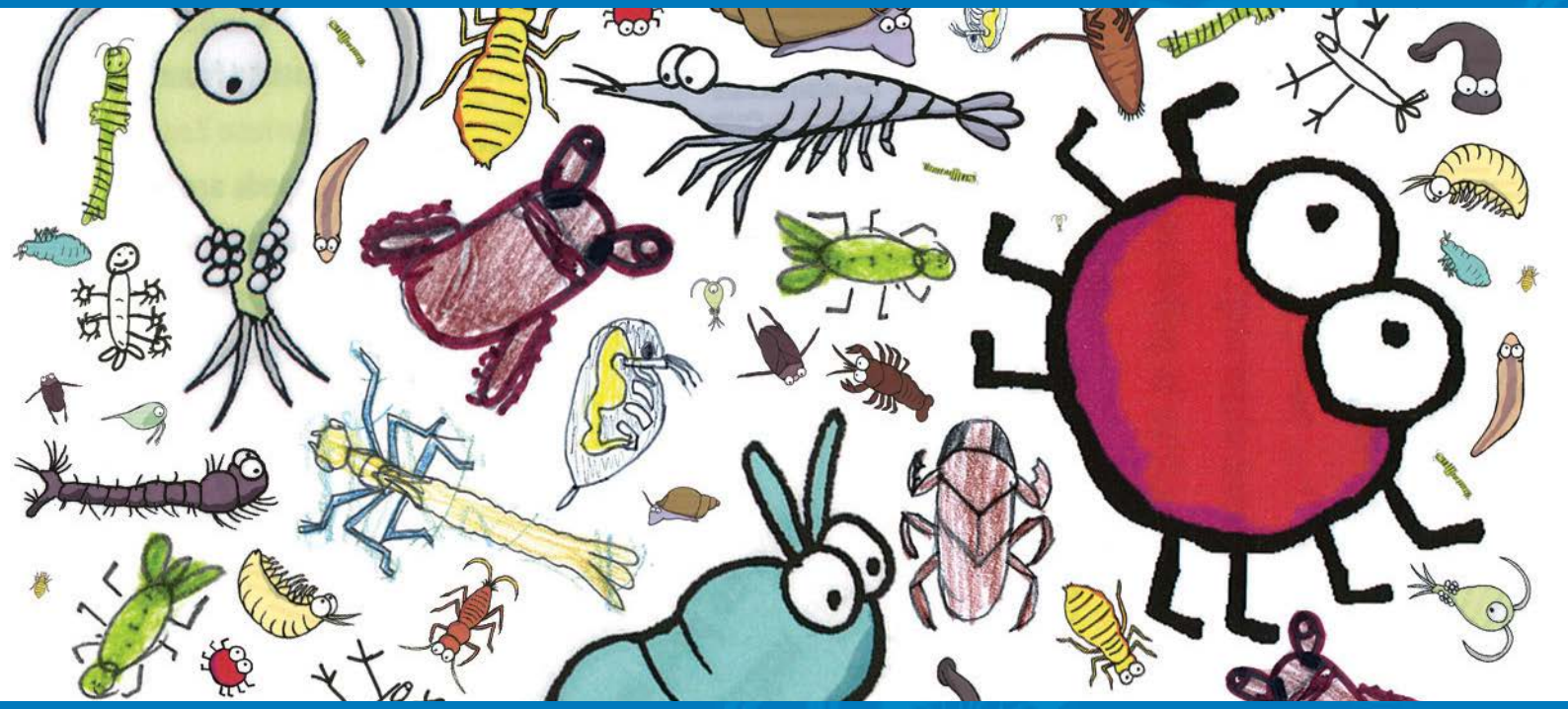
Natural Resources
SA Murray-Darling Basin

Critters Galore

Teacher Resource Pack
Early Years - Middle Years



NRM Education
Supporting environmental sustainability in schools.

Government of South Australia

NRM Education

The NRM Education Program is playing a critical role in contributing to the knowledge, skills and confidence of young people and educators to manage natural resources sustainably.

Critters Galore actively engages students in learning about aquatic macroinvertebrates, their habitats, features and reliance on healthy waterways. Water samples containing live specimens are collected and used to familiarise students with local macroinvertebrates and techniques for sorting and identifying them.

This unit is usually used in conjunction with the Water Watch resource.

For more information or to discuss opportunities for your school, contact your local NRM Education Coordinator:

Upper Murray

NRM Education Coordinator

Natural Resources Centre

2 Wade Street

Berri SA 5343

Phone 08 8580 1837

Fax 08 8582 4488

Lower Murray

NRM Education Coordinator

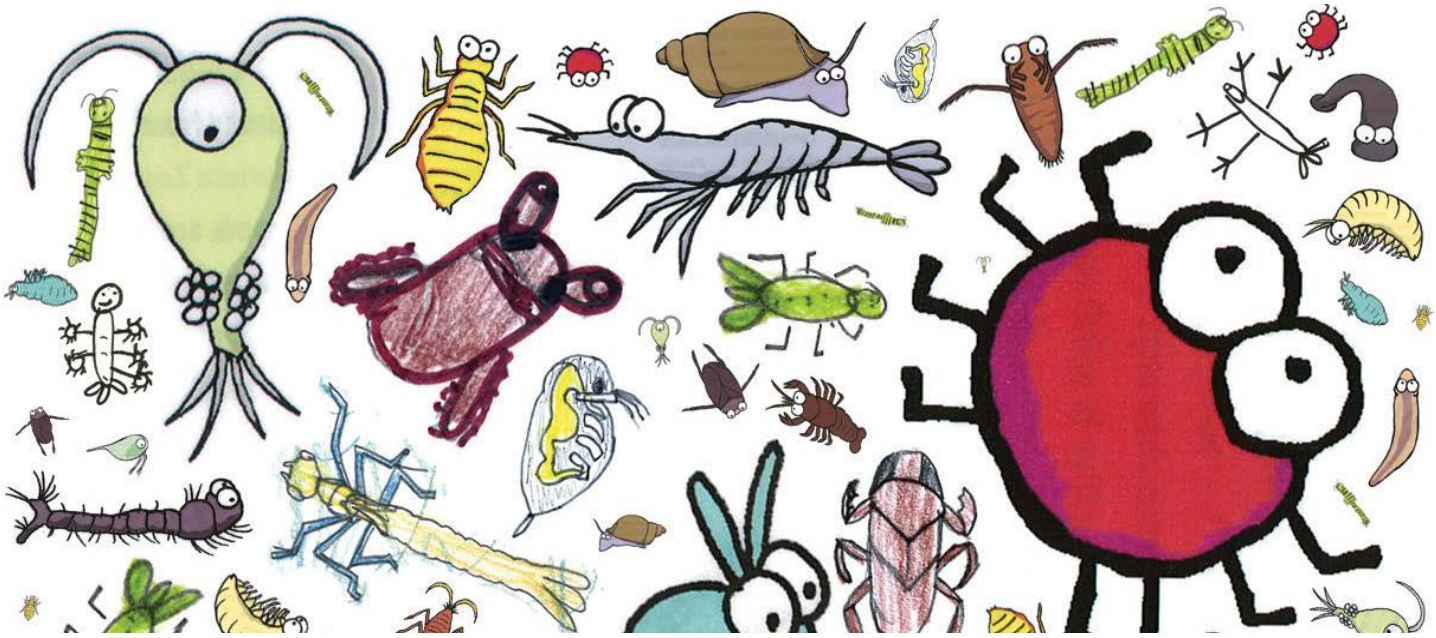
Natural Resources Centre

110A Mannum Road

Murray Bridge SA 5253

Phone 08 8532 9134

Fax 08 8531 1843



Contents

Unit Overview

Year levels: Foundation to Year 10

Learning areas: Science, Geography, Maths

Big ideas: Macroinvertebrates are important to aquatic environments and are indicators of water quality.

Sustainability organising ideas:

OI.1 The biosphere is a dynamic system providing conditions that sustain life on Earth.

OI.2 All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

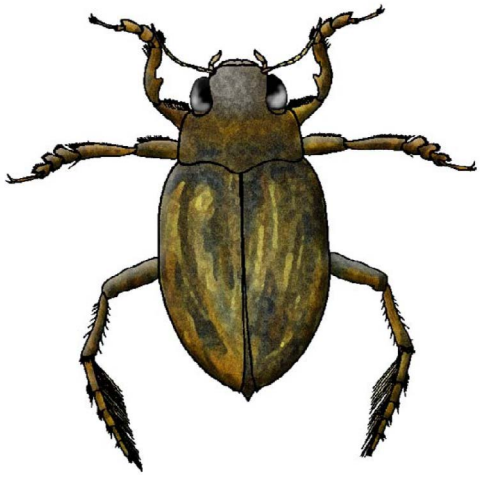
OI.7 Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

Students will know / understand / do:

- Understand the difference between healthy and unhealthy waterways
- Understand the factors that influence waterway health
- Know that macroinvertebrates are indicators of water quality
- Understand the definitions of ‘tolerant’, ‘sensitive’ and ‘diversity’
- Know where different macroinvertebrates can be found
- Identify local macroinvertebrates
- Suggest ways to improve water quality
- Implement actions to improve water quality

Essential questions:

- How can we tell the difference between a healthy and an unhealthy waterway?
- What are macroinvertebrates?
- Why are macroinvertebrates used to measure water quality?
- What features of macroinvertebrates can help us identify them?
- How can we improve water quality?



Introductory Lesson

Equipment

- Posters showing healthy and unhealthy waterways (available from NRM Education website)
- Cut outs of macroinvertebrate images from Macroinvertebrate ID Chart or Macroinvertebrate Information pages (pages 15-20)

Step 1

Display the Healthy and Unhealthy Waterways posters.

Ask the students what sorts of observations they can make about the poster. How are the sides different? What does one side have that the other doesn't?

Aim: *Distinguish between one side that is natural and another side that is polluted. Point out that the state of the environment affects the types of critters that can live there.*

Key words:

- Healthy / Natural / Clean
- Vegetation / Plants / Reeds
- Native trees / Evergreen
- Yabby hole
- Snags / Logs
- Rocks
- Unhealthy / Polluted / Unclean
- Litter / Rubbish
- Introduced species / Willow / Deciduous
- Stormwater drain
- Leaves
- Bank erosion / Exposed roots

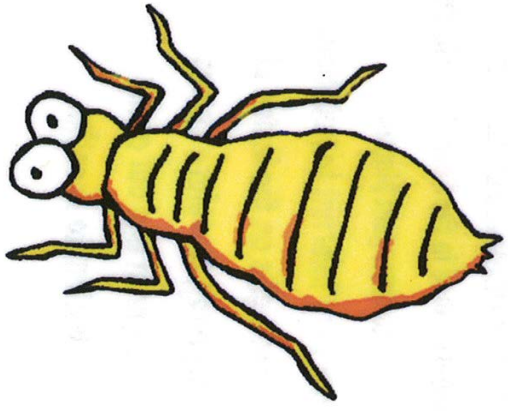
Step 2

Tell the group about the 5 different zones in the waterway:

- SURFACE - at the top
- DEEP - the rest of the water
- BENTHIC – the bottom or bed
- REED – in the plants
- SUBSTRATE – anything hard that animals can cling to

*For younger students, discuss the different areas of the waterway without using the terminology.

Ask what would be considered as substrate in the polluted side? Answers: tyre, can, bottle, milk carton, stormwater drain, roots of tree etc



Introductory Lesson continued

Step 3

Ask “Can anyone tell me what a macroinvertebrate is?”

If you do not get the answer you’re looking for, break the word down a bit - ask what “macro” means? What about invertebrate? Or what is a vertebrate animal?

Answer: Macro means big enough to see with the eye. Invertebrate means it has no backbone.

We are looking at Aquatic Macroinvertebrates - the ones that spend at least part of their life cycle in the water. Because they live in the water for all or part of their lives, their survival is related to water quality and therefore macroinvertebrates can tell us whether a waterway is healthy or not.

Macroinvertebrates are sensitive to different physical and chemical conditions. If there is a change in water quality, or a change in the flow, then the macroinvertebrate community may also change.

Macroinvertebrates are significant within the food chain as larger animals such as fish and birds rely on them as a food source.

Refer back to the Healthy and Unhealthy Waterways poster.

What would it mean if we found macroinvertebrates in the unhealthy side? Introduce TOLERANT species.

What would it mean if we didn’t find any macroinvertebrates in the unhealthy side? Introduce SENSITIVE species.

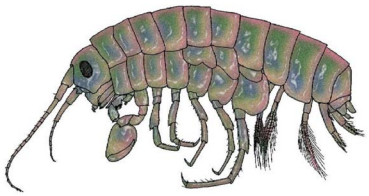
What would it mean if we found lots of different types of macroinvertebrates in the water? Introduce DIVERSITY.

TOLERANT: They can put up with some pollution, but can live in either clean or dirty water.

SENSITIVE: They won’t be able to survive if the water has any pollution.

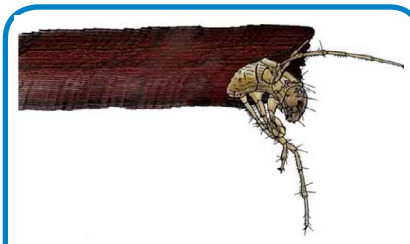
DIVERSITY: The number of different species found. Clean water often has more diversity because both the sensitive and tolerant animals can live there. More than 10 species is said to be good.

Display or hand out copies of the Macroinvertebrate ID charts (available from the NRM Education website).
Show students the sensitivity rating of the macroinvertebrates. Examples shown below. L to R: Very Tolerant, Very Sensitive, Sensitive



Scud
(Sideswimmer)

3



Caddisfly Larvae

8

Riffle Beetle Larvae

7

Introductory Lesson continued

Step 4

Using the table below as a guide, cut out and stick the pictures of macroinvertebrates on the Healthy and Unhealthy Waterways poster and explain why each macro would be found in that area. See the Macroinvertebrate Information on pages 15-20 for more information about each macro.

Macroinvertebrate	Sensitivity	Side	Location
Water Boatman	2	Polluted side	Still water, live in plants or mud
Segmented Worm	2	Polluted side	Live anywhere
Seed Shrimp	Not rated	Non-polluted side	On bottom with plants
Scud	3	Polluted side	Still or slow-moving water, amongst plants
Dragonfly Nymph	3	Non-polluted side	Edge of water amongst rocks and plants
Mayfly Nymph	9	Non-polluted side	Clinging to rocks or muddy bottom
Yabby	4	Polluted side	Burrows into mud
Stonefly Nymph	10	Non-polluted side	Fast-moving water, under rocks or in plants in slow-moving water
Backswimmer	1	Polluted side	Underside of water surface
Copopod	Not rated	Polluted side	Slow-moving water near aquatic plants
Water Mite	7	Non-polluted side	Water surface
Freshwater Snail	1	Polluted side	Amongst plants, rocks, twigs and rocks
Scavenger Beetle	2	Polluted side	Diving in open water
Water Flea	Not rated	Polluted side	Slow-moving water, amongst plants
Flat Worm	2	Polluted side	Rocks, logs and stones
Water Strider	4	Polluted side	Water surface
Damselfly Nymph	3	Non-polluted side	Edges of slow-moving water, amongst plants
Mosquito Larvae	1	Polluted side	Still water
Non-biting Midge Larvae	3	Polluted side	Still or slow-moving water

Note: Macroinvertebrates found in the polluted side would also be found in the non-polluted side.

Identifying Macroinvertebrates Lesson

Step 1 - Collecting your sample

Samples can be collected from a range of waterbodies including rivers, streams, dams, creeks, drains, lakes, wetlands and ponds. Choose a site that is easily accessible. If the site is on private land, ensure you have permission to sample.

Safety precautions

- Don't visit waterways on your own.
- Always tell someone where you are going and when you will be back.
- Do not enter the waterway if you don't need to.
- Wear appropriate clothing for the weather conditions, including a hat and enclosed shoes.

When to sample

If you are collecting macroinvertebrates as part of a monitoring program, you should collect data at least once or twice a year. If you are involved in the Water Watch program, Snapshots are taken each term. The highest diversity of macros is generally when high water levels and flows have reduced and temperatures begin to increase.

Equipment

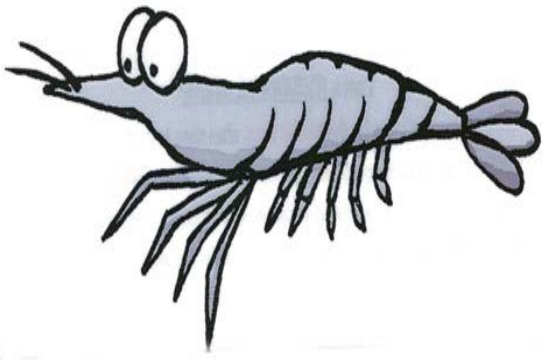
- Sampling net
- Waders or gum boots (recommended)
- Buckets

How to collect a sample

Bounce the net over the bottom of the waterway to stir up sediment and macros, then scoop it forward. Repeat this several times, swirling the net to collect debris. Scrape the net against rocks, vegetation and logs to collect macros that live in these locations.

Carefully rinse the net several times in the waterbody to let excess sediment pass through. Transfer the contents of the net into a bucket that has been half-filled with water from the sample site.

Take at least five minutes to collect your sample - it is better to over-sample the under-sample!



Identifying Macroinvertebrates Lesson continued

Step 2 - Identifying Macroinvertebrates

Equipment:

- White trays
- Ice cube trays
- Laminated ID sheets (available from NRM Education website)
  - ID sheet for Early Years-Primary Years
  - ID sheet for Primary Years-Middle Years
- Double-sided *Waterwatch Monitoring Record Sheet* (available from NRM Education website)
- Plastic spoons and pipettes
- Pens or pencils
- Two-way microscope viewers
- Magnifying glasses

Transfer some of the collected sample into the white trays, which should have approx 2 cm of clean water from the sample site in them.

Remind the students that macroinvertebrates can tell use about water quality.

Aim for the lesson: To determine if the waterbody sampled is a healthy environment.

Tell the class where the sample came from and show them the equipment they will be using to identify the critters.

Explain that the ice cube tray is to sort different species and make it easier to do a diversity count at the end.

The spoons and pipettes are to be used for picking things out – NOT HANDS.

The ID sheets will help them decide what they have found. Discuss the features that can be used to differentiate macros e.g. number of legs, presence of wings, ability to swim, size, etc.

The record sheets are used to record what macroinvertebrates they find (see the Macroinvertebrate Monitoring Record Sheet on Page 11 or download from the NRM Education website).

Show them how to use the two-way viewer and explain that water inside will fog it up.

Divide the students into 4-6 smaller groups, depending on the number of trays you have available.

As the groups are identifying things, circulate around and check their answers.

Identifying Macroinvertebrates Lesson continued

Step 4 - Interpreting your results

Explain that counting the number of Macroinvertebrates that students find and adding up their sensitivity scores can indicate the quality of the water they are living in! Use a simple equation to get the "SIGNAL SCORE" which can then help to estimate the health of the water you are monitoring.

Here is an example:

Let's say we found the following bugs: Freshwater shrimp, Whirligig Beetle, Sow Bug, Damselfly Nymph, Water Boatman, Backswimmer, Caddisfly Larvae and a Yabby.

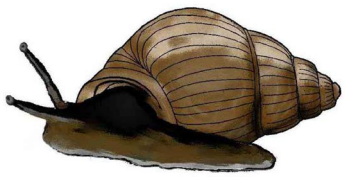
1. Add up the number of different macros you found. This is your TAXA RICHNESS number: **8**

2. Add up all of the sensitivity numbers for those bugs that you found. This give you your POLLUTION INDEX number. In this example it would be: **27**

3. Calculate your SIGNAL SCORE by dividing your POLLUTION INDEX number by your TAXA RICHNESS number: 27 divided by 8 = 3.3 so your SIGNAL SCORE is **3.3**

4. Use the SIGNAL SCORE Table to help estimate the health of your waterway.

SIGNAL SCORE	POLLUTION RATING
Higher than 5	Healthy habitat
More than 4 and up to 5	Mild pollution
Between 3 and 4	Moderate pollution
Less than 3	Severe pollution



So you see - the MORE different bugs you find, and the MORE sensitive bugs you find - the better the water quality must be!

Ask the students to discuss what the results tell them about the quality of the water.

Extension Activity: *Primary and Middle Years students can complete the other monitoring tests in the Water Watch resource (salinity, turbidity, phosphates and nitrates). Do these results support your conclusions based on your macroinvertebrate monitoring?*

Alternative Activity: Macroinvertebrate Game

Students find one of the macroinvertebrates in their tray.

Using the Macroinvertebrates ID Chart, students identify the macro and once they think they know what it is, they yell out 'MACRO', put their hand up and the teacher will confirm the ID. If the ID is correct, students mark that macro on their recording sheet. If they have not got the ID correct, they will have to try again or find another bug to identify.

The macroinvertebrate points are allocated according to their pollution sensitivity ratings (e.g. a Backswimmer is 1 point, while a Caddisfly Larvae is 8 points). At the end of the game, students tally up their points and the team with the most points at the end of 15 minutes is the winner.

	Common name	Pollution sensitivity	Tick if present	Sensitivity number
Very Sensitive	Stonefly Nymph	10		
	Mayfly Nymph	9		
	Caddisfly Larvae	8		
Sensitive	Riffle Beetle Larvae	7		
	Water Mite	7		
	Marsh Beetle Larvae	7		
Tolerant	Black Fly Larvae	5		
	Crane Fly Larvae	5		
	Pea Shell	5		
	Biting Midge Larvae	4		
	Freshwater Limpet	4		
	Freshwater Prawn	4		
	Little Basket Shell	4		
	Water Strider	4		
	Whirligig Beetle Adult/Larvae	4		
	Yabby	4		
Very Tolerant	Crawling Water Beetle	3		
	Damselfly Nymph	3		
	Dragonfly Nymph	3		
	Freshwater Shrimp	3		
	March Fly Larvae	3		
	Needle Bug	3		
	Non-biting Midge Larvae	3		
	Round Worm	3		
	Scud	3		
	Small Water Strider	3		
	Water Measurer	3		
	Water Scorpion	3		
	Fishing Spider	2		
	Flatworm	2		
	Hydra	2		
	Isopod	2		
	Predacious Diving Beetle	2		
	Segmented Worm	2		
	Soldier Fly Larvae	2		
	Water Boatman	2		
	Water Scavenger Beetle	2		
	Backswimmer	1		
	Gilled Snail	1		
	Leech	1		
	Mosquito Larvae/Pupae	1		
	Pounch Snail	1		
	Springtail	1		
Other				
Not Rated	Copepod	NR		
	Seed Shrimp	NR		
	Waterflea	NR		
		TOTALS		

Count the number of macroinvertebrate types. This is the TAXA RICHNESS.

Add up the sensitivity numbers to calculate the POLLUTION INDEX.

Macroinvertebrate monitoring record sheet

Interpreting your results

Step 1

Calculate the Signal Score for your site:

☐ POLLUTION INDEX

/ ☐ TAXA RICHNESS

= ☐ (SIGNAL SCORE)

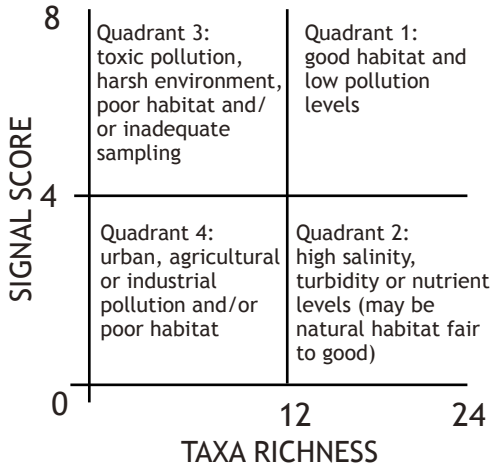
Step 2

Use the Signal Score to determine the Pollution Rating at your sampling site.

Signal Score	Pollution Rating
Higher than 5	Healthy habitat
More than 4 and up to 5	Mild pollution
Between 3 and 4	Moderate pollution
Less than 3	Severe pollution

Step 3

The pollution indicator graph below can suggest possible sources of pollution. Use your SIGNAL SCORE and TAXA RICHNESS to plot a point on the graph.



Identifying Macroinvertebrates Lesson continued

Step 5 - Improving water quality

Ask the students what things can affect water quality. *Answers: salt, increased flows from storms, pollution (fertilisers, pesticides, manure, fuel), rubbish, increased or decreased flows due to modification of the waterway (installing locks or weirs, removing large rocks).*

Reflection: Ask students to consider what they want the place sampled to be like in the future. What can be done to improve water quality? What can students themselves do to look after the waterbody sampled?

Take action

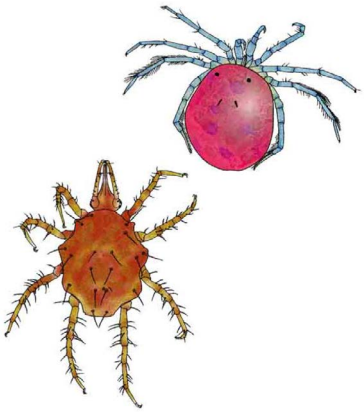
Sustainability is a cross-curriculum priority in the Australian Curriculum. Sustainability is not only about giving students the knowledge and tools to live more sustainably, but also encourages them to take steps to create change and improve their environment.

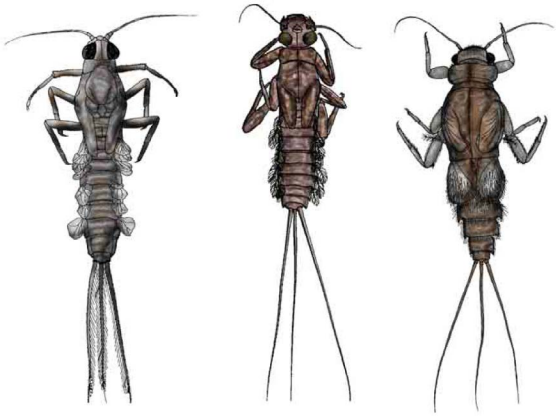
Encourage students to act upon their knowledge about water quality and macroinvertebrates to improve the quality of local waterways.

In small groups, students select an achievable action and implement their plan to improve water quality. If students are interested in community actions (e.g. a revegetation program), your local council, Local Action Planning (LAP) Association or Natural Resources Centre should have details for community groups in the area that may be interested in partnering with your school.

Take action suggestions:

- Make your own Artificial Substrate Sampler and place it at your Water Watch site. A substrate sampler sits on the bottom of your waterway for around 6 weeks allowing macroinvertebrates to move in and make the substrate their home. Next time you visit your site, pull it out and collect a sample of macroinvertebrates to identify.
- Provide a better habitat for your local macroinvertebrates by clearing any litter left at your site and revegetating the banks of your local waterway with local native species.
- Implement a recycling program at school to reduce rubbish entering waterways.





Additional Activities

Early Years

These learning opportunities encourage the learner to actively use information and knowledge gained in Critters Galore to further their understanding of macroinvertebrates and catchment health.

- If you could be an aquatic macroinvertebrate, which would you most like to be and why?
- Study the features of your favourite macroinvertebrate and draw a picture of it. You could also construct your favourite macroinvertebrate out of clay, plasticine or other material.
- Create a macroinvertebrate environment in the classroom. Display drawings of macroinvertebrates or dress up and live the life of a macroinvertebrate for a day.
- Imagine you are a macroinvertebrate. Write a story about one day in your life. Describe the place where you live, your daily activities and the dangers you face.
- Select 5 macroinvertebrates of your choice and compare their features. How are they similar? What makes them different?
- Write and perform a macroinvertebrate play, exploring what happens to macroinvertebrates after certain events such as a flood or chemical spill.
- Construct a find-a-word, crossword or jumbled words puzzle using words relating to aquatic macroinvertebrates. Give your puzzle to a classmate or another class to solve.
- Describe how learning about macroinvertebrates has changed your thinking about water pollution and water care. What can you do locally to protect macroinvertebrates?
- Many people in the community don't realise there are lots of little critters in our waterways or what they can tell us about catchment health. Display pictures or posters of the macroinvertebrates you have studied to tell the community about your findings.

Primary Years

These learning opportunities encourage the learner to use knowledge gained in Critters Galore to further their understanding of the significance of macroinvertebrates in healthy waterways.

- Using an appropriate form of visual media (photos, paintings, models), show the stages in the life cycle of an aquatic macroinvertebrate.
- Draw a simple food chain of 3 to 5 steps with a large animal such as a bird or fish at the top showing a macroinvertebrate's place in it.
- Imagine a world with no macroinvertebrates (land or water-dwelling). What would this world be like? What would the problems or benefits be?
- If you could be an aquatic macroinvertebrate, which would you most like to be and why?
- Compare the lives and roles of aquatic macroinvertebrates with those of land-dwelling minibeasts.
- Write a letter to another class in your school or to the media, convincing them of the need to look after aquatic macroinvertebrates.
- Select 5 macroinvertebrates of your choice and compare their features. How are they similar? What makes them different?
- Imagine you are running a restaurant for aquatic macroinvertebrates. What would you have on the menu and who do you think your customers would be?
- Research the features of your favourite macroinvertebrate and construct a 3-D model out of clay, plasticine or other material.
- Describe how learning about macroinvertebrates has changed your thinking about water pollution and water care. What sorts of things can you do locally to protect macroinvertebrates?

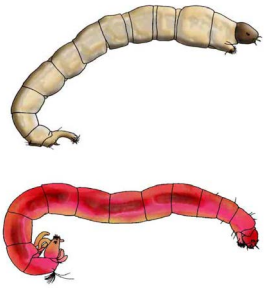
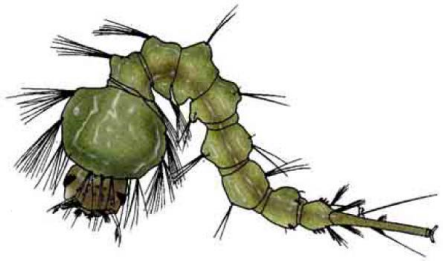
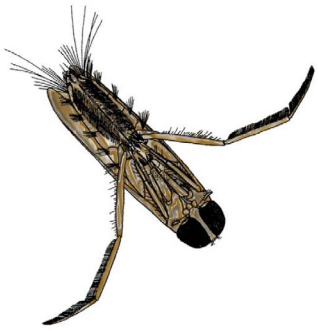
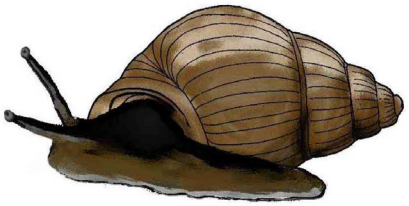
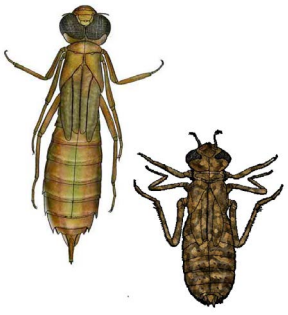
Additional Activities continued

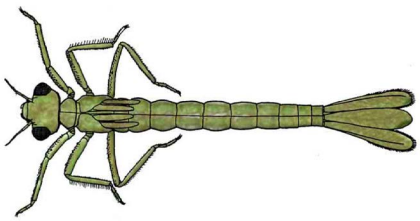
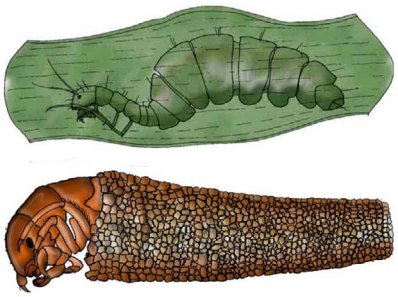
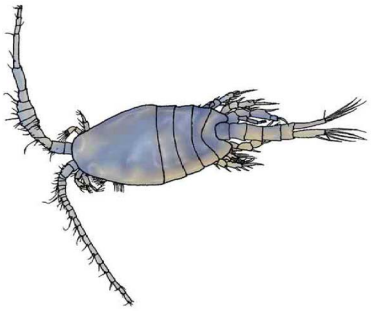
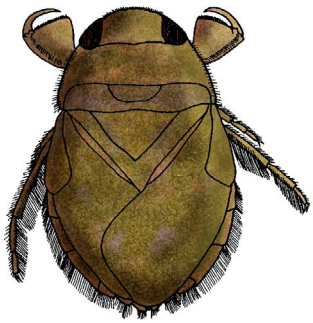
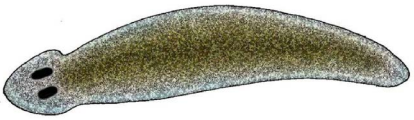
Middle Years

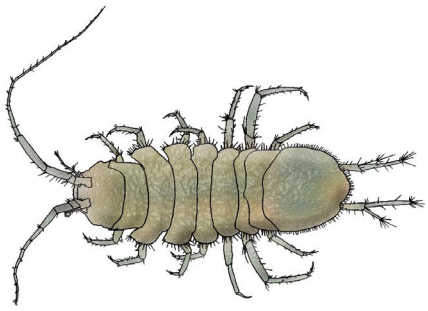
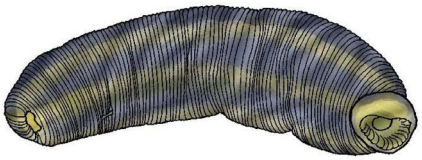
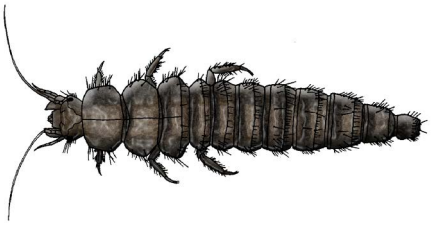
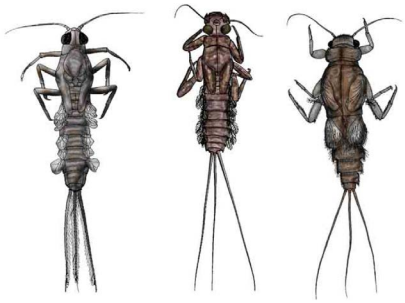
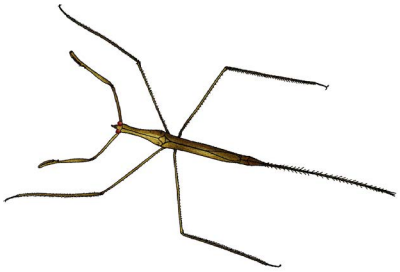
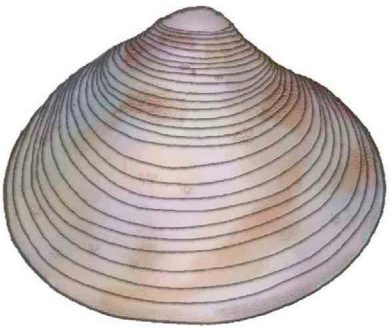
These learning opportunities encourage the learner to use knowledge and information gained in Critters Galore as a basis for furthering their understanding of macroinvertebrates and their significance as indicators of water quality.

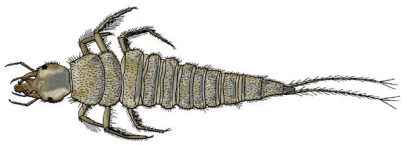
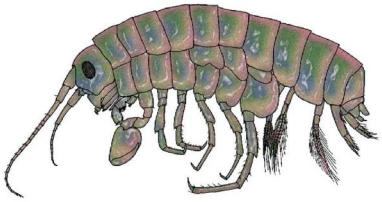
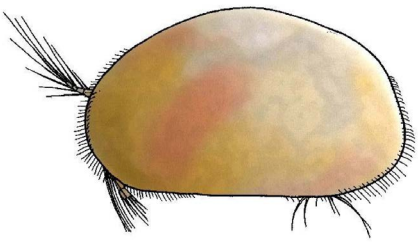
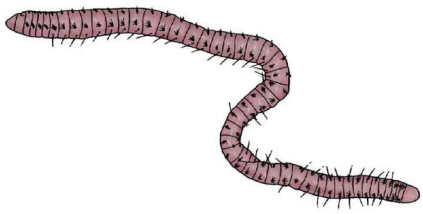
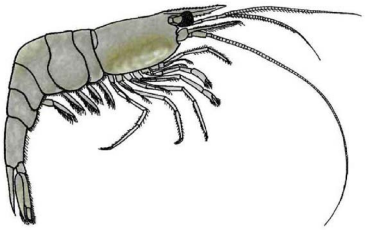
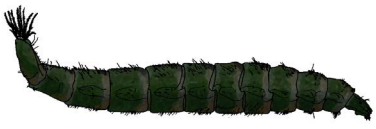
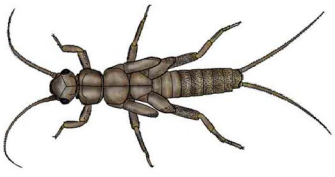
- Using an appropriate form of visual media (photos, painting, models, etc), show the stages in the life cycle of an aquatic macroinvertebrate.
- Imagine a world with no macroinvertebrates (land or water-dwelling). What would this world be like? What would the problems or benefits of this world be?
- Investigate and compare historical macroinvertebrate data at your monitoring site.
- Investigate why numbers increase or decrease throughout the year. Is it due to seasonal change or on-ground activities such as revegetation?
- If you could be an aquatic macroinvertebrate, which would you most like to be and why?
- Compare the lives and roles of aquatic macroinvertebrates with those of land-dwelling minibeasts.
- Write a letter to another class in your school or to the media, convincing them of the need to look after aquatic macroinvertebrates.
- Select five macroinvertebrates of your choice and compare their features. How are they similar? What makes them different?
- Develop a sensitivity rating for students in your class to environmental factors e.g. noise, temperature, shelter and food.
- Construct a board game or puzzle to communicate the importance of having good quality water and conserving aquatic habitats for macroinvertebrates species.
- Imagine that you are designing a constructed wetland aimed at conserving macroinvertebrate diversity. You wish to stock the wetland with a range of different macroinvertebrates to ensure the survival of those species. Communicate what you think are the most important factors affecting macroinvertebrate diversity at a site.

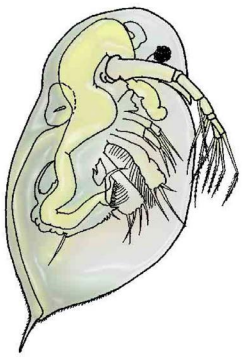
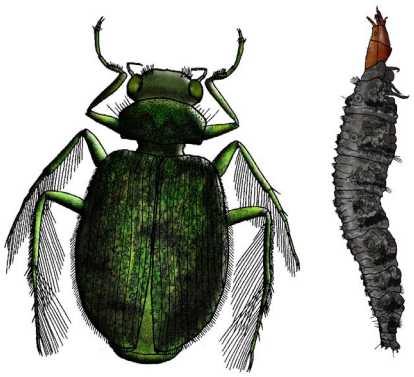
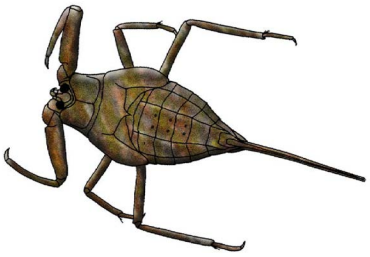
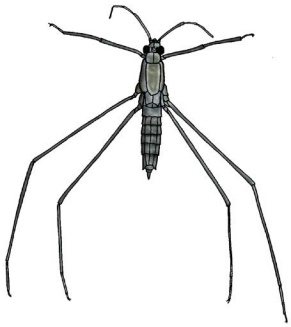
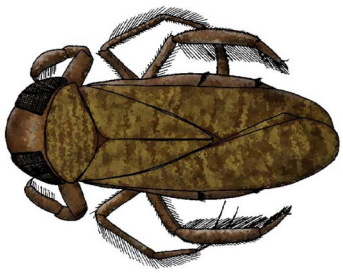
Macroinvertebrate Information

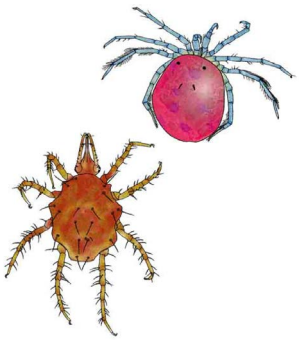
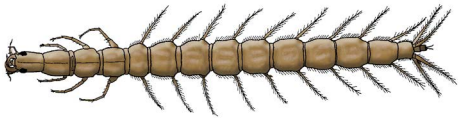
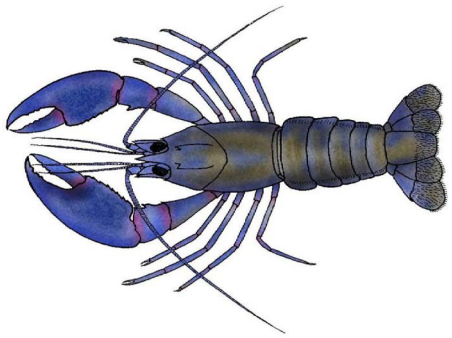
Non-biting midge larvae	Lives in the Benthic Zone. Is very tolerant to pollution. It is an omnivore and eats decaying plants and animal matter. Also know as a blood worm because of its colour and because it has very similar blood to humans (they have haemoglobin). This allows it to live in places with little oxygen available such as down at the bottom of the waterways or where leaves are rotting.	
Mosquito larvae	Usually found in the Surface Zone. Is very tolerant to pollution. It is a detritivore but when it becomes a pupa it does not eat at all so it has to eat enough in its larval stage so it can make it through to become an adult! The pupa breathes through its bum. Breaks the surface with its tail and breathes. If oil is spilt on the water it can't breath (is this a good or bad thing?). Life cycle for mosquitoes is: mosquito larvae - pupa - adult mosquito.	
Backswimmer	Usually found in the Deep Zone. Is tolerant to pollution. It is a carnivore that likes to suck the body juices of other insects, tadpoles and small fish! It can even snatch bugs on the water surface, drag them under and eat them. Swims on its back. When it needs to breathe it comes to the surface, does a backflip, opens its wings and collects an air bubble under its wings. It then dives down and a small tube from its side connects the air sack to the inside of its body.	
Freshwater snail	Lives in the Benthic Zone. Is very tolerant to pollution. It is a herbivore. Snails have a big long tongue that looks like a chain saw. Its tongue rotates in its mouth very slowly and scrapes algae off rocks for it to eat. *Notapala* is a native freshwater snail and is extinct in the SA reaches of the River Murray. One possible reason is that it once fed on the algae that grew when the river flowed faster before locks and weirs. Now it is only found in irrigation pipelines where the water flows very fast. Unfortunately the snails block up the pipes.	
Dragonfly Larvae	It is usually found in the Reed Zone clinging to emergent plants. Is very tolerant to pollution. Its gills are in its bottom. If you watch them closely you can see them sucking in and squirting out air from their bum so they can breathe. The female adult will dive bomb the water dropping her eggs in. The larvae hatch, grow up and when ready they use the long reeds to climb out of the water, moult and fly off as an adult dragonfly. They also have very big jaws, which extend out from their head to catch their prey.	

Damselfly Larvae	Usually found in the Reed Zone clinging to reeds, vegetation or snags. Is very tolerant to pollution. It is a carnivore. The three tail feathers at the end of its body are actually gills that help it to breathe. Also has very big jaws just like a dragonfly.	
Biting midge larvae	Lives in the Benthic Zone. Is tolerant to pollution. Most are herbivores but some are carnivores.	
Caddisfly larvae	Usually found in the Benthic Zone amongst rocks, branches and plants. Is very sensitive to pollution. It is a herbivore, scraping algae from the surface of rocks, or is a carnivore, hunting for small invertebrates. It builds itself a protective case out of leaves, sand, reeds or sticks.	
Copepod	Usually found in the Surface Zone. Most Copepods are herbivores but some are carnivores. It only lives for less than two months!	
Creeping water bug	Lives in Reed Zone. It moves slowly, crawling or swimming. It eats small aquatic organisms. When submerged it breathes using air stored under its wings.	
Flatworm	Lives in the Benthic Zone. Is very tolerant to pollution. It likes to eat decomposing plant matter which makes it a detritivore.	

Isopod	Isopods are a group of macroinvertebrates. Most are small greyish or whitish animals with rigid, segmented exoskeletons (external skeletons). They have two pairs of antennae, seven pairs of jointed limbs on the thorax, and five pairs of branching appendages on the abdomen that are used in respiration. Some eat dead or decaying plant and animal matter, others are grazers or strain food particles from the water around them, a few are predators, and some are internal or external parasites, mostly of fishes. Mostly live in the Benthic Zone.	
Leech	Found in the Benthic Zone. Is tolerant to pollution. It is a carnivore and mainly feeds on the blood and juices of snails and other large aquatic animals. It has suckers at each end of its body that helps it to move and latch onto its prey.	
Marsh beetle larvae	Larvae live in stagnant and flowing water (mostly rich in decomposing plant material), while adults live on vegetation, in rotting plant material in the Reed Zone. They feed on decomposing organic matter by filtering the particles from the surface of leaves and stones using complex comb-like mouthparts.	
Mayfly	Lives in the Substrate Zone. Is very sensitive to pollution. It is a herbivore and likes to graze on dead plants and leaves. When it is an adult, it may only live for a few days or even hours!	 (larvae shown)
Needlebug	Has a breathing tube tail, which is often half the length of the insect. Usually found in shallow water in weedy ponds. It is a carnivore. They are swimming insects, and the adults can fly. Sometimes called the ‘water stick insect’.	
Peashell	Found in mud or sand in the Benthic Zone. Bivalves accumulate toxic chemicals in the tissues, so peashells can be used to monitor copper, zinc and ammonia pollution.	

Predacious diving beetle larvae	Lives in the Surface Zone. Is very tolerant to pollution. It is a carnivore and eats other aquatic invertebrates and sometimes even attacks small fish and tadpoles! It has chewing mouthparts, which helps it eat them.	
Riffle beetle larvae	Most riffle beetle species are found crawling on stones and woody debris in the riffle zones of freshwater streams. Some are found in the Benthic Zone. Feed on algae and fine detritus (decomposing organic matter).	
Scud	Is usually found in the Reed Zone in still or slow-flowing water. Is tolerant to pollution. It is an omnivore and eats most things that fit in its mouth.	
Seed shrimp	Live in the Benthic Zone. Seed shrimp include thousands of different species. They have a wide range of diets, including carnivores, herbivores, scavengers and filter feeders.	
Segmented worm	Live in the Benthic Zone. Most feed on detritus (decomposing organic matter).	
Freshwater shrimp	Found in the Benthic Zone, often close to the bank, or on rocks or aquatic plants. Very tolerant to pollution. Is a detritivore and mainly eats decomposing vegetation, bacteria and algae. It eats by using the first two pairs of its legs to grab the food and put in its mouth.	
Soldier fly larvae	Feed on algae. Most species are found in still water or the Reed Zone.	
Stonefly larvae	Usually found in the Substrate Zone on stones in the fast-flowing sections of creeks or amongst reeds in slow-moving water. Is very sensitive to pollution. It is a herbivore and eats decaying plant material.	

Water flea	Lives in the Deep Zone. Is a tiny herbivore and eats algae. Unfortunately for it, it is a tasty meal for many aquatic invertebrates.	
Water scavenger beetle	The larvae are predatory while the adults may be herbivores or predators in addition to scavenging by feeding on algae or decaying matter. Many species are able to produce sounds. When its ready to dive underwater, it folds back its antennae, capturing a bubble of air, which is stored as a silvery body covering.	 adult larvae
Water scorpion	Lives in the Reed Zone. Is very tolerant to pollution. It is a carnivore. It has a breathing tube, which it uses like a snorkel, and it has excellent eyesight.	
Water strider	Can run across the surface of water. It lives on ponds and slow-running streams. It rarely goes underwater. The underside of the body is covered with water-repellent hair. Water striders eat small insects that fall on the water's surface and also larvae.	
Water boatman	Common in all types of aquatic habitats in the Deep Zone. Is very tolerant to pollution. It is an omnivore and eats algae and other small invertebrates. It breathes underwater by carrying a bubble of air under its wings.	

Water mites	Is usually found in the Reed Zone amongst plants in sheltered waterways. Is sensitive to pollution. It is a carnivore and feeds on small animals by sucking their juices.	
Whirligig beetle	Lives in the Deep Zone. Is tolerant to pollution. Is a carnivore and likes to eat dead insects, worms and insect larvae. It can take a bubble of oxygen under its wing covers, so when it dives under water it can breathe.	 Above: adult Below: larvae 
Yabby	Lives in the Benthic Zone. Is tolerant to pollution. It is an omnivore and eats both plant and animal matter. It has a hard shell (exoskeleton) which it will shed as it grows.	

Curriculum Links

	Year	Content Description
Science	F	Living things have basic needs, including food and water (ACSSU002)
	1	Living things have a variety of external features (ACSSU017)
	1	Living things live in different places where their needs are met (ACSSU211)
	3	Living things can be grouped together on the basis of observable features and can be distinguished from non-living things (ACSSU044)
	4	Living things, including plants and animals, depend on each other and the environment to survive (ACSSU073)
	5	Living things have structural features and adaptations that help them to survive in their environment (ACSSU043)
	6	The growth and survival of living things are affected by the physical conditions of their environment (ACSSU094)
	7	There are differences within and between groups of organisms; classification helps organise this diversity (ACSSU111)
	7	Water is an important resource that cycles through the environment (ACSSU222)
	Critters Galore also uses Science Inquiry Skills in all year levels, including Questioning and Predicting (predicting whether they think the water quality will be good or bad), Planning and Conducting (using equipment to make observations about macroinvertebrates), Processing and Analysing Data and Information (using the table to represent data and suggesting reasons for their findings), and Communicating (sharing their predictions and results). See ACARA for details.	
Geography	F	The reasons why some places are special to people, and how they can be looked after (ACHGK004)
	1	The natural, managed and constructed features of places, their location, how they change and how they can be cared for (ACHGK005)
	4	The importance of environments to animals and people, and different views on how they can be protected (ACHGK022)
	7	The ways that flows of water connect places as it moves through the environment and the way this affects places (ACHGK038)
	7	The quantity and variability of Australia's water resources compared with those in other continents (ACHGK039)
	8	The human causes and effects of landscape degradation (ACHGK051)
	8	The ways of protecting significant landscapes (ACHGK052)
	Critters Galore also uses Geographical Inquiry and Skills in all year levels, including Observing, questioning and planning; Collecting, recording, evaluating and representing; Communicating; and Reflecting and responding (particularly in relation to proposing individual and collective action). See ACARA for details.	
Maths	2	Collect, check and classify data (ACMSP049)
	2	Create displays of data using lists, table and picture graphs and interpret them (ACMSP050)
	3	Collect data, organise into categories and create displays using lists, tables, picture graphs and simple column graphs, with and without the use of digital technologies (ACMSP069)
	3	Interpret and compare data displays (ACMSP070)
	4	Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095)
	5	Describe and interpret different data sets in context (ACMSP120)

Note 1: curriculum links are not included for Additional Activities. Please refer to ACARA for relevant links if you undertake any of these activities.

Note 2: links can be made to other subject areas including English (Creating texts), Civics and Citizenship (Problem solving and decision making) and Health and Physical Education (Contributing to healthy and active communities). Refer to ACARA.

Note 3: For Cross-curiculum priorities and General capabilities, check the Content Descriptions at ACARA.

Resources

NRM Education Sessions and Resources

Water Watch

Students test water samples from local waterways and make predictions about the water quality. They discuss possible reasons for their results including human activities that can affect water quality and suggest actions to improve water quality.

The River Murray Story

Students listen to a short narrative that tells the story of the River Murray as it travels from its source to the sea with the students playing the part of pollutants. Discuss solutions for preventing water pollution.

A Frog's Life

A Frog's Life is an investigation of local frogs and their features, encouraging students to become involved in monitoring the health of their waterways using frogs as an indicator.

For a copy of these resources (and more) or to book a classroom session please visit www.naturalresources.sa.gov.au/samurraydarlingbasin

Useful Websites

The following websites contain information, resources, activities and interactive games associated with macroinvertebrates, the River Murray, SA waterways and their issues:

SIGNAL 2.iv – A Scoring System for Macroinvertebrates ('Water Bugs') in Australian Rivers: www.environment.gov.au/system/files/resources/a9ad51d4-a8a2-4e21-994d-c6381f7445ee/files/signal.pdf

Murray Darling Basin Authority: www.mdba.gov.au

Fantastic website with a Basin Kids page and lots more!

Save Water: www.savewater.com.au

Useful and practical advice for Australians on how to save water and why.

Save the Murray: www.savethemurray.com.au

Clean up and protect the River Murray and its surrounds.

SA Water: www.sawater.com.au/SAWater/Education/LearningProgram/OnlineRes2.htm

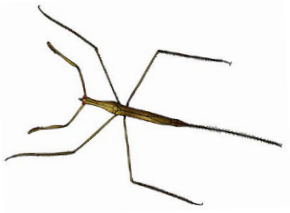
Waterwise fact sheets, student and teacher resources.

Natural Resources SA Murray-Darling Basin: www.naturalresources.sa.gov.au/samurraydarlingbasin/home

Information in relation to drought, drought management, water use efficiency projects and funding opportunities within the SA Murray-Darling Basin NRM Region.

MurrayCare: http://murraycare.org

School and teacher resources on the River Murray.



Resources

Books

- Gooderham J & Tsyrlin E (2002) *The Waterbug Book: A Guide to the Freshwater Macroinvertebrates of Temperate Australia*, CSIRO Publishing.
- Winters B (1998) *Australian Guide to Pondlife*, Gould League of Victoria Inc.

Posters and ID Charts

Macroinvertebrate Identification Chart (best for Early Years - Primary Years)
Macroinvertebrate Identification Chart (best for Primary Years - Middle Years)
Both available from the Natural Resources SAMDB website:
www.naturalresources.sa.gov.au/samurraydarlingbasin/home

CDs

Hodson A (2002) *A Guide to Minibeasts of the Wetland*, Urrbrae Wetland. Ph: 8272 6010
(also available from Natural Resources SAMDB NRM Education)

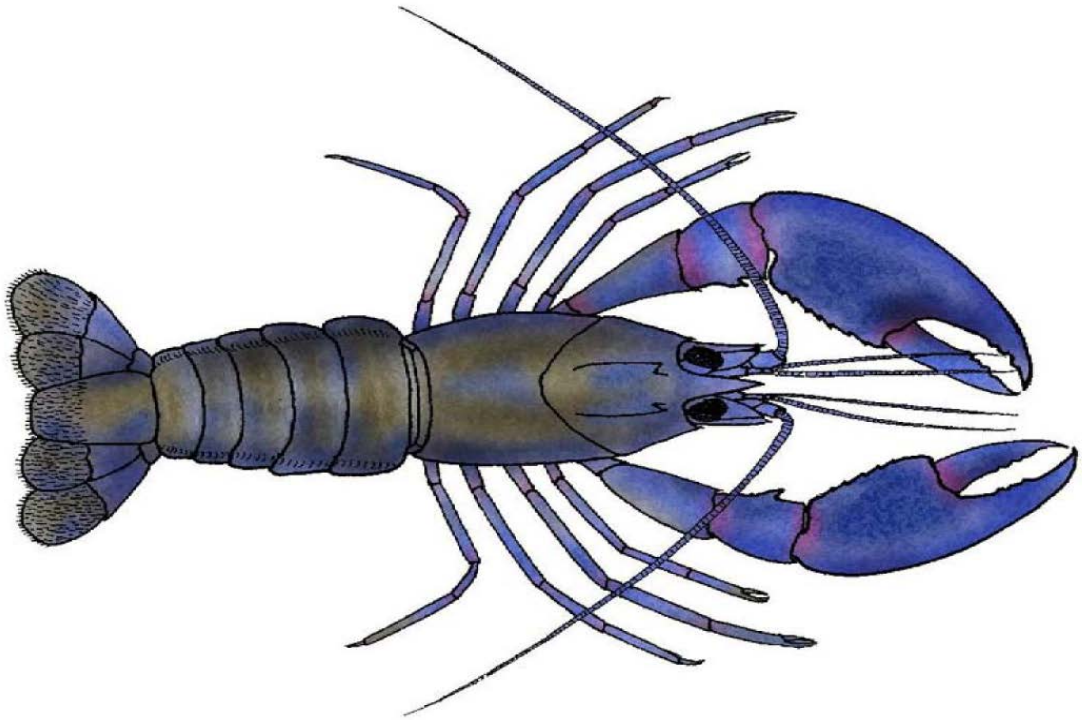
School Water Audit Kit

Produced by River Murray Urban Users Committee and WaterWise South Australia.

Available from libraries or online book shops.

Waterwatch Monitoring Kits

Available to borrow from Natural Resources Centres at Murray Bridge and Berri.




Healthy Wetland/Habitat


Unhealthy Wetland/Habitat

Contact Details

Upper Murray
NRM Education Coordinator
Natural Resources Centre
2 Wade Street
Berri SA 5343
Phone 08 8580 1837
Mobile 0418 822 734
Fax 08 8582 4488

Lower Murray
NRM Education Coordinator
Natural Resources Centre
Mannum Road
Murray Bridge SA 5253
Phone 08 8532 9134
Mobile 0409 693 057
Fax 08 8531 1843