WATERWATCH

The life of waterbugs (Years 3–4)

Lesson sequence

Introduction

Waterbugs (aquatic macroinvertebrates) tell us a lot about water quality. The presence (and absence) of certain species can indicate the health of a waterway through their known sensitivities and tolerances to pollution and disturbance.

This lesson plan explores the key features of waterbugs. Students observe waterbugs and consider how their structure and function is intrinsic to their survival in waterways. The stages of their metamorphic life cycle are examined with links made to the importance of healthy waterways.

Activity 1: Hunting Waterbugs

Students identify waterbugs in the classroom. This activity is most effective when conducted as part of a field excursion. If this is not possible it can be run as an in-class activity.

Activity 2: How do waterbugs move?

Students demonstrate the different ways that waterbugs move.

Activity 3: Waterbug life cycles

Students explore the life cycles of waterbugs.

Activity 4: Where are the waterbugs?

Students explore a scenario about a river then play a game to discover why the waterbugs are disappearing.

Victorian Curriculum F–10[1] links:

Science

Levels 3 and 4

Science Understanding

Science as a Human Endeavour

Science knowledge helps people to understand the effects of their actions (VCSSU056)

Biological sciences

Living things can be grouped on the basis of observable features and can be distinguished from non-living things (VCSSU057)

Different living things have different life cycles and depend on each other and the environment to survive (VCSSU058)

Geography

Levels 3 and 4

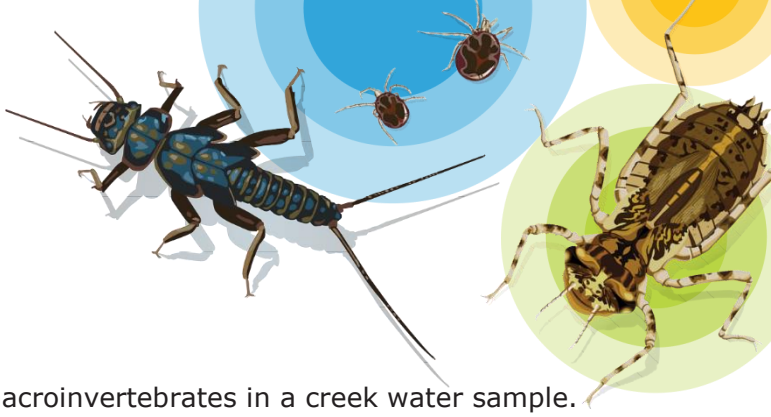
Geographical Knowledge

Diversity and significance of places and environments

Types of natural vegetation and the significance of vegetation to the environment, the importance of environments to animals and people, and different views on how they can be protected; the use and management of natural resources and waste, and different views on how to do this sustainably (VCGGK082)

Similarities and differences in individuals' and groups' feelings and perceptions about places, and how they influence views about the protection of these places (VCGGK083)

[1] Victorian Curriculum and Assessment Authority (VCAA) <victoriancurriculum.vcaa.vic.edu.au/> Accessed 8 January 2019.



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Activity 1: Hunting waterbugs

Students use their observation skills to identify macroinvertebrates in a creek water sample.

If you are conducting this activity in the classroom, a waterbug sample must be collected early on the morning of the activity. Students then view the waterbugs in the classroom. Refer to the *Waterbug identification in the classroom* (page 5) of the *Teacher guide: Running a waterbug session with students*. Amend the activity steps below as required. Additional classroom viewing equipment could include magnifying lamps with LED lights, digital microscopes (10X magnification) and laptops.

Equipment

For the teacher:

Teacher guide: Running a waterbug session with students
<https://www.melbournewater.com.au/media/8431/download>

Bug sampling equipment: Net, bucket and gloves

One bucket of water with a waterbug sample from local waterway

Images of local waterways, including where the sample was collected

Digital microscope and plastic petri dishes (if possible)

Whiteboard or data projector

For each group:

As per the equipment list in the *Teacher guide: Running a waterbug session with students* (page 7). Provide magnifying lamps with LED lights or a digital microscope (10X magnification) and laptop, if available.

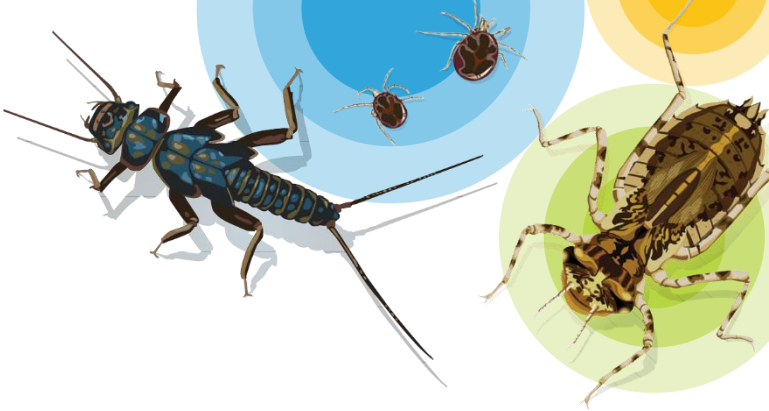
Preparation

Refer to pages 2–6 of the *Teacher guide: Running a waterbug session with students.* This guide provides detailed instructions about how to collect waterbugs for an in-class waterbug identification activity (and how to conduct a field excursion). Topics include: acknowledgement of the Aboriginal connection to the local area, what are waterbugs, why they are important, how they can be used to assess waterway health, safety aspects, data sheets, detailed instructions for sampling, sorting, identifying and analysing waterbug data and information about waterway hygiene. Ensure that you comply with your school safety requirements.

Take photographs of the sampling site or gather some images of local waterways.

If you need to collect a waterbug sample, ensure that you comply with your school's risk assessment procedures. Take someone with you when you collect the sample.

Prior to the excursion, explain the context of the activity using Activity steps 1–5 below.



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Activity steps

Healthy waterways

Have the sample of waterbugs visible to pique students' interest. Ask them to imagine they are a citizen scientist. Their job is to discover life in the water. How will you do that? What do you think you will find?

Display the images of waterways. Ask students:

- What can you see that is not living (e.g. rocks, fallen logs, soil, water)?
- What can you see that is living (e.g. animals, trees, grass)?
- Can you tell if the water is clean by looking at it? (No)

Ask students to think about a waterway near their house or school.

- Is it a healthy place for the animals and plants that live there or an unhealthy place? How can we decide?
- What might you find in a healthy waterway?
- What might be missing if the waterway is not healthy? We are looking for an abundance of life.

Explain that one of the ways that we can tell if a river or creek is healthy is to find out what is living in the water. Introduce the term waterbug or aquatic macroinvertebrate. This term refers to the fact that these animals live in water and have no backbone.

Review students' understanding that animals with backbones are called vertebrates and animals without backbones are called invertebrates. Explain that waterbugs are a collection of bizarre and fascinating creatures that spend some or all of their lives in waterways. You find them in ponds, streams, estuaries and irrigation drains. Some common waterbugs are freshwater snails, freshwater shrimp, backswimmers, dragonflies and damselfly nymphs. They can be used to assess the health of a waterway.

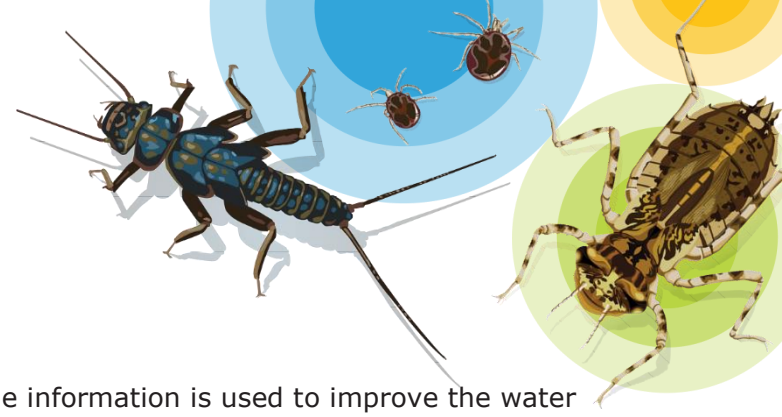
As a citizen scientist, you are required to collect samples of waterbugs from different waterways. Tell students that you have collected a sample of waterbugs for them to learn about in today's session. Explain where and how you collected the sample.

Once you, as the citizen scientist, collect the sample of waterbugs, you observe and examine their features in order to identify them. That's what we'll do today. Explain the features to look for in waterbugs. For example: head shape, body shape, legs (shape and movement), colour and markings, additions (antennae).

Identifying waterbugs

On the excursion, follow the *Waterbug identification and data collection activity* instructions in the *Teacher guide: Running a waterbug session with students* (pages 8–9). Challenge students to find specific-looking waterbugs to focus their observation skills: for example, a bug with six legs and three tails (mayfly or damselfly) or a stick that moves (caddis fly).

Students identify the waterbugs and record and draw one or two of their favourite waterbugs in their notebooks.



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Findings

Citizen scientists always record their findings. The information is used to improve the water quality of our waterways. Students discuss their findings and how these can help us determine if the waterway is healthy. What do these findings mean for the waterway our sample was taken from? What are some reasons it might be healthy/unhealthy?

Students write down some reasons then pair with a student from another group. Each student reads out a reason, in turn, until all their reasons have been mentioned. If they have different or additional reasons, each student records these too.

Students re-join their original group and share the insights from the other group.

As a class, discuss ways you could improve the water quality at the waterway. For example: pick up litter, pick up dog poo, participate in group activities like weeding and tree planting.

Useful resources

Waterwatch Program
<www.melbournewater.com.au/community-and-education/waterwatch-program>
Melbourne Water's Waterwatch Program supports people to get involved in exploring and protecting their local waterways through the Frog Census, Platypus Census, Waterbug Census or becoming a water quality testing volunteer. In addition, schools can apply to participate in the River Detectives program.

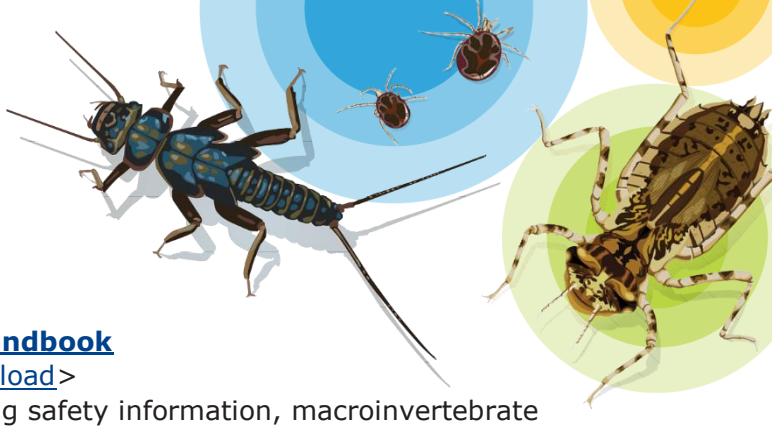
The program also provides keen citizen scientists with training and tools to become involved in monitoring the health of our waterways. Data collected contributes to scientific research, management planning and on-ground actions that improve the health of our waterways.

You can become involved by joining a Waterwatch group, attending one of their events, using the citizen science apps or downloading resources to learn more about your local waterway.

Waterbug Census
<www.melbournewater.com.au/community-and-education/waterwatch-program/waterbug-census>
Waterbugs (macroinvertebrates) are very useful biological indicators and students can join other citizen scientists in monitoring waterbugs in Melbourne Water's Waterbug Census. This data is important for ongoing research and water management.

River Detectives
<www.riverdetectives.net.au/>
The River Detectives sustainability program supports educators in schools and youth community programs to explore their local waterways with students. Some activities include monitoring waterways for waterbugs, collecting samples, recording findings and compiling data.

As part of the program, your group will receive a water monitoring kit (on loan), invitations to training sessions and access to more activities, resources and an interactive data recording portal. Applications open towards the end of Term 4 for the following year.



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Healthy Waterways, Waterways Program Handbook
<www.melbournewater.com.au/media/425/download>
Complete Waterways Training document, including safety information, macroinvertebrate identification and data forms.

Waterbug Census: discovering the world of waterbugs brochure
<www.melbournewater.com.au/media/442/download>
This brochure provides readily accessible graphics to introduce waterbugs to students. It includes a map of the Waterbug Census sites across Melbourne, a diagram of the main types of waterbugs including their feeding strategies and a 'waterbug profile' diagram.

A beginners guide to waterbug identification, Melbourne Water
www.melbournewater.com.au/media/117/download
This guide assists students to identify the more common waterbugs found in the Melbourne area. It also provides information about the taxonomy of the waterbugs, their anatomy, distribution, diet and sensitivity to pollution.

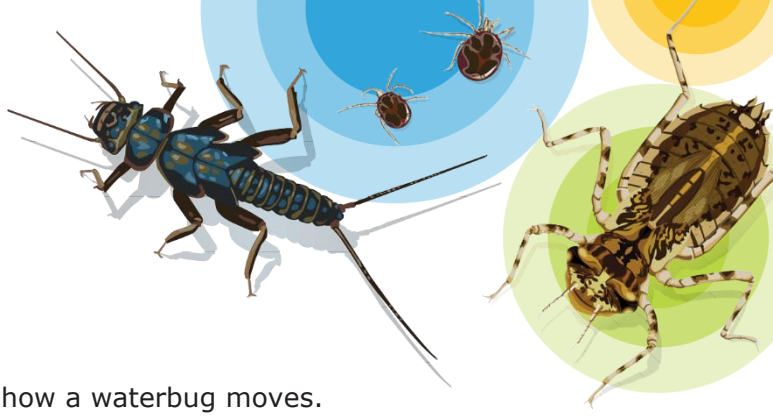
The waterbug app
<https://thewaterbugapp.com/>
The waterbug app is a very useful tool for identifying and uploading waterbug data. Students can identify waterbugs using a dichotomous key with engaging cartoon diagrams to explain structural features.

River health and monitoring
<www.melbournewater.com.au/water/health-and-monitoring/river-health-and-monitoring>
Melbourne Water monitors rivers and creeks so they know if their condition changes or if the improvement programs need adjusting. Learn how Melbourne Water assess river health and view current data. Other information includes: indicators of river health, the health of Melbourne's waterways, and key waterway values.

Know your river booklets
Know your river - Werribee River
Know your river - Yarra River
Know your river - Maribyrnong River
Know your river - Dandenong Creek
Know your river - Bass River
The booklets provide teacher background information about the history, geography and wildlife of the Werribee River, Yarra River, Maribyrnong River, Dandenong Creek and Bass River.

Melbourne's Living Museum of the West Inc.
<https://www.livingmuseum.org.au/>
Melbourne's Living Museum of the West is a community Museum which actively involves the people of Melbourne's West and others in documenting, preserving and interpreting the richness and depth of the region's social, industrial and environmental history.

Melbourne Water – Melbourne's Water Story
<http://www.waterstory.melbournewater.com.au/>
Melbourne's Water Story is an interactive timeline that explores significant milestones that have helped shape the city of Melbourne.



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Activity 2: How do waterbugs move?

In this activity, students work in groups to mime how a waterbug moves.

Equipment

Duplo, Lego or other building bricks that float

Simple battery powered motor (available online)

Access to a whiteboard or data projector

A copy of *What waterbugs can you find?* poster <www.melbournewater.com.au/media/6751/download> This poster is suitable for Years 2–6 or as an introductory ID guide for older students. It uses clear drawings of waterbugs, their habitats and their common names. Students tick the waterbugs they find and calculate a Waterway health score for the sample site. If possible, laminate A3 colour copies of the poster so they can be reused.

Plus Minus Interesting chart (Resource 1)

This is why water striders make terrible lifeguards <www.youtube.com/watch?v=E2unnSK7WTE> [3:33] This video takes a close-up look at how the water strider can sit on top of the water and how it moves across the water to catch its prey.

For each group:

A bowl filled with water

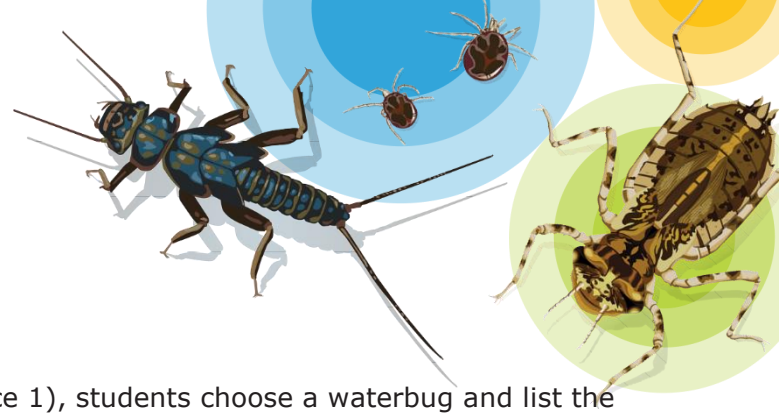
Activity steps

Move your body parts

1. Students refer to their *What waterbugs can you find?* poster to remind them how their waterbugs moved. Working in small groups, students choose a waterbug they found in Activity 1 and work out how to demonstrate this waterbug moving. They could also use videos of waterbugs from YouTube, such as *This is why water striders make terrible lifeguards* or take their own videos of the waterbugs collected.
2. Clear a large space and invite each group to demonstrate how their chosen waterbug moves.
3. Discuss how the way a waterbug moves, helps it to survive. This should prompt students to think about the key ideas of feeding, escaping predators and life cycle stages.

Make a model

4. Based on their chosen waterbug, students use Duplo or Lego to create a waterbug to test in a bowl of water. They could also try to create a waterbug with a simple battery powered motor. They can experiment with weight, drag, submersion and attachments.

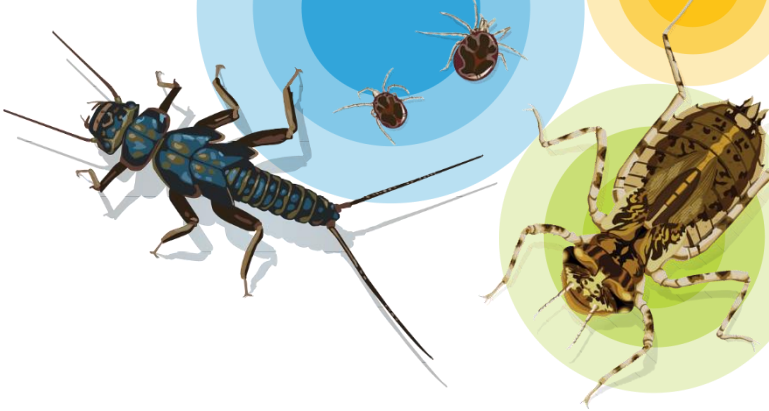


Waterbug movements

5. Using a *Plus Minus Interesting chart* (Resource 1), students choose a waterbug and list the advantages and disadvantages of how that waterbug moves. They also list anything they find interesting about the waterbug and how it moves.
6. Students share their findings with a partner or in a small group.

Useful resources

See Activity 1.



WATERWATCH The life of waterbugs (Years 3–4)

Activity 3: Waterbug life cycles

Students explore waterbugs' life cycles.

Equipment

A life cycle chart of a dragonfly (Resource 2)

The waterbug app <https://thewaterbugapp.com/>

Access to a whiteboard or data projector

YouTube videos of waterbugs, for example *Aquatic insects: voracious predators, architects, and environmental indicators* <www.youtube.com/watch?v=-qSNXRxJWTc> [10:50]

Activity steps

Growing and changing

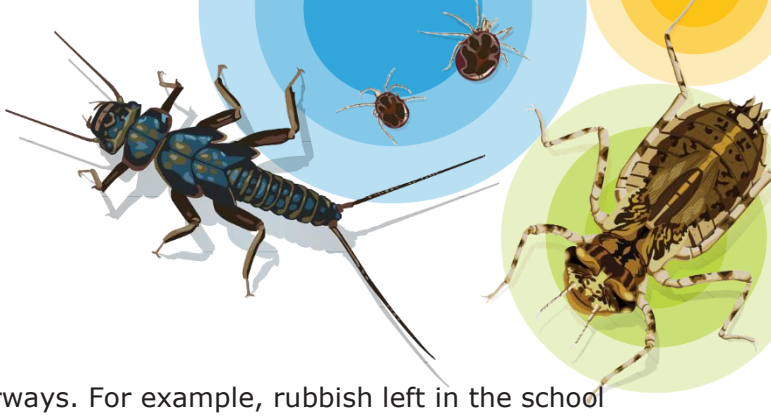
1. Use student observations and a life cycle chart of a dragonfly (Resource 2), damselfly, caddis fly or similar insect to highlight that most waterbugs follow a simple life cycle:
    - All waterbugs lay eggs.
    - Some waterbugs have young that hatch and are called nymphs. Nymphs develop straight into adults.
    - Nymphs look like adults but do not have wings and cannot fly.
    - Because insects have a rigid external skeleton this must be shed regularly to allow it to grow.
    - Each nymph goes through a series of moults and after the last moult an adult emerges with fully developed wings, enabling it to fly.
    - Some other waterbugs (like mosquitoes) have a larval stage and larvae transform into pupae before developing into adults.

Alternatively, you could use images from *The waterbug app*.

Also, the video *Aquatic insects: voracious predators, architects, and environmental indicators* offers some interesting facts on the life cycle of waterbugs. It can be stopped and started to view and discuss different species.

During the discussion, compare a complete and incomplete metamorphosis explaining, in very simple terms, that bugs undergo an incomplete metamorphosis so that nymphs look like adults but do not have wings and cannot fly. Incomplete metamorphosis is a type of metamorphosis in which an insect hatches from an egg and then goes through several nymphal stages. Each nymphal stage looks like a small version of the adult but slightly bigger with age. At the final nymphal stage the insect then moults into the adult form.

Ask students if they have seen a dragonfly, where they saw it and why they think it was in that location. Use this discussion to point out that the waterbugs they observed may have actually been dragonflies, caddis flies or stone flies at the nymph or larval stage.



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Impacts on life cycle

Discuss the impact our actions can have on waterways. For example, rubbish left in the school yard can end up in stormwater drains which flow to waterways. We need a range of waterbugs for a healthy river – some are tolerant to pollution and some are not. Discuss what students can do to help e.g. pick up litter, pick up poo when walking their dog, wash their car on the grass to prevent soap suds entering the stormwater drains etc.

Now that they are aware that the waterways are home to so many different aquatic macroinvertebrates, what messages would students give other people about the importance of looking after waterways for these tiny animals?

Students develop a poster or sign to teach visitors about responsible behaviour in and around waterways.

Extension activity

Students review their notes and drawings from Activity 1. Think about the way they observed waterbugs moving and decide on words to describe them. Example: wrigglers, swimmers, walkers, flyers, crawlers.

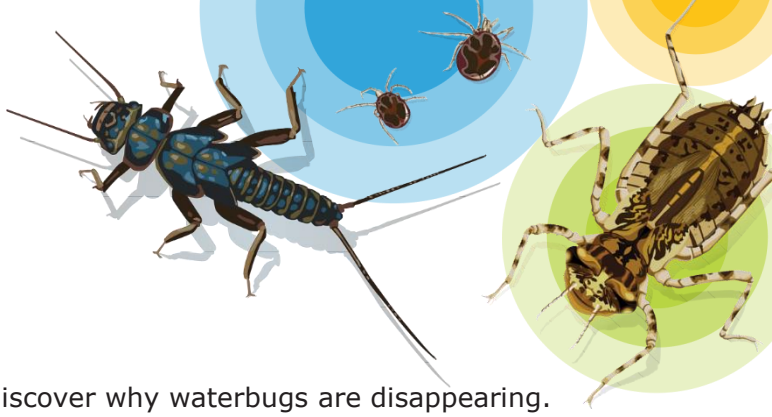
List the agreed categories on the whiteboard. Students select one of their waterbugs and decide which category it would best fit into. Students form category groups to share their waterbug observations, identifying common features such as long wriggling tails, large antennae.

Ask groups to consider why these specific features are important for their waterbugs. Think about the invertebrates (i.e. insects) seen in the school yard. Compare and contrast the features of terrestrial invertebrates with those of aquatic invertebrates.

- What features are the same or similar and which are different?
- Discuss why there are these similarities and differences.

Useful resources

See Activity 1.



WATERWATCH The life of waterbugs (Years 3–4)

Activity 4: Where are the waterbugs?

In this activity, students explore a scenario and discover why waterbugs are disappearing.

Equipment

The Melbourne River scenario (based on life in a fictional Melbourne river) (Resource 3)

Macroinvertebrate mayhem game (Resource 4)

The waterbug app <https://thewaterbugapp.com/>

Activity steps

The situation

1. As a class, read the scenario *The Melbourne River scenario* (Resource 4). Ask students to listen or read carefully and emphasise or take note when a platypus and the different species of waterbugs are mentioned.

Discuss:

- What happened to make the mayfly nymphs and stonefly nymphs leave?
- What happened to make the dragonfly larvae and damselfly larvae leave?
- Where did the pond snails come from? (Introduced species)
- What sorts of waterbugs were in the river when the factories were polluting the river?
- What happened to make the platypus disappear?
- What happened to bring the sensitive species back?
- How might we bring the platypus back?

2. Outline the rules for the *Macroinvertebrate mayhem game* (Resource 4). This game gives students an understanding of how hard it is for platypus and certain species of waterbugs to survive in a polluted waterway.
3. Discuss why some of the species were more easily caught than others.

Further activity

Using *The waterbug app*, discover the waterbugs in your local waterway as a school group or family outing.

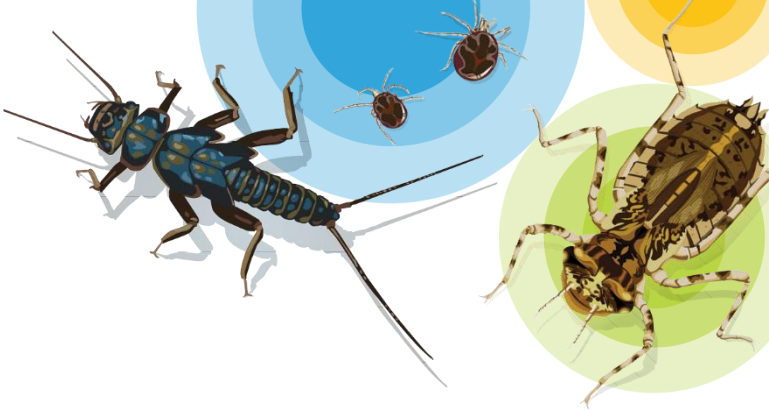
Key messages

- Our waterways are home for a range of animals including waterbugs.
- Waterbugs are an important food source for platypus, fish and frogs. They are very sensitive to changes in the environment and are a good indicator of waterway health.

- Everyone can help improve our local rivers and creeks by reducing stormwater pollution and litter – simple things like picking up after your dog, binning rubbish and fixing oil leaks in your car can reduce the impacts.

Useful resources

See Activity 1.



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Resource 1 Plus Minus Interesting chart

Plus List the advantages in the way in which the waterbug moves.	**Minus** List the disadvantages in the way the waterbug moves.	**Interesting** List the surprising, weird and wonderful things about the way the waterbug moves.

Resource 2 Life cycle of a dragonfly

Dragonfly - eggs

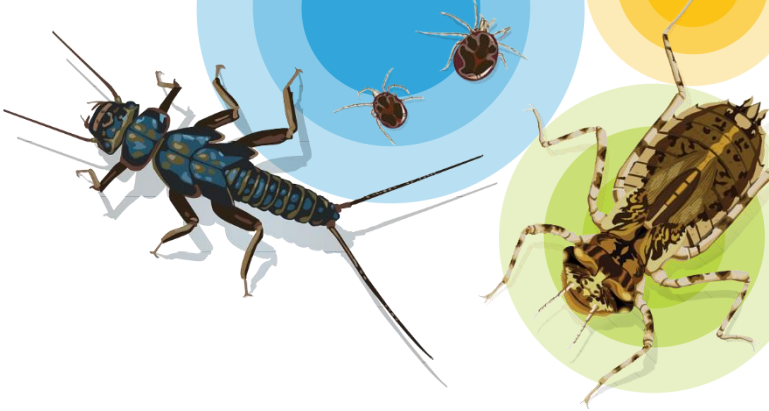
Source: Jay Cossey, 2007 http://www.images.ca/Cossey/Eggs%20Gallery/pages/.htm.

Dragonfly - nymph

Source: Amy Piesse, 2007.

Dragonfly - Adult

Source: Alan Fear, http://www.fluffyfeathers.com/index.php.



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Resource 3 The Melbourne River scenario

This story describes the history of a fictional river that starts on the western outskirts of Melbourne and explains the changes that occurred over time in a number of rivers and urban streams in this area.

Using historical knowledge, you could tailor the scenario for your local river to demonstrate the impacts that urbanisation has on the health of your river.

The Melbourne River starts in the hills and flows through farmland and the suburbs, through the city and finally out into Port Phillip Bay where it meets the ocean.

Every day for thousands of years, families of the Wurundjeri People came to the river to collect water to drink. The river was cool and fresh. The river also provided food and was an important place for ceremonies.

Edible plants grew near the river flats, big game such as kangaroos and emus were found on the great basalt plains. Smaller animals like echidna, possum, lizards and water birds lived nearby. The Wurundjeri People saw platypus, fish and eels and listened to the frogs. They collected water from the top layer of the river so it was clean to drink. When they looked closely at the river surface and in the water, they found caddisfly larvae, dragonfly larvae, damselfly larvae, stonefly nymphs, mayfly nymphs, water boatmen, backswimmers, amphipods and leeches.

In the mid-1830s, Europeans arrived in the Melbourne area and thought it was a good place to settle. More and more people followed and that was the beginning of the city we now call Melbourne.

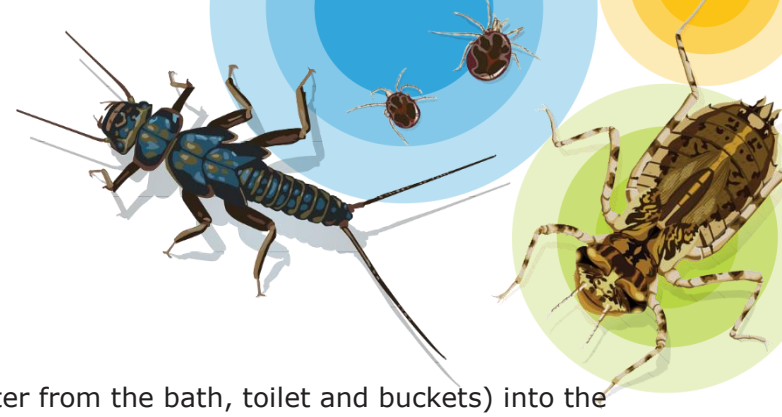
By 1840, farmers settled much of the land next to the Melbourne River. The river provided a reliable source of water for their sheep.

During the 1850s, people came from other parts of Australia and overseas to find gold. They travelled through Melbourne to the goldfields in Ballarat and Bendigo and camped along the river on their way. They tried their luck at gold panning in the Melbourne River. This stirred up the sediment on the bottom of the river.

The children liked to scoop up the tiny creatures in the water to see what they could find. They saw lots of backswimmers, amphipods, leeches, mosquito larvae and dragonflies but it was a surprise to find a caddisfly larvae. They played platypus 'I spy' and were thrilled when they saw the head of a platypus.

Market gardeners drew water from the river to irrigate their fruit and vegetables. They noticed pond snails (like the ones in England) in the water they pumped. They also noticed mosquito larvae and dragonflies.

During the 1860s and 1870s, factories were built along the river: these factories included abattoirs, tanneries, soap works, candle works, acid works and a wool washer. All of the dirty wastewater from these factories drained into the river. The river often flooded and homes and businesses went under water.



People also poured household sewage (wastewater from the bath, toilet and buckets) into the river. This was before we had a network of sewerage pipes. During this time, the river became highly polluted and only the very tolerant waterbugs like flatworms and backswimmers were found. Platypus could not live there anymore. The river earned the nickname 'Stinkopolis' because it smelt terrible!

In the early 1900s, the area continued to be developed. Native vegetation was cleared to make way for recreational facilities. People enjoyed fishing and picnicking along cleaner parts of the river. They explored the waterways but only saw platypus occasionally. Following a Royal Commission into the public health crisis, the Melbourne and Metropolitan Board of Works was formed. Their job was to manage the drinking water supply system and to build a sewerage system to take away wastewater.

Twenty years later, urban planners and engineers reshaped the waterways to control flooding. They built bluestone banks and diverted floodwater. A wetland next to the river was filled in with soil to make way for houses. Even the flatworms and backswimmers disappeared. Platypus had to find somewhere else to live.

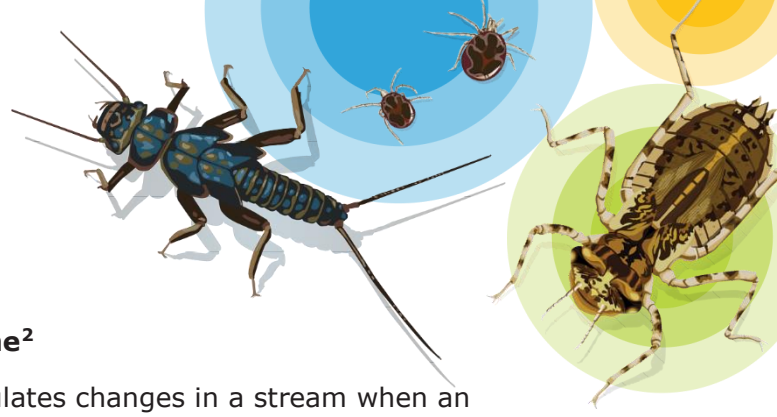
Life on the river continued like this for some time until the 1970s, when people started to realise how important the river and their natural environment was. The Environment Protection Act was passed. Waste from industry now had to be treated before being released into the environment, ensuring that our waterways are protected for future generations.

In the 1980s and 90s, the factories and warehouses that used to dispose of their waste in the river were converted to apartments, houses, cafes and restaurants. People liked to walk and jog along the river paths. They took family bike rides. Most talked about seeing a platypus but it had been many years since platypus had lived here. Every so often, someone saw a dragonfly or damselfly.

Now, we have community groups, councils and government agencies who all look after the river. Friends groups and Melbourne Water create healthy waterways with help from the community. The area has been replanted. Native vegetation is considered to be very important because it stabilises the eroded banks and provides habitat for the animals that rely on the river for food. Traditional Owners work with these people to help bring life back to the river.

The people who live along the river feel very lucky to call it home. They participate in rubbish clean-up days and tree planting days. They help Melbourne Water to identify frogs around the river. They pick up their dog's poo when they're out walking. They understand that hair ties and rubber bands can be fatal to platypuses so they collect these when they find them.

A local school group participates in the River Detectives program and tests the water quality, including the waterbugs that live in the river. They find caddisfly larvae, dragonfly larvae, damselfly larvae, stonefly nymphs, mayfly nymphs, water boatmen, backswimmers, amphipods and leeches. They also use an app called PlatypusSPOT to see if they can find platypus in the river. They haven't found one yet but they will keep looking.



WATERWATCH The life of waterbugs (Years 3–4)

Resource 4 Macroinvertebrate mayhem game[2]

Students form groups and play a game that simulates changes in a stream when an environmental stressor, such as a pollutant, is introduced. This can be played on a large oval, basketball court or other open area.

Groups:

- Platypus
- Caddisfly larvae
- Dragonfly larvae and damselfly larvae
- Stonefly nymph
- Mayfly nymph
- Flatworms and backswimmers
- Amphipods and leeches

One or two students:

- Act as an environmental stressor (e.g. pollution, sedimentation, sewage or factory waste)

1. Divide the class (apart from the one or two students acting as the environmental stressors) into seven groups. Each group represents one of the above macroinvertebrate species, or a platypus.

2. Create name stickers for each group.

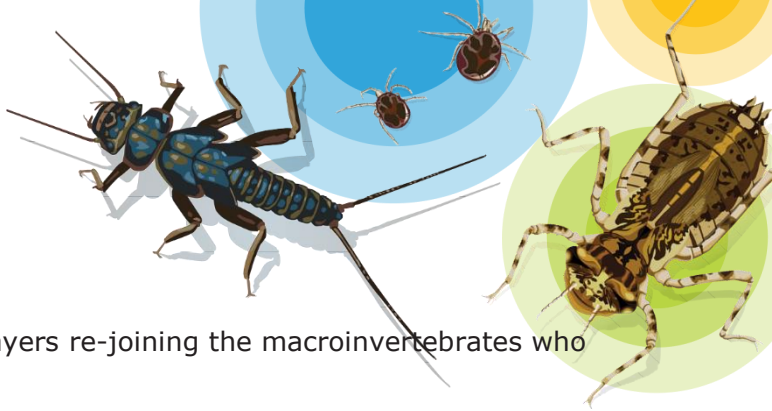
3. Inform students that some macroinvertebrates have hindrances to crossing the field (see table below). These obstacles symbolise very sensitive organisms' intolerance to pollutants. Ask the students with these labels to practice their motions.

4. Assemble the macroinvertebrate groups at one end of the oval and the environmental stressors in the middle of the oval. When a round starts, macroinvertebrates will move toward the opposite end of the oval and the stressor will try to tag them. To "survive", the macroinvertebrates must reach the opposite end of the oval without being tagged by the environmental stressor. The environmental stressor can try to tag any of the macroinvertebrates, but will find it easier to catch those with hindered movements.

5. Begin the first round of the game. Once tagged, macroinvertebrates must go to the sidelines. They can remain there or join the other more tolerant species groups (and put on a new sticker name tag, e.g. flatworms and backswimmers).

6. The round ends when all of the macroinvertebrates have either been tagged or have reached the opposite end of the playing field.

[2] Used with permission, *Cascadia Conservation District* www.kidsinthecreek.com/wp-content/uploads/2012/06/macroinvertebrate_mayhem.pdf *Accessed 4 May 2019*



7. Complete two more rounds, with all tagged players re-joining the macroinvertebrates who successfully survived the previous round.

8. Record, or simply draw students' attention to, the number of tolerant species who "survived" compared to the number of sensitive species who "survived".

Organism	Hindrance	Rationale for hindrance
Caddisfly	Must place both feet together and hop across the field, stopping to gasp for breath every five hops.	Caddisflies are intolerant of low oxygen levels. They build cases and attach themselves to rocks for protection and stabilisation.
Stonefly	Must do a push up every ten steps.	When oxygen levels drop, stoneflies undulate their abdomens to increase the flow of water over their bodies.
Mayfly	Must flap arms and spin in circles when crossing the oval.	Mayflies often increase oxygen absorption by moving their gills.
Platypus	Must bend down and touch the ground with one hand every five steps.	Platypus constantly forage for food and require an abundant supply of macroinvertebrates.