Teacher's notes

The water quality of a river, creek or pond, sometimes called 'ecological health' or 'river health', can be assessed using the presence or absence of the animals that live in water. This is called bioassessment and it gives an indication of how well the water can sustain animal life rather than the levels of chemicals and microbes that are associated with the quality of drinking water for people. Biotic indices are used to numerically represent the 'health' of the water. An easy-to-use biotic index is the SIGNAL index.

SIGNAL is a simple biotic index for macroinvertebrates that uses the pollution tolerance levels of different macroinvertebrate types to create a site score and water quality rating for the river, creek or pond being studied. Waters with high SIGNAL site scores are likely to have high levels of dissolved oxygen with low levels of salinity, turbidity and nutrients (nitrogen, phosphorous). Still waters and slow flowing lowland waters, by nature, will always produce a lower site score because the physical habitat and chemical levels (noted above) are **naturally different**. Few macroinvertebrate types that are rated as very sensitive occur naturally in still waters or slow flowing lowland waters. SIGNAL2 has been developed from data collected from the National River Health Program to produce a scoring system that can be used across Australia.

SIGNAL2 grades and scoring system have been sourced from;

- *New sensitivity grade for Australian river macroinvertebrates*. Chessman, B. (2003) Marine and Freshwater Research 54: 95-103
- *A scoring system for macroinvertebrates ('water bugs') in Australian Rivers: User manual.* Chessman, B. (2003) Monitoring River Health Initiative Technical Report, No. 31
- *The Waterbug Book: A guide to the Freshwater Macroinvertebrates of Temperate Australia.* Gooderham, J. & Tsyrlin, E. (2002) CSIRO Publishing: Australia

To assist with macroinvertebrate identifications, more resources can be downloaded from the online Bug Guide http://www.mdfrc.org.au/bugguide/index.htm

- **Guide to Major Groups** – an overview, with whole animal colour digital imagery, of the descriptive features of the 17 major groups of macroinvertebrates commonly found in live-pick sampling
- **Terminology Images** – a set of 16 files, sorted by major group and order, containing colour digital imagery of whole and part animals labelled with the features that are required for identification when using the taxonomic keys within the Bug Guide

Acknowledgements
Draft versions of this guide were trialled at the Wirramina Environmental Education Centre, Burrumbuttock with the assistance of the Principal of Burrumbuttock Public School, Mr Owen Dunlop. Concepts for the PowerPoint resource files were developed for a Waterwatch Victoria project with the assistance of the previous State Co-ordinator, Sara Johnson (Victorian Regional Resources Project). Layouts were designed by Tiana Johannis Designs.

The Murray-Darling Freshwater Research Centre

Macroinvertebrate Survey

Version 2009.2

Instructions

1. write your group name, water site name and date in the boxes at the bottom of this page
2. place a tick in the green box to the right of the image of each macroinvertebrate you find
3. add up the number of different types of macroinvertebrates and write it in the space for *Total Number of Types*
4. work out which SIGNAL Band had the most number of types and write it in the space for *Dominant SIGNAL Band*
5. add up the SIGNAL grades for each ticked image and write the answer in the space for *Total SIGNAL Grades*
6. divide the *Total SIGNAL Grades* by *Total Number of Types* and write the answer in the space for *Site Score*
7. match the *Site Score* to a rating in the *Water Quality Rating* table below and write the answer in the space for *Site Water Quality Rating*

Date	Name of Group	Name of Water Site

Biodiversity	**Total Number of Types**	
Ecological Health	**Dominant SIGNAL Band**	
	Total SIGNAL Grades	
	Site Score	
	Site Water Quality Rating	

Site Score	Water Quality Rating
>6	healthy habitat
5-6	mild pollution
4-5	moderate pollution
<4	severe pollution

The Murray-Darling Freshwater Research Centre

Definitions

- **Macroinvertebrate:** an animal without a backbone that is visible by eye, without a microscope
- **Biodiversity:** the number of different types of animals living in an area
- **Ecological health:** the ability of an area to sustain animal life; a diverse community of high grade taxa indicates a healthy ecosystem; a community with high numbers of a few low grade taxa indicates a degraded aquatic habitat
- **SIGNAL:** Stream Invertebrate Grade Number Average Level
- **SIGNAL grade:** a number given to each type of macroinvertebrate that indicates its pollution tolerance or intolerance

SIGNAL Grade	Pollution Tolerance
10 – 8	indicates a greater sensitivity to pollution
7 -5	indicates a sensitivity to pollution
4 – 3	indicates a tolerance to pollution
2 -1	indicates a greater tolerance to pollution

- **SIGNAL Site Score:** equals the sum total of the SIGNAL Grades of the different types of macroinvertebrates collected divided by the total number of different types of macroinvertebrates collected
- **Live-pick sampling:** live macroinvertebrates are collected into trays, sorted in to their different types, then returned to the water

The Murray-Darling Freshwater Research Centre

Macroinvertebrate Survey

Version 2009.2

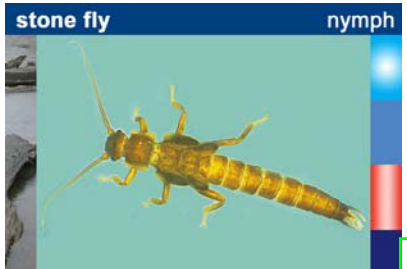
SIGNAL Band: Very Sensitive


beetle — larva
Coleoptera Ptilodactylidae 10


net-winged midge — larva
Diptera Blephariceridae 10

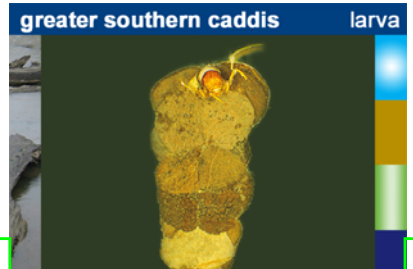

mayfly — nymph
Ephemeroptera Siphlonuridae 10


lesser southern caddis — larva
Trichoptera Helicophidae 10

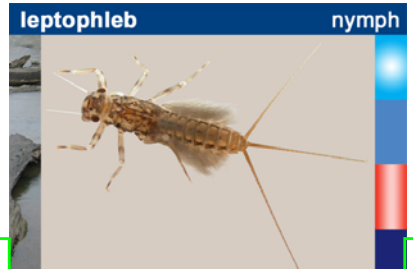

stone fly — nymph
Plecoptera Austroperlidae 10

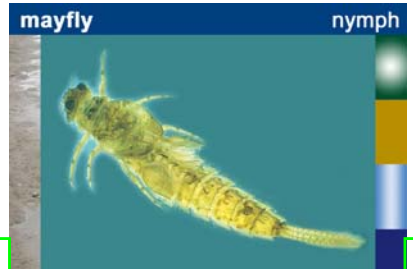

stone fly — nymph
Plecoptera Eustheniidae 10


scorpion fly — larva
Mecoptera Nannochoristidae 9


greater southern caddis — larva
Trichoptera Calocidae 9


glossos — larva
Trichoptera Glossosomatidae 9


leptophleb — nymph
Ephemeroptera Leptophlebiidae 8


mayfly — nymph
Ephemeroptera Oniscigastridae 8


snail-shelled caddis — larva
Trichoptera Helicopsychidae 8

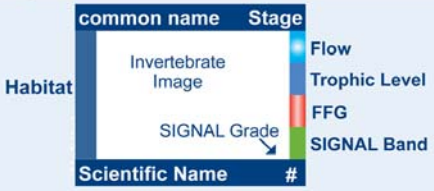

evil claw caddis — larva
Trichoptera Hydrobiosidae 8


archaic caddis — larva
Trichoptera Limnephilidae 8


soft lipped caddis — larva
Trichoptera Philopotamidae 8


cased hunter — larva
Trichoptera Philorheithridae 8

Legend



Habitat
- Fine Substrate (mud, leaf, silt pack)
- Coarse Substrate (snags, rocks, logs)
- Vegetation
- Water Column
- Water Surface

Trophic Level
- Herbivore
- Detritivore
- Carnivore
- Omnivore

Functional Feeding Group (FFG)
- Shredders
- Filtering Collectors
- Gathering Collectors
- Scrapers
- Predators
- Macrophyte Piercers

Flow
- Flowing
- Standing
- Both

SIGNAL Band
- Very Sensitive
- Sensitive
- Tolerant
- Very Tolerant

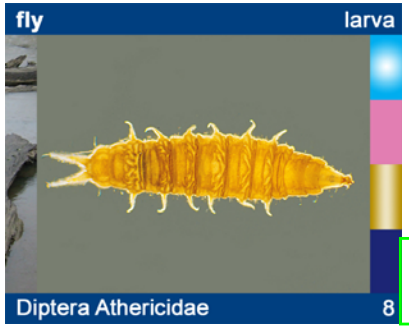
Place a tick in the green box to the right of the image of each animal you find.

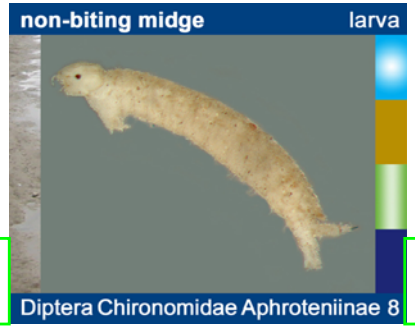
The Murray-Darling Freshwater Research Centre

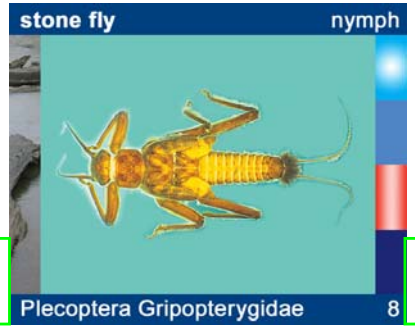
Macroinvertebrate Survey

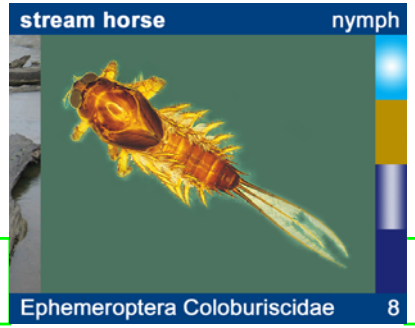
Version 2009.2

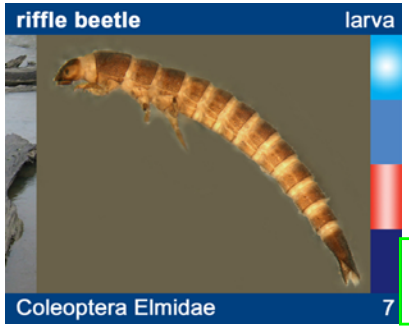
SIGNAL Band: Very Sensitive (continued)

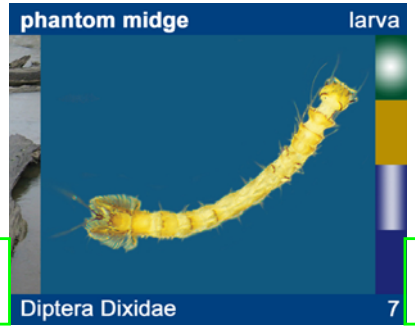


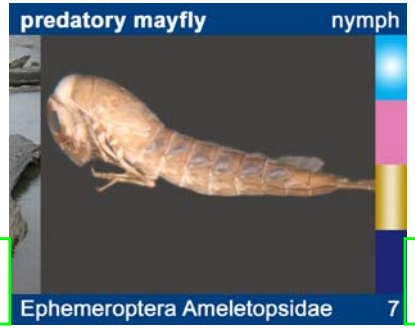


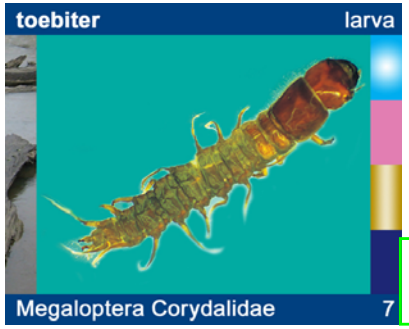


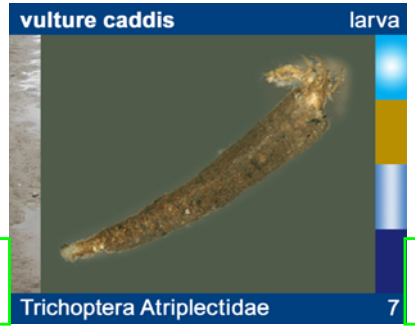


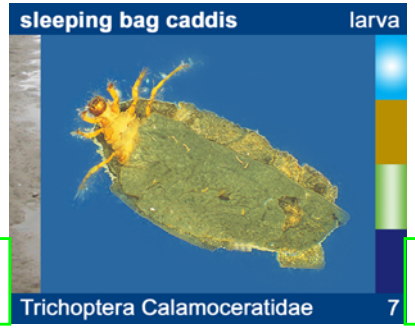


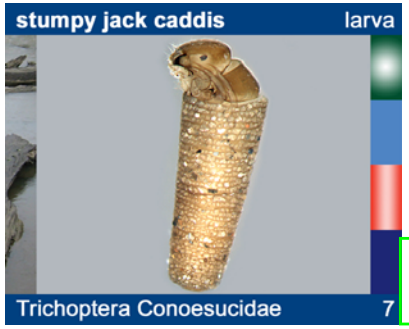


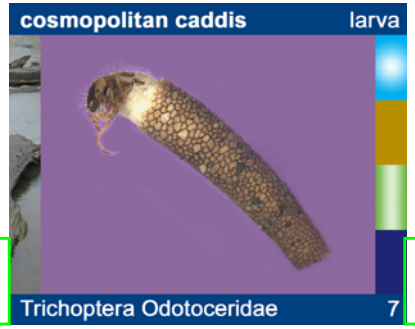


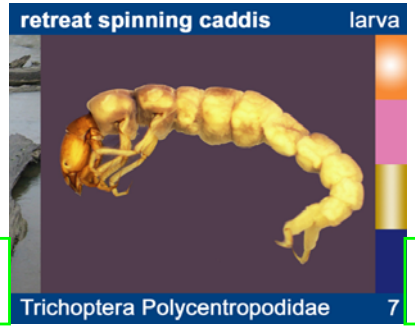


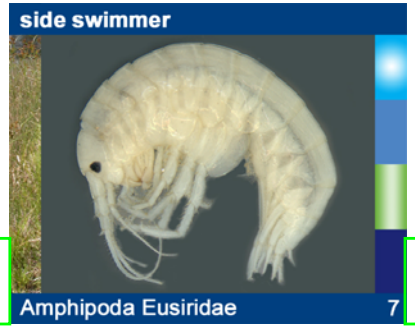












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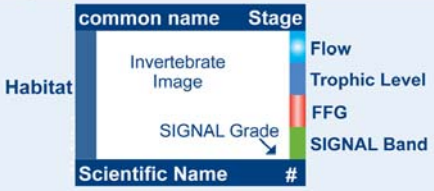

Habitat
- Fine Substrate (mud, leaf, silt pack)
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- Vegetation
- Water Column
- Water Surface

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- Herbivore
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- Omnivore

Functional Feeding Group (FFG)
- Shredders
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- Gathering Collectors
- Scrapers
- Predators
- Macrophyte Piercers

Flow
- Flowing
- Standing
- Both

SIGNAL Band
- Very Sensitive
- Sensitive
- Tolerant
- Very Tolerant

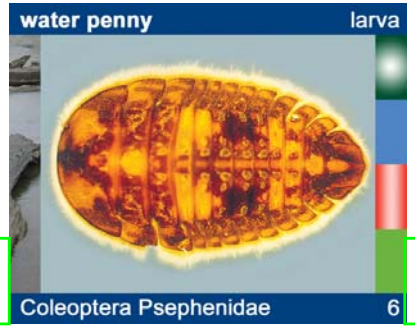
Place a tick in the green box to the right of the image of each animal you find.

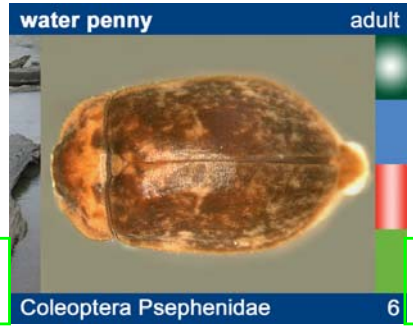
The Murray-Darling Freshwater Research Centre

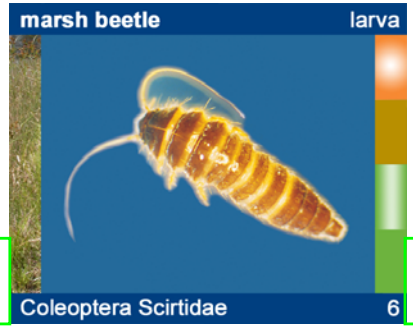
Macroinvertebrate Survey

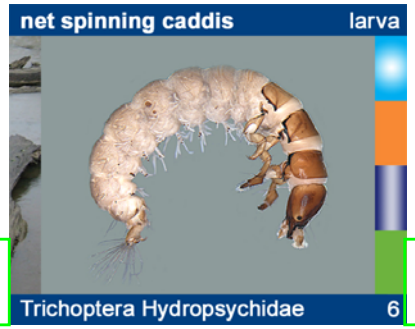
Version 2009.2

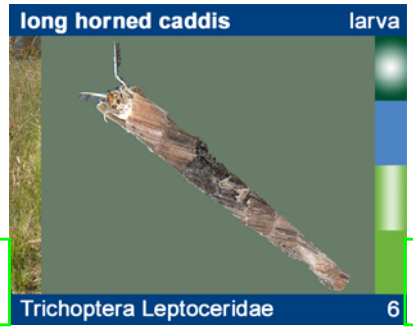
SIGNAL Band: Sensitive

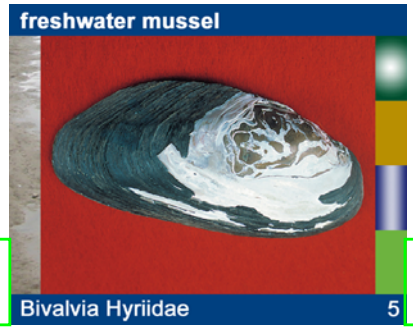


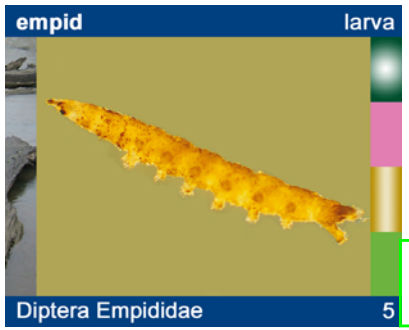


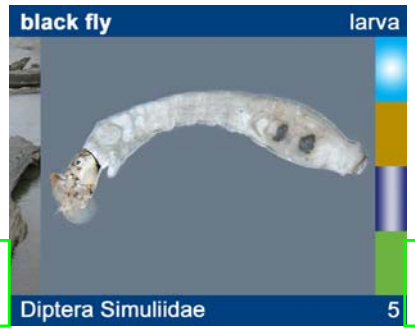


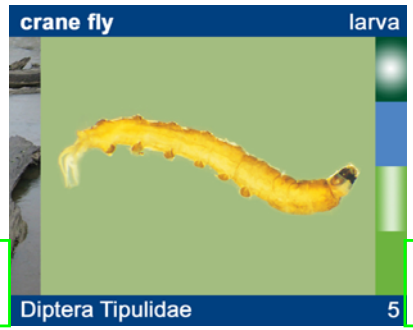


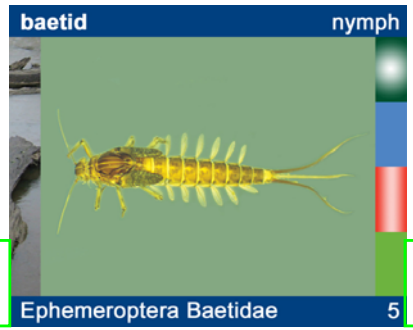


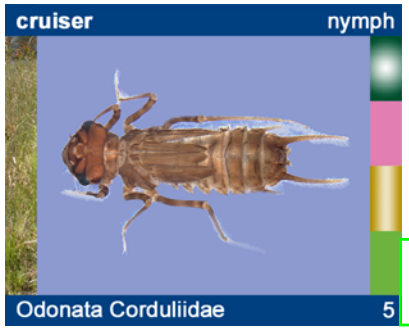


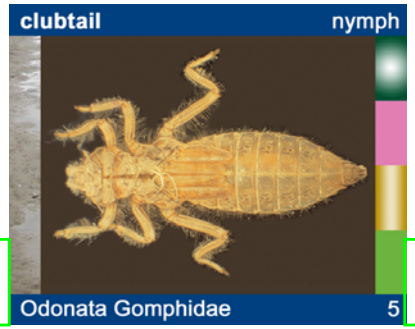


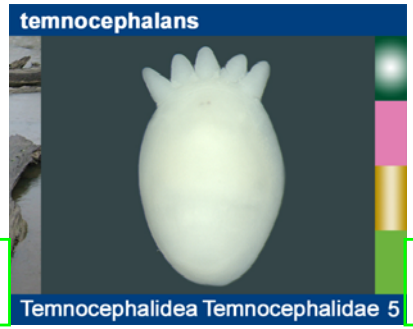




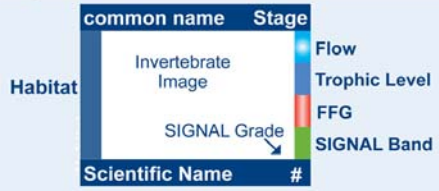








Legend



Habitat
- Fine Substrate (mud, leaf, silt pack)
- Coarse Substrate (snags, rocks, logs)
- Vegetation
- Water Column
- Water Surface

Trophic Level
- Herbivore
- Detritivore
- Carnivore
- Omnivore

Functional Feeding Group (FFG)
- Shredders
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- Predators
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Flow
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SIGNAL Band
- Very Sensitive
- Sensitive
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- Very Tolerant

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The Murray-Darling Freshwater Research Centre

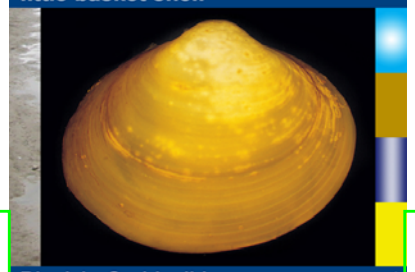
Macroinvertebrate Survey

Version 2009.2

SIGNAL Band: Tolerant

side swimmer

Amphipoda Neoniphargidae 4

little basket shell

Bivalvia Corbiculidae 4

whirligig beetle larva

Coleoptera Gyrinidae 4

whirligig beetle adult

Coleoptera Gyrinidae 4

yabby

Decapoda Parastacidae 4

biting midges larva

Diptera Ceratopogonidae 4

non-biting midge larva

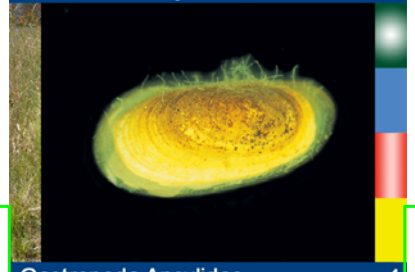
Diptera Chironomidae Orthocladiinae 4

non-biting midge larva

Diptera Chironomidae Tanypodinae 4

caenid nymph

Ephemeroptera Caenidae 4

freshwater limpet

Gastropoda Ancylidae 4

river snail

Gastropoda Hydrobiidae 4

water strider

Hemiptera Gerridae 4

darner nymph

Odonata Aeshnidae 4

walkabout caddis larva

Trichoptera Ecnomidae 4

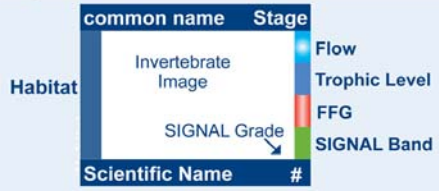
microcaddis larva

Trichoptera Hydroptilidae 4

colonial hydra

Cnidaria Clavidae 3

Legend



Habitat
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Macroinvertebrate Survey

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SIGNAL Band: **Tolerant** (continued)

shrimp

Decapoda Atyidae 3

bloodworms larva

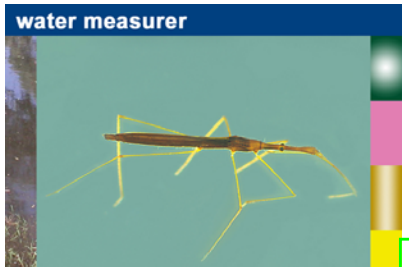
Diptera Chironomidae Chironominae 3

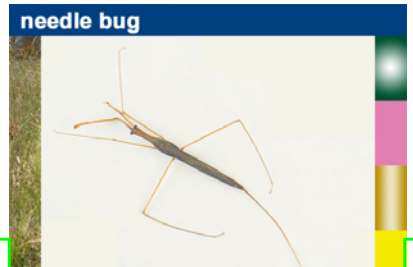
dollie larva

Diptera Dolichopodidae 3

water slater

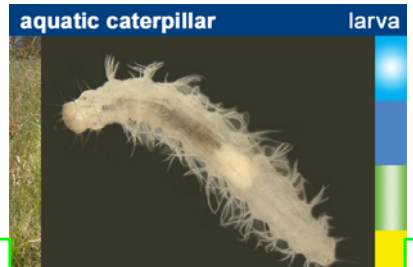
Isopoda Janiridae 3

water measurer

Hemiptera Hydrometridae 3

needle bug

Hemiptera Nepidae 3

small water strider

Hemiptera Veliidae 3

aquatic caterpillar larva

Lepidoptera Pyralidae 3

Place a tick in the green box to the right of the image of each animal you find.

SIGNAL Band: Very Tolerant

side swimmer

Amphipoda Hyalidae (Ceinidae) 2

soldier fly larva

Diptera Stratiomyidae 2

freshwater snail

Gastropoda Planorbidae 2

pond damselfly nymph

Odonata Coenagrionidae 2

The Murray-Darling Freshwater Research Centre

Macroinvertebrate Survey

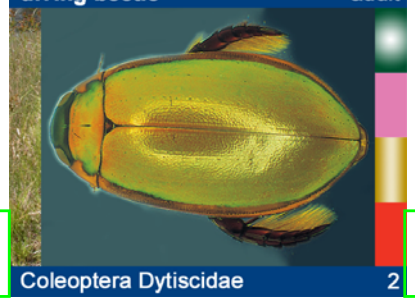
Version 2009.2

SIGNAL Band: Very Tolerant

tiger beetle — larva

Coleoptera Dytiscidae — 2

diving beetle — adult



Coleoptera Dytiscidae — 2

water scavenger beetle — larva

Coleoptera Hydrophilidae — 2

water scavenger beetle — adult

Coleoptera Hydrophilidae — 2

water boatmen

Hemiptera Corixidae — 2

water treader

Hemiptera Mesoveliidae — 2

creeping water bug

Hemiptera Naucoridae — 2

pygmy backswimmer

Hemiptera Pleidae — 2

worm

Oligochaeta — 2

flatworm

Tricladida Dugesiidae — 2

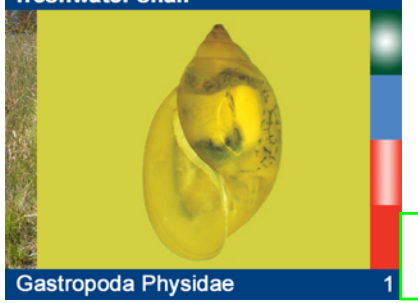
mosquito wriggler — larva

Diptera Culicidae — 1

backswimmer

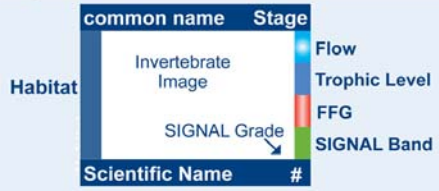
Hemiptera Notonectidae — 1

freshwater snail



Gastropoda Physidae — 1

Legend



Habitat
- Fine Substrate (mud, leaf, silt pack)
- Coarse Substrate (snags, rocks, logs)
- Vegetation
- Water Column
- Water Surface

Trophic Level
- Herbivore
- Detritivore
- Carnivore
- Omnivore

Functional Feeding Group (FFG)
- Shredders
- Filtering Collectors
- Gathering Collectors
- Scrapers
- Predators
- Macrophyte Piercers

Flow
- Flowing
- Standing
- Both

SIGNAL Band
- Very Sensitive
- Sensitive
- Tolerant
- Very Tolerant

Place a tick in the green box to the right of the image of each animal you find.

The Murray-Darling Freshwater Research Centre