below shows the stages in the life cycle of snails and slugs (eggs, young and adult). In this case the young look like the adults, unlike in moths, flies and butterflies.



F. Gathering data about invertebrates in your green space

Curriculum links

Science: Nature of science: Investigating in science, Communicating in science

Living world: Evolution

Planet Earth and Beyond: Earth systems

Minor curriculum links: Mathematics: statistics

Science capabilities: Gather and interpret data, engage with science

Learning outcome

Students are learning to:

- Gather data about invertebrates in their green space

Success criteria

Students can:

- Record accurate data and observations about invertebrates on Invertebrate tally sheet p16 link

Introduction to gathering data

- View the video clip: **Meet the locals – 'Bugs'**. (This video shows the children of an entomologist re-discovering a species of beetle, and describes how scientists study invertebrates).
- Discuss how scientists might gather data about invertebrates. Do students know of any methods to survey invertebrates?

Which data will we observe and record?

- View the **Invertebrate tally sheet** for ideas about what students will look for during an invertebrate survey. They could create an alternative observation template if desired.
- Decide on an appropriate format for recording student finds and observations.

Gathering data about invertebrates in your green space

- Choose several different areas within your green space, in the school garden/local environment.
- Students can explore how many and what sort of invertebrates live in the various areas.
- Predict which areas might have no invertebrates or lots of invertebrates. Record predictions.

NB: Invertebrates are living things- make sure they are handled gently. After your survey put back invertebrates and other objects where they were found. Remember to wash your hands after handling soil and bugs.

- Write a safety plan and/or discuss health and safety with students before any outdoor activities. Emphasise that a survey is not a competition to find the most invertebrates, but is meant to be an accurate sample of what is living in your green space. Limit students to a small area (such as within a piece of string or square quadrat to increase their focus and observation.
- Observing: Ask students to focus on a small area and look very closely. Encourage them to use their senses to explore the area and discover what is living there. What can they see/smell/hear/feel? Before beginning to gather data, ask students to describe what they have seen/smelt or heard or felt in the area and what they noticed about invertebrates.

Resources

Useful resources for gathering data about invertebrates:

- Instructions for monitoring (see sampling methods pages 17 and 18)
- **NZ Invertebrate ID guide**
- **Invertebrate tally sheet**

Not sure about which bug you found? This guide only covers some of our thousands of invertebrate species in New Zealand. For more help with identifying the invertebrates you have found see also:

What is this bug? **Landcare Research**

Try putting a photo of your invertebrate up on **iNaturalistNZ** or the **iNaturalist app** for help with ID from experts! (for tips on how to use iNaturalistNZ, see **Exploring your local environment resource**)

Or try these books by Andrew Crowe:

Which New Zealand insect (Penguin books)

The life-size guide to insects (Penguin books)

Sampling methods

Using the **Invertebrate ID guide** and **Invertebrate tally sheets**, identify and record the invertebrates you find in your green space using one of the following methods:

Leaf litter investigation

Equipment

- One trowel per group
- Garden gloves (if desired)
- Magnifying glasses (if possible)
- Plastic trays or lids for each group
- ID sheet, tally sheet per group.

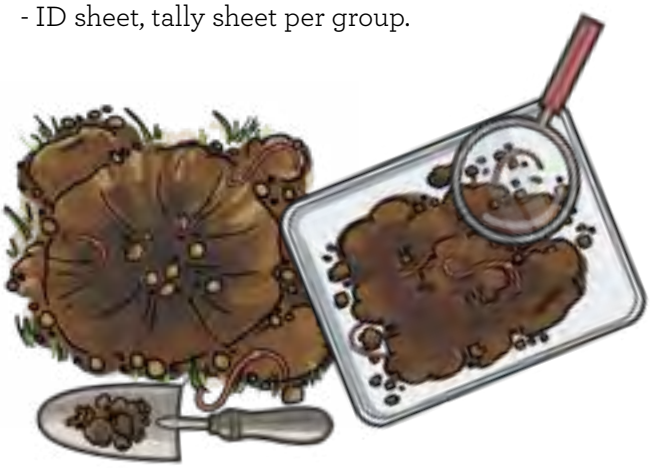
Method

- Scoop up two handfuls or small spades of leaves from the leaf litter (fallen leaves found on ground, under trees/ shrubs or in the bush).
- Put the leaf litter on a tray (light coloured trays work best as it is easiest to see things).
- Separate out leaves and look for movement and signs of life.
- Try to identify any invertebrates you find. Some invertebrates such as hoppers, springtails and larvae may be very small and hard to see but are an important part of the survey. Magnifying glasses could be helpful to see smaller bugs/ invertebrates.

Soil dig

Equipment

- One tray and trowel/garden fork per group
- Garden gloves (if desired)
- Magnifying glasses (if possible)
- ID sheet, tally sheet per group.



Method

- Dig a hole with a trowel or garden fork about 5-10cm x 5-10 cm in soil in your green space.
- Look for soft, dark coloured soil as you will probably find more invertebrates.
- Put your soil sample on a tray or plastic lid. Separate the pieces of soil, looking for signs of life.

Handy tips for soiling digging

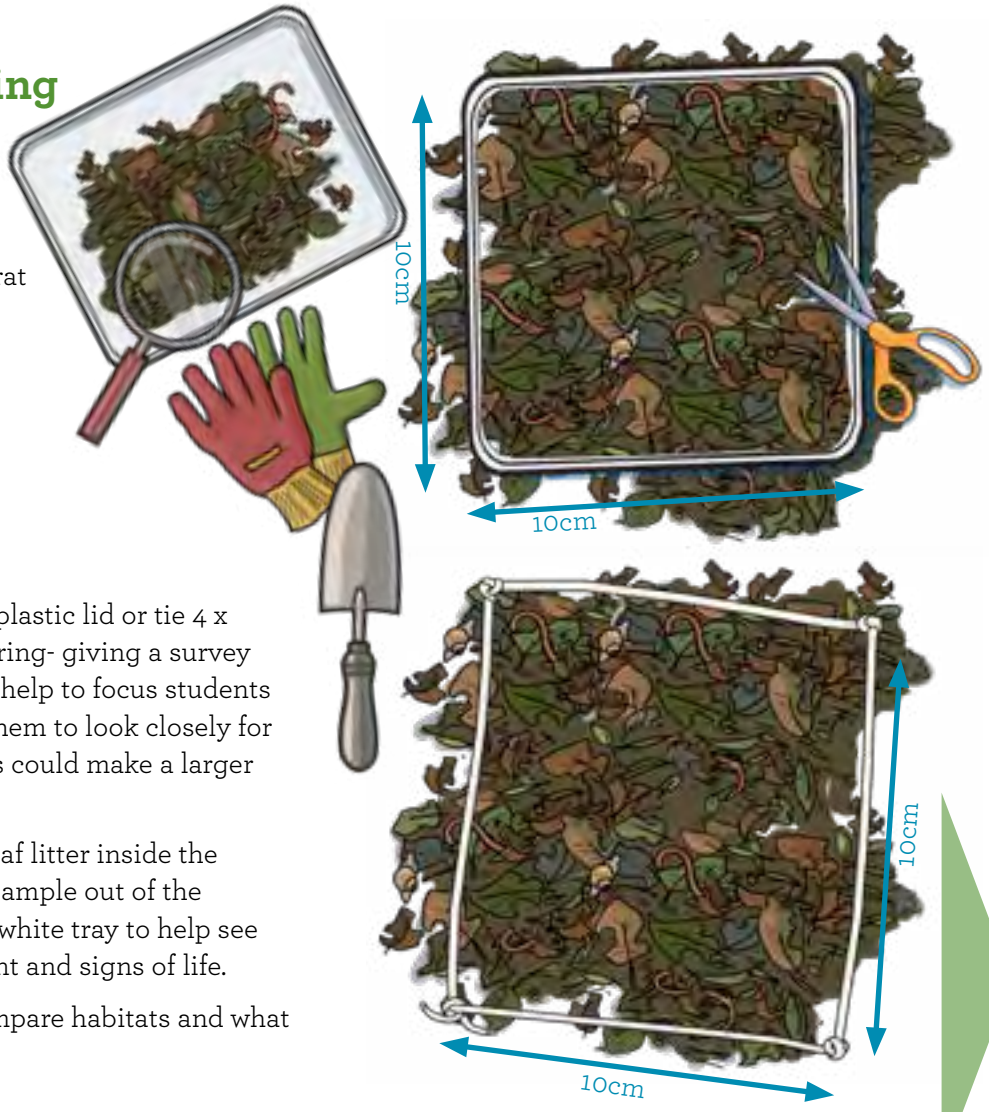
- Wait for a day when it is not too dry or too wet.
- Dry soil (usually in summer months) can be hard to dig in.
- Wet, muddy soil (during winter months) can be very messy! Use a blunt trowel or small spade to dig. Working with adult helpers works best.

Question

Do you find the same invertebrates under the soil as in the leaf litter? Why/why not? (invertebrates living under soil are adapted to that environment e.g. worms- have no eyes and need moisture to survive).

Expert bug sampling

Invertebrate quadrat



Equipment

- One cardboard/plastic/string quadrat
- Trowel/garden fork
- Plastic spoon
- Magnifying glasses
- Tally sheet and ID sheet
- White tray per group

Method

- Cut a 10 x 10cm quadrat out of a plastic lid or tie 4 x 10cm spaced knots on piece of string- giving a survey area of 100 cm squared. This can help to focus students in on a small area, encouraging them to look closely for invertebrates. Advanced students could make a larger quadrat.
- Students can search first in the leaf litter inside the quadrat area. Take the leaf litter sample out of the quadrat and place leaf litter on a white tray to help see bugs. Look carefully for movement and signs of life.
- Look in several locations and compare habitats and what was found in each place.

Another interesting method

Pitfall traps (insects) – These are small traps that can be made easily using a simple container, dug into the ground so the rim is level with the ground. Place sticks and stones across trap. See example of pitfall trap design: **doc.govt.nz**

Invertebrate investigation at Verran School

G. Reflecting on and critiquing data

Using evidence

- What did students notice during the invertebrate survey? What do they think about their observations? (Which knowledge can they connect to what they have observed?) Think, pair share ideas and then record.

  For example:

  I noticed: *'The wētā had spikes all over his legs'*

  I think: *'A wētā might be like dinosaurs and use spikes to defend itself'*

  I wonder: *'If the spikes are used for defence or for holding on to branches?'*

I noticed...	I think...	I wonder...

Critiquing evidence

- Students can review the data and information they have gathered. Did their observations support or challenge their ideas and predictions?
- It may help to create a presentation, report or graph results to aid their reflection.
- The following questions could prompt students to critique their evidence about invertebrates:
  - How many invertebrates did you find?
  - Which groups were most common? Why was this?
  - Were the results different in each location? Why?
  - Were there areas with NO invertebrates or areas where there were MANY invertebrates? Can you think of any reasons for this?
  - Were your sampling methods good? Do you think they gave a reliable result?

- Were your predictions correct?
- If you used a different survey method- do you think you would have had the same findings?
- Do you think you found every invertebrate in the survey area? What were the limitations of your surveying methods?

- Looking back at your survey and observations in your green space- would you say that your green space is healthy or unhealthy?
- How is the mauri/life force in the green space? (To determine the mauri of the area think about and sense- how does the green space feel? If there is a lot of mauri in a place it will feel vibrant, clean and full of invertebrate life. If mauri is depleted it may feel stagnant, unclean or not have many signs of invertebrate life)
- Compare findings to predictions and look for patterns or themes in results. Think about how your observations and results may have been influenced by different factors such as the weather, the type of survey, location of survey, knowledge of observers, and other factors. How could you ensure your data was more accurate in future?

H. Exploring Māori perspectives

Invertebrates in Te Ao Māori

Invertebrates are an important part of the natural world in Te Ao Māori. The insect world is known as Te aitanga pepeke.

Tāne (Atua/God of the forest) and Punga (another Atua- son of Tangaroa) created the trees, birds and insects of the forest. There are many legends, songs, whakatauki (sayings) and traditions about the importance of insects.

Explore the importance of insects in Te Ao Māori using these songs/ poems

- Explore the vocabulary and concepts in the two songs below. Students can then create their own songs and/ or poems about an invertebrate, using ideas from the songs they have heard. Songs can include the sounds insects make, sayings or stories and the Māori names.

Pepetuna (pūriri moth) song/ poem

teara.govt.nz/en/music/12619/pepe-tuna-puriri-moth

Pepe-tuna nunui
Kēhua kākāriki
Wairua rere o te pō
Pepe-tuna nunui
Kēhua kākāriki
rere runga pūriri e.
Large pepe-tuna (pūriri moth)
A green ghost/ apparition
Flying spirit of the night
Large Pepe-tuna
A green ghost/ apparition
Flying on to a pūriri tree.

Credit - Bradford Haami, Te Ara—the Encyclopedia of New Zealand

The puriri moth's other name is the 'ghost moth' as it flies at night and is very large.

Pūrerehua (butterfly) song

by Dr Hirini Melbourne **folksong.org.nz**

Other resources relating to Māori perspectives of invertebrates

Te Ara: the insect world: stories and sayings from Te Ao Māori relating to insects: **teara.govt.nz**

A video of Dr Peter Buchanan describing a carving at a Landcare Research building which tells the story of the creation of insects: (2m 57s) **sciencelearn.org.nz**

I. Finding out more about invertebrates in your green space

Curriculum links

English: Listening, reading and viewing: Ideas

Science: Living world, Nature of science

Science capabilities: Gather and interpret data, Use evidence, Critique evidence, Interpret representations

Learning outcome

Students are learning to:

Collect relevant information and make observations to demonstrate an increasing understanding of invertebrates

Success criteria

Students can:

Find and record information about a New Zealand invertebrate

Steps to continue an inquiry and find out more about invertebrates

A. Identify a native or endemic New Zealand invertebrate species	Choose a focus invertebrate that is native or endemic to New Zealand and is found in your green space. This may be a species you have observed.
B. Review your initial wonderings and predictions and find a topic you want to find out more about	Discuss students' further questions/wonderings. Reflect on other initial questions and predictions. Identify what students would like to find out more about. Options include finding out more about invertebrate predators/feeding/behaviour/movement/conservation/cultural significance.
C. Head back out into your green space to investigate invertebrates further	Observe your focus invertebrate or its eggs/larvae in your green space or classroom. Look more closely into how it behaves, where it lives and what it feeds on by observing it in more detail. What does this creature actually do? You could observe some interesting things, for example: did you know that ants recycle animal poo by feeding it to their larvae? Record information and observations about your invertebrate through notes, photos and videos.
D. Add to your new knowledge with more research	Students can then add to observations with research and information gathering. Find out more about the species using the resource list on pages 23-24. Research an idea or wondering about invertebrates. This may be done individually, in groups or as a class, depending on the level of students. This could be used as an integrated literacy activity.
E. Support or challenge your research and observations	After considering your evidence as a whole, reach appropriate conclusions. Use your research to support or challenge your observations and ideas.
F. Reach new understandings	What new understandings do students have about invertebrates after their observations and research? Discuss.
G. Express new understandings	Students can use their photos, records, research and notes to create a presentation, artwork, written report, blog or poem about the focus invertebrate.

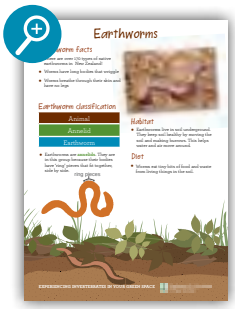
J. Invertebrate resources

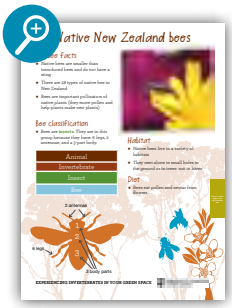
Invertebrate slideshow and factsheets

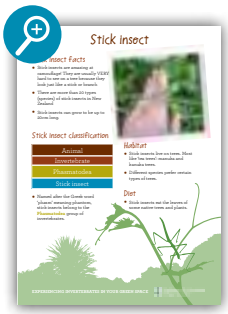
For more information on other New Zealand invertebrates, see **NZ invertebrate slideshow.**

Print the invertebrate information sheets (opposite) for an integrated literacy lesson, adding to student's research and inquiries. Also use other resources listed below.

The fact sheets are: wētā (suitable for about year 4-8), pūriri moth (Year 4-8), stick insect (Year 4-8), New Zealand native bee (Years 2-3+) and earthworm (Year 2+).







General websites

DOC's invertebrate webpage **doc.govt.nz**

Science Learning Hub's collection of insect resources on 'the Pond': **pond.co.nz**

Te Ara- Insects and other invertebrates **teara.govt.nz**

Videos

'Yucky bugs': Ruud Kleinpaste talks about the bugs around us:

youtube.com

Meet the locals - 'Bug kids': **youtube.com**
Kids re-discovering a species of beetle, damselflies

Video about earthworm adaptations **sciencelearn.org.nz**

School journals

My worm house. Ready to Read series, 2002

Stick insects. Ready to Read, 2015

Wētā weriweri, wētās with backpacks. Junior journal 13

Worm Wise. School Journal, Part 1 No. 2, 2002

Tag and Release. School Journal, Part 2, Number 4, 2009 by Sue Gibbison (about monarch butterfly tagging)

Books

What is this bug? A guide to common invertebrates of New Zealand. By Andrew Crowe, Penguin Books. 2002

Which New Zealand Insect? Andrew Crowe: Penguin Books. 2002

Which New Zealand Spider? Andrew Crowe: Penguin Books. 2007

Other teaching resources

Landcare Research invertebrates teaching resources: **landcareresearch.co.nz/resources/teaching/Insects-and-spiders**

Posters/information sheets by Landcare Research (suitable for Year 5-8 students):

- Insects - **landcareresearch.co.nz/Insect_Poster.pdf**
- Spiders - **landcareresearch.co.nz/Spider_Poster.pdf**
- Millipedes - **landcareresearch.co.nz/Millipede_Poster.pdf**
- Centipedes - **landcareresearch.co.nz/Centipede_Poster.pdf**

TKI worksheet: Spiders (or not) **scienceonline.tki.org.nz**

Auckland Council's Investigating invertebrates resource: **aucklandcouncil.govt.nz**

Crazy about wētā?

Find out more about these fascinating creatures with these online resources:

Wētā information: **doc.govt.nz**

Giant wētā brochure: **doc.govt.nz**

Giant wētā video clip: **www.doc.govt.nz**

Teaching resource about giant wētā: **www.doc.govt.nz**

Tusked wētā: **youtube.com**

Interested in spiders?

Te Papa's 'what spider is that?': **collections.tepapa.govt.nz**

Curious about native New Zealand butterflies?

See this Science Learning Hub presentation for information about New Zealand butterflies and which plants they depend on: **sciencelearn.org.nz**

Maths link

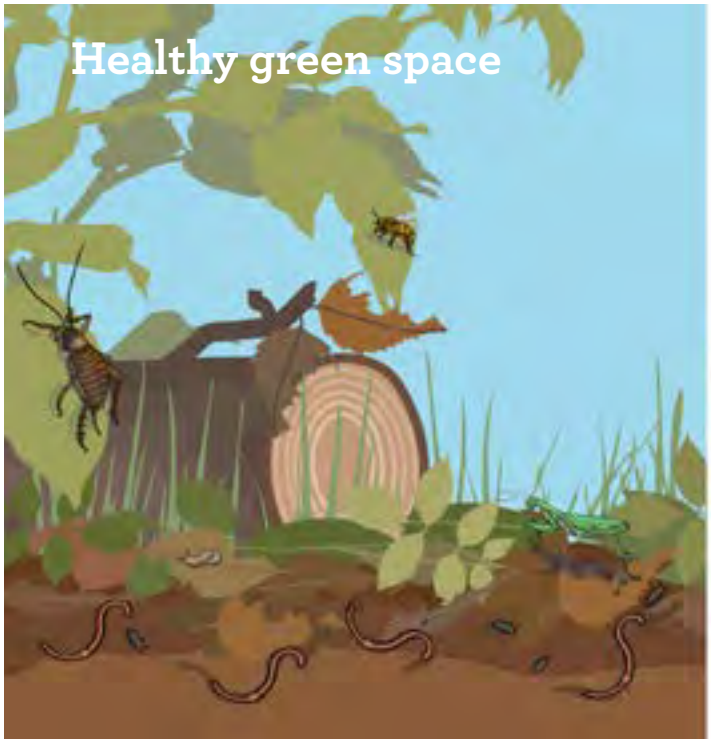
Explore the symmetry of bugs and butterflies with this New Zealand maths activity: **nzmaths.co.nz**

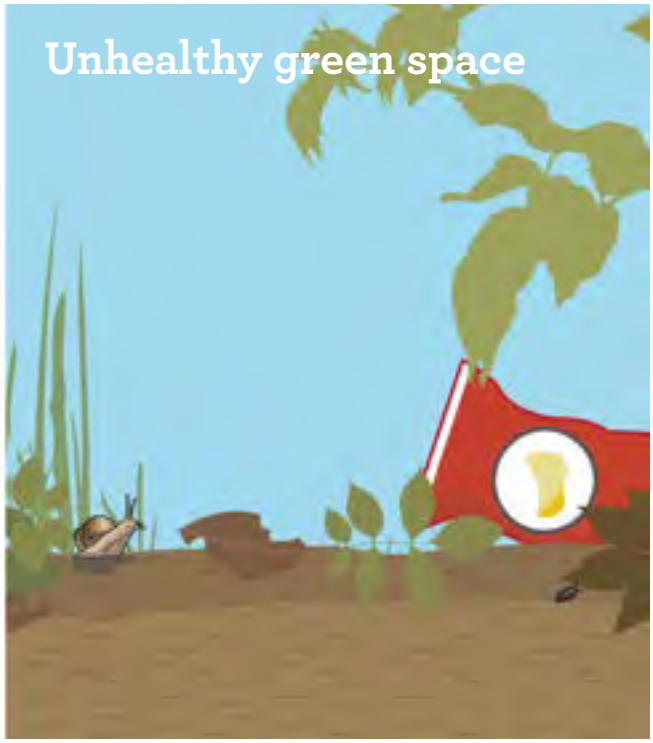
K. Using evidence to try to determine the health of an ecosystem

We can make observations to determine if our green space has signs of being a healthy ecosystem.

NB: These observations can differ with the seasons, temperature and the weather.

Supporting evidence to determine the health of a green space





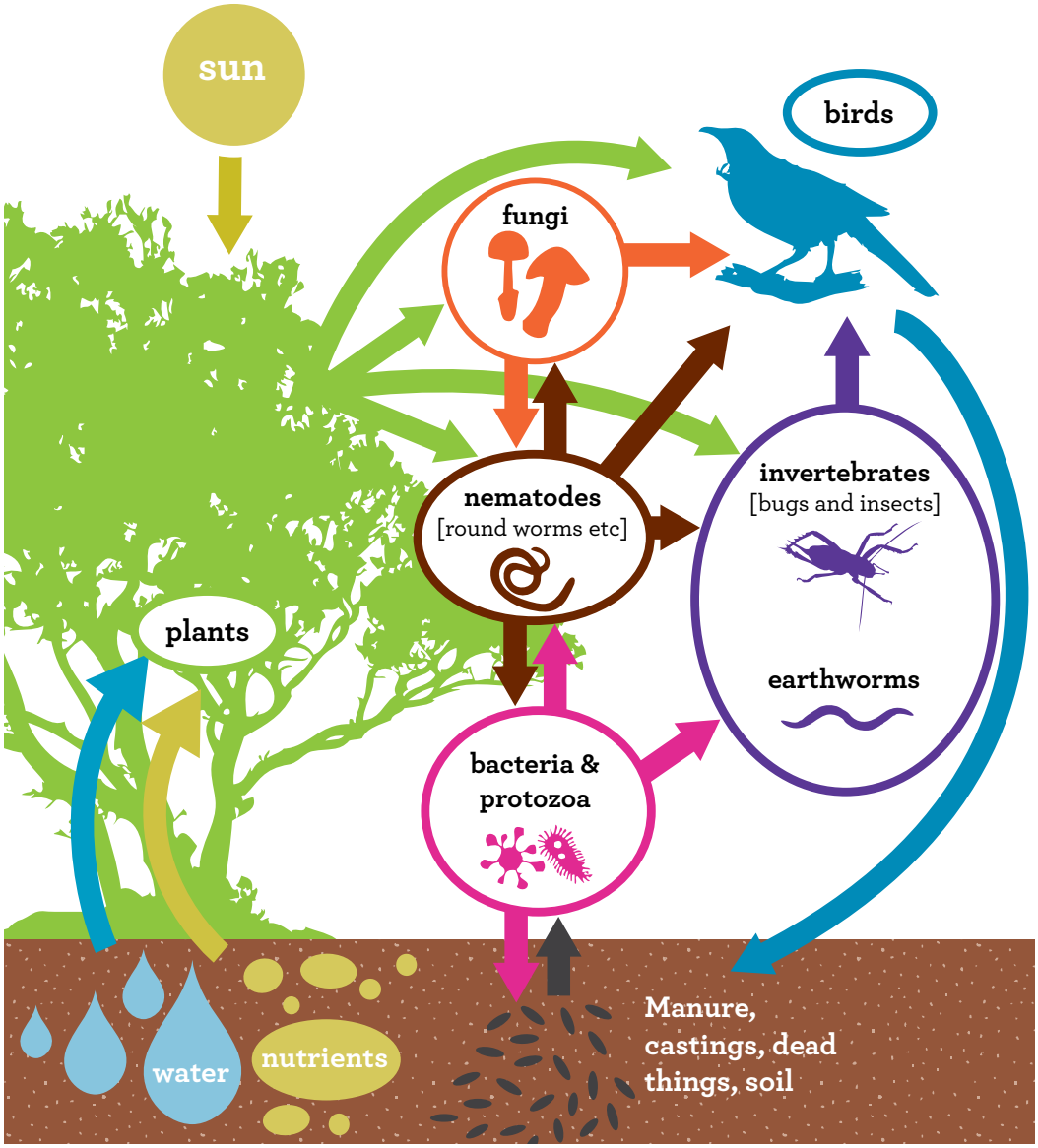
A wide variety of invertebrates	Few invertebrates and not much variety
Leaf litter is filled with invertebrate life	Leaf litter has not much living in it
Litter hoppers/land hoppers found	Land hoppers not found
Beetles and/or wētā found	Beetles and wētā not found
Insect calls can be heard (especially at night e.g. wētā) this depends on the season	Not much insect noise
Lots of native/endemic invertebrates found	More introduced invertebrates than natives
Pollinator invertebrates found (e.g. bees and butterflies)	Not many pollinator invertebrates

Invertebrates in an ecosystem

Invertebrates are a vital part of any ecosystem. They exist in almost every habitat and have different roles to play depending on where they live and which other living things are present. In a green space, invertebrates often help to keep waste under control and create healthy soil. Without healthy soil people could not grow nutritious foods.

Invertebrates are an important food source for some native birds, frogs, lizards, fish and bats. Some invertebrates even eat other invertebrates (e.g. dragonflies eat mosquitoes and help to keep mosquito numbers down).

Other invertebrates eat fungi, plants, nematodes, bacteria or protozoa. For more information about invertebrates in the ecosystem, see the video clip: 'Yucky bugs':
youtube.com



L. Sharing your knowledge and data

Citizen science

Citizen science enables students to participate in the scientific community and contribute to increasing our knowledge about New Zealand invertebrates and other animals. It develops all aspects of the Nature of science strand, as well as the science capabilities.

There are many citizen science projects which students could be involved with. A lot of projects involve invertebrates: from Monarch butterflies to ants to moths! For a list of citizen science projects suitable for New Zealand primary students see: **pond.co.nz**

Examples of citizen science projects involving invertebrates include:

- Monarch butterfly New Zealand trust: Butterfly tagging: **monarch.org.nz**
- Supporting information for getting students involved in citizen science through monarch butterfly tagging: Science Learning Hub case study of teacher using **sciencelearn.org.nz**
- Ants: international citizen science: host a picnic for ants! **blog.nature.org**
- Moths: In Otago (shedding light on the night): **landcareresearch.co.nz**
- The great kiwi bee count: **pond.co.nz**

Sharing other findings

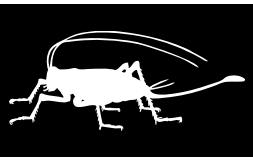
Students could create presentations, speeches, assembly items, newsletters or blogs about what they have found in their green space. They may want to contact community groups in the area and share information. Sharing findings can lead to new opportunities for insight and environmental action.

M. Next steps

Continue inquiring into invertebrates in your community and beyond. Network with others who are involved with invertebrate conservation. Start to think about and learn how invertebrates interact with other living things in your green space. Plants, birds, pests and invertebrates are all part of an ecosystem and are connected in many ways. Next, students could investigate plants and/or pests in your green space. Use **Enhancing biodiversity in your green space resource** to reflect on the species found in your green space and to form a plan for which species you will target for increasing biodiversity and eliminating pests.

Use the **Tools for action resource** to organise and plan an environmental action which will enhance the invertebrate life in your green space. This could be enhancing invertebrate habitat, foods or shelter in your green space or dealing with introduced predators that may harm them.

N. Glossary



Ecosystem A natural system of complex relationships, including the physical environment, plants, animals and other living things.

Entomologist An expert scientist who is an insect specialist.

Evolve Change over time through genes passed down through generations.

Habitat A place where a living thing/population naturally lives.

Larva(e) A young insect (plural larvae).

Mammal An animal that has a backbone (is a vertebrate), has hair, is warm blooded and feeds its young milk.

Mauri The essence or life force present in all living things.

Nematodes A group of worms including round worms.

Predator An animal that hunts and eats other animals.

Protozoa A group of simple living things that are often very small and hard to see but are an important part of microscopic ecosystems.

NZ Invertebrates: ID guide for students

How many legs does the invertebrate have?

No legs

Snails, slugs and worms

Molluscs

Snails

Soft, slimy bodies

Hard shell

Slugs

Soft, slimy bodies

No shell

Annelids

Earthworms

Long, thin bodies

No shell

Rings/ segments around body

Other worms

Do not have segments and can be different shapes (e.g. flatworms and round worms)

Photo: Phil Bendle

6 legs

Insects [ALL insects have 6 legs, 2 antennae/feelers and a 3 - part body (head- thorax-and abdomen)]. Some insect groups:

Beetles

Bees and wasps

Bees

Wasps

Wētā

Cock-roaches

Stick insects

Crickets & grasshop-pers

Ants

Dragon-flies

Butterflies & moths

Flies

Mosquitoes

Photo: Phil Bendle

Cicadas

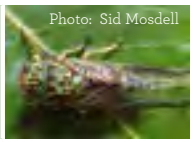


Photo: Sid Mosdell

8 legs

Arachnids (Spiders, harvestmen, mites and ticks)

Spiders

Harvest-men

Mites and ticks

Mite photo: Alastair Robertson and Maria Minor, Massey University

Not sure about which bug you found? This guide only covers some of our thousands of invertebrate species in New Zealand.

More than 8 legs

Myriapods, crustaceans and other

Myriapods

Centipedes

Millipedes

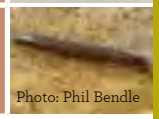


Photo: Phil Bendle

Crustaceans

Isopods: Slaters

Amphipods: Hoppers

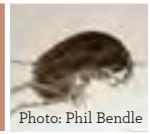


Photo: Phil Bendle

Other

Caterpillars & larvae

Although caterpillars have many legs (if you look closely) they are insects not myriapods or crustaceans. Being a caterpillar is just one part of their life cycle. As adults they will only have 6 legs.

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EXPERIENCING INVERTEBRATES IN YOUR GREEN SPACE

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Invertebrate tally sheet

Number of legs	Group	Type of invertebrate	Tally	Total number
No legs	Molluscs	Snails		
		Slugs		
	Worms	Earthworms		
		Other worms		
6 legs	Insects	Ants		
		Beetles		
		Crickets		
		Cockroaches		
		Moths Butterflies		
		Mosquitoes Flies		
		Bees Wasps		
		Other		
8 legs	Arachnids	Spiders		
		Other		
Many legs	Myriapods	Centipedes		
		Millipedes		
	Crustaceans	Land hoppers		
		Slaters		
		Other		

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Grouping invertebrates


Photo: Phil Bendle


Photo: Sid Mosdell


Photo: Landcare Research


Photo: Phil Bendle


Photo: Jean and Fred


Photo: Ruud Kleinpaste


Photo: Ruud Kleinpaste

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Wētā

Wētā facts

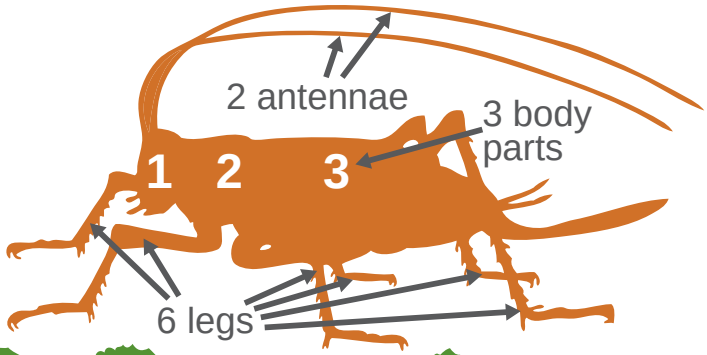
- There are over 70 types of wētā in New Zealand, and 16 of those are at risk. Wētā only live in New Zealand (they are endemic).
- There are 5 types of wētā: giant wētā, tusked wētā, cave wētā, tree wētā and ground wētā.
- Giant wētā weigh as much as a golf ball and are too heavy to jump!
- They've been here for at least 100 million years and were around when dinosaurs roamed the Earth.

Male Auckland tree weta. Photo: Maureen Robertson

Wētā classification

- Wētā are arthropods.
- They belong to the insect group because they have: 6 legs, 2 antennae, and a 3-part body.

Animal
Invertebrate
Arthropod
Insect
Wētā



Diet

- Wētā eat native plants. Different species prefer certain plants.
- A number of weta species are also omnivorous. That means they'll eat most things - plants, fruit, insects sometimes even things like cardboard.

Habitat

- They are nocturnal (only come out at night) and live in a variety of habitats including grassland, shrub land, forests, and caves. Some live in holes under stones, rotting logs, or in trees.
- All weta species except tusked weta can also live in alpine areas.

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Pūriri moth / pepetuna

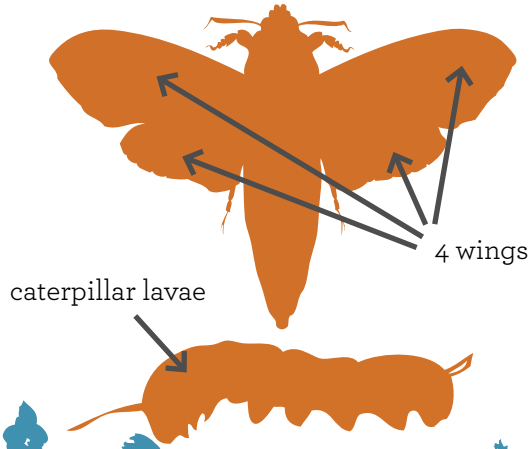
Pūriri moth facts

- The pūriri moth is New Zealand's **BIGGEST** moth.
- A female can grow to up to 15 cm (about as wide as your stretched out hand). Males are a little smaller.
- Caterpillars start life in the leaf litter and then climb up a tree and make an 'L' shaped burrow in the trunk and live there for around 5-7 years.

Pūriri moth classification

Animal
Invertebrate
Lepidoptera
Pūriri moth

- Moths and butterflies both belong to the **Lepidoptera** group.
- **Lepidoptera** have 4 large scale-covered wings and larvae that are caterpillars.



Diet

- Adult moths do not eat. They only live for a few days and their purpose is to lay eggs/ have babies.
- When they are caterpillars they eat fungus, rotten wood and native tree parts.

Habitat

- They are nocturnal (only come out at night) and live in a variety of habitats including grassland, shrub land, forests, and caves. Some live in holes under stones, rotting logs, or in trees.
- These moths usually live in or near native forests.
- They are only found in the North Island.

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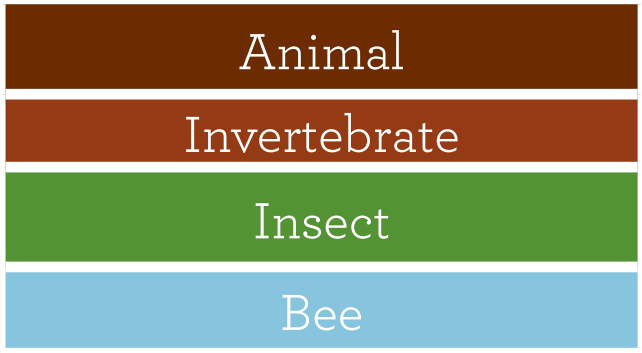
Native New Zealand bees

New Zealand bee facts

- Native bees are smaller than introduced bees and do not have a sting.
- There are 28 types of native bee in New Zealand.
- Bees are important pollinators of native plants (they move pollen and help plants make new plants).

Bee classification

- Bees are **insects**. They are in this group because they have: 6 legs, 2 antennae, and a 3-part body.

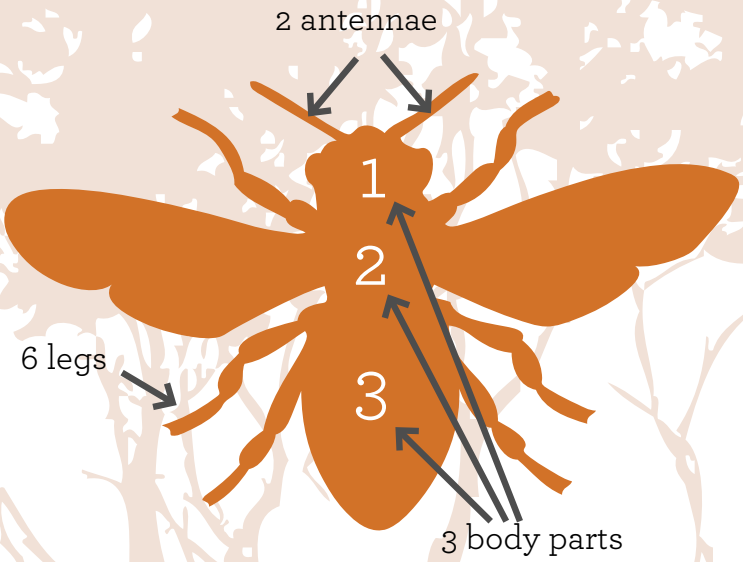


Habitat

- Native bees live in a variety of habitats.
- They nest alone in small holes in the ground or in trees- not in hives.

Diet

- Bees eat pollen and nectar from flowers.



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Earthworms

Earthworm facts

- There are over 170 types of native earthworms in New Zealand!
- Worms have long bodies that wriggle.
- Worms breathe through their skin and have no legs.

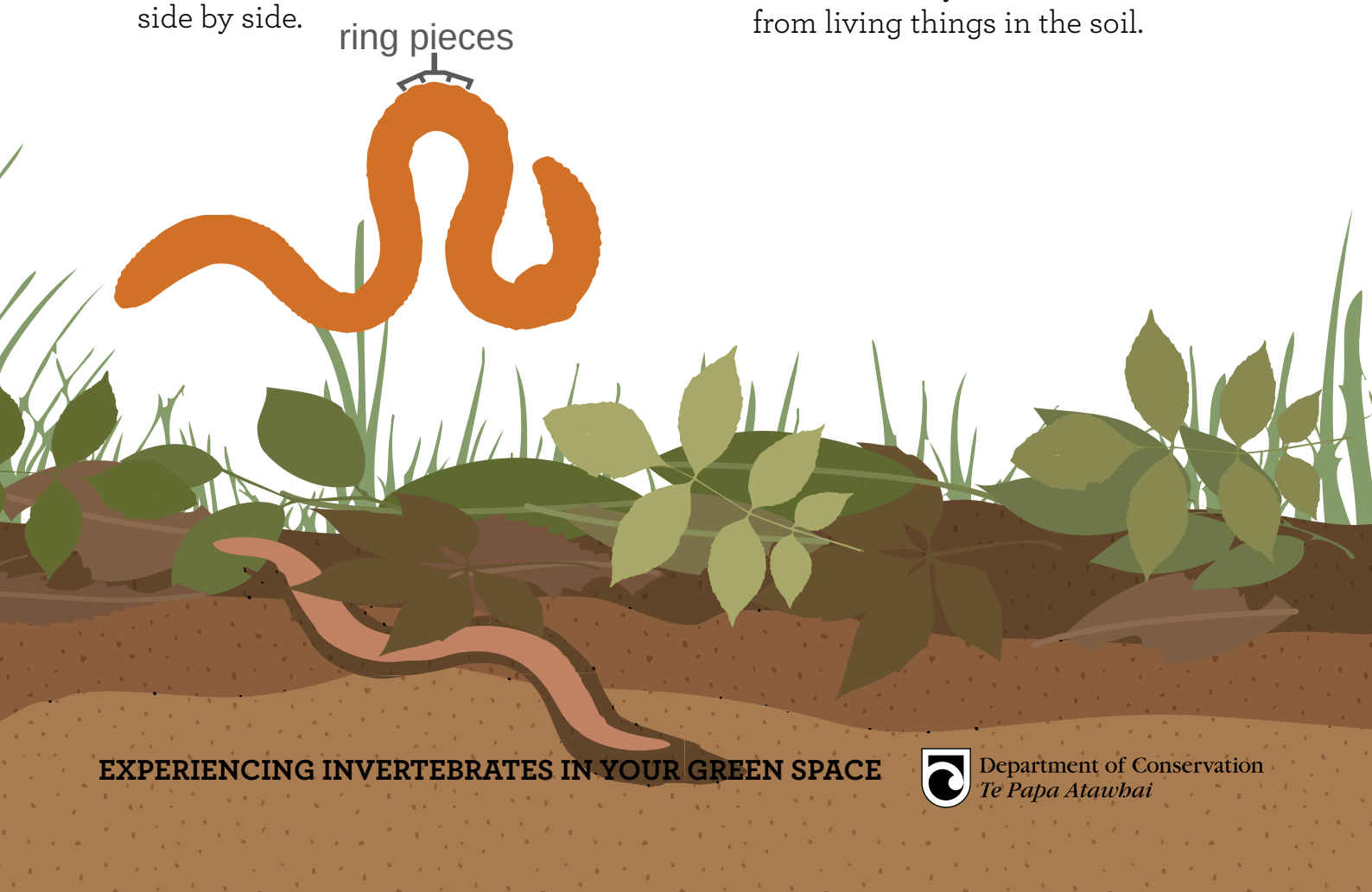
Earthworm classification

Animal

Annelid

Earthworm

- Earthworms are **annelids**. They are in this group because their bodies have 'ring' pieces that fit together, side by side.



Habitat

- Earthworms live in soil underground. They keep soil healthy by moving the soil and making burrows. This helps water and air move around.

Diet

- Worms eat tiny bits of food and waste from living things in the soil.

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Stick insects

Stick insect facts

- Stick insects are amazing at camouflage! They are usually VERY hard to see on a tree because they look just like a stick or branch.
- There are more than 20 types (species) of stick insects in New Zealand.
- Stick insects can grow to be up to 20cm long.

Stick insect classification

Animal
Invertebrate
Phasmatodea
Stick insect

- Named after the Greek word 'phasm' meaning phantom, stick insects belong to the **Phasmatodea** group of invertebrates.

Habitat

- Stick insects live on trees. Most like 'tea trees': manuka and kanuka trees.
- Different species prefer certain types of trees.

Diet

- Stick insects eat the leaves of some native trees and plants.

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