Giant Water Bug, *Lethocerus insulanus*

Water Scorpion, *Laccotrophes sp.*


Wandering Percher Dragonfly, *Diplacodes bipunctata.* Image: kookr, Creative Commons, BY, NC.


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Other Queensland Museum online resources that can be used with the *Micro Marvels* kit include: the *Adaptations Teaching Unit* which focuses on *Year 5* of the Australian Science Curriculum; and the *Backyard Explorer Leader’s Guide* and *Backyard Explorer User’s Guide* which are part of the Wild Backyards online resource and covers Year 4 – 9. The Backyard Explorer booklets show how to collect and identify organisms found in your local habitat. All these resources can be found at: http://www.qm.qld.gov.au/Learning+Resources/Resources

This booklet supports several topics within the Australian Science Curriculum.

**Year 6**

**Effects of the Physical Environment**

*The growth and survival of living things are affected by the physical conditions of their environment.*

- investigate how changing physical conditions affect the distribution and survival of organisms.e.g. salinity, pollutants, fertilisers, and water clarity
- research organisms that live in extreme environments such as tidal estuaries

**Year 7**

**Classification**

*There are differences within and between groups of organisms; classification helps organise this diversity.*

- group a variety of organisms on the basis of similarities and differences in particular features
- classify using hierarchical systems which may include: kingdom, phylum, class, order, family, genus, species
- use scientific conventions for naming species
- use provided keys to identify organisms surveyed in a local habitat

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</tr>
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</table>

This booklet was developed by:

Adriana Bauer  
Senior Project Officer (Biodiversity)  
Strategic Learning  
Queensland Museum  
2011
WATERWAYS SURVEY – EFFECTS OF THE PHYSICAL ENVIRONMENT

Visit a local waterway such as a creek or stream and take samples of the water. Information about how to survey local creeks and streams and how to identify macro-invertebrates can be found at the following links:


These resources list: safety measures; the equipment needed; how surveys are done; how to make a stocking dip net; and how to record and analyse data. Remember to return your specimens to the water after they have been viewed.

AQUATIC MACRO-INVERTEBRATES

An invertebrate is an animal that does not have a backbone. Macro-invertebrates are animals that can be seen with the naked eye. That is, a microscope is not needed to see them. However, the digital microscope in the Micro Marvels kit and hand lenses can be used to view their features and adaptations in more detail, and to help with their identification. Still images can be captured as well as video segments.

Some examples of macro-invertebrates include insects, worms, snails, crayfish and spiders. The larval stages of many insects are found in creeks, rivers and streams. The type of animals found in waterways gives an indication of water quality. Some larvae are sensitive which means they are found only in areas with good to excellent water condition. Others are more tolerant of pollutants and so can be found in poorer quality water.

Firstly, take water samples from different parts of the creek or from different creeks in your local area. Record some of the abiotic (physical) conditions of these different areas. These abiotic factors may affect the types of animals and plants found there.

(Some tests rely on access to chemicals and laboratory equipment. However, there are many that students in upper primary schools are able to perform without the need for specialised equipment.)

A BIOTIC FACTORS

Dissolved Oxygen (DO)

DO is the small amount of oxygen that is dissolved in the water. It is also a useful general indicator of water quality. It can indicate the presence of certain pollutants, particularly organic matter e.g. fallen leaves, animal manure, sewage effluent. It can be measured in mg/L or as per cent saturation (% sat)

DO is affected by

1. **How fast the oxygen can get into the water** - this depends on: the agitation at the water surface; the rate at which the water mixes; and the depth. Therefore stagnant or deeper pools may have reduced oxygen levels in their deeper layers.
2. **How fast the oxygen is used up** in respiration by animals, plants and bacteria. Generally, the more organic matter, the lower the oxygen levels.
3. **Photosynthesis by plants & algae** releases large amounts of oxygen. Peak oxygen levels occur in the early afternoon and minimum levels just before sunrise.
4. **Flow Variations** - the lower the rate of flow, the lower the oxygen levels are likely to be.
5. **Temperature** - warmer water cannot hold as much oxygen as cooler water.

**Temperature**

* Temperature influences the amount of dissolved oxygen.
* Temperature influences the rate of photosynthesis as warmer temperatures increase the rate of photosynthesis in plants.
* Temperature influences the sensitivity organisms to toxic wastes, parasites & disease as in warmer temperatures these organisms become less resistant to these stresses.
* Temperature varies according to the water body. e.g. sub-artesian may be cool & artesian bores may contain boiling water.

Use a thermometer to measure the air and water temperature at your different locations. Try to take readings from the surface of the water; at a depth of about 30 cm; and, at the bottom of the creek.
Turbidity
Turbidity affects how far you can see, and therefore how far light can penetrate in the water. This is the result of suspended solids and is a relative measure of the clarity of the water. The greater the turbidity, the murkier the water. High turbidity reduces the transmission of light and therefore affects the photosynthetic rate of plants.

Soil type affects turbidity as clay soils release more suspended solids into the water. Heavy rainfall and flooding can stir up the water and increase turbidity levels too. To measure turbidity, a Secchi disc can be used.

Salinity
This is a measure of the amount of salt dissolved in the water. e.g. NaCl (sodium chloride), CaCO₃ (calcium carbonate).

It can be measured using total dissolved salts (TDS) or using electrical conductivity (EC). For TDS a specific quantity of water is filtered, then evaporated, and the salts left behind are weighed. The greater the weight, the more saline or salty is the water. For EC, a special conductivity probe is needed.

pH
This is a measure of how acidic or alkaline the water is on a scale of 1 – 14:
1 - 6 is acidic 7 is neutral 7 - 14 is basic.

pH can be measured very simply using pH paper and checking the colour against a chart. Alternatively, pH probes can be used.

pH may change over the 24 hour period as plants remove CO₂ from the water during photosynthesis. (When carbon dioxide dissolves in water, the water becomes slightly acidic.) Therefore the highest pH is usually in mid-afternoon.

Measure and record the pH of the water in the different sample locations.

Pollution
The main kinds of pollutants are chemical effluents such as pesticides, detergents, oil, plastic, paper, and fertilisers that may create algal blooms.

Ammonia is one product formed when plant or animal protein and faeces decay. It is also formed when urine decomposes. Therefore the presence of ammonia in water may indicate that sewage is entering the water. Many fertilisers used in agriculture contain compounds of ammonia. Therefore, water run-off from farms can also cause an increase in the content of ammonia. If the ammonia content becomes high, animal and plant life can be destroyed. It is therefore undesirable to have any ammonia present in the water. If ammonia is present, yellow turmeric paper will change to a reddish-brown colour.

Sulphates occur naturally and are often present in small amount in natural waters. They may be formed when organic matter containing sulphur breaks down. Sulphate compounds such as sulphuric acid are used in industry. These may be discharged into rivers or lakes and this will artificially increase the sulphate level in the water. Sulphates are left over from many of the detergents people use and this can be another cause for an increase in sulphate content.

BIOTIC FACTORS
Plants & animals (biotic factors) are affected by the abiotics of their environment. Plants growing along the banks and up to 20-30 metres from the bank make up the riparian vegetation and serve an important purpose in reducing erosion close to the water’s edge. This also reduces turbidity. Plants provide food and shelter for many animals. Riparian vegetation also reduces the light intensity near the banks and provides shade that lowers water temperature.

What special adaptations would plants need to survive in a fast-flowing creek or river?
What adaptations would animals need in order to survive in the same situation?
What adaptations would they need for the following?
• movement
• respiration
• feeding

To help answer these questions, collect specimens to view in more detail. Keep a record of where they were collected. Later you can see if any relationships exist between the types of organisms found and the abiotic factors in their environment.
Equipment:
- aquarium nets or home-made plankton nets
- white ice-cream containers
- jars with screw top lids
- Petri dish or shallow tray
- hand lens and/or digital microscope

To collect specimens use an aquarium net or make your own Plankton nets. You will need an old broom handle or piece of dowelling, a metal hoop or bent wire coat hanger, some old stocking or panty-hose, and a needle and thread.

Sample the water around the vegetation close to the creek bank and also near the bottom (to reveal benthic organisms). Pour the specimens into a large, white ice-cream bucket for viewing at the site. Smaller specimens can be put into screw top jars for more detailed examination.

Pour these smaller specimens into a shallow tray or Petri dish. Examine these with a hand lens. You can also examine them using a laptop and the digital microscope in the Micro Marvels kit. Once viewed, return the specimens to their container and release them back into the location where they were collected. (Do not allow any part of the microscope to touch water. Use the stackable spacers to give the required viewing distance between the specimen and the lens.)

Some examples of animals that may be found in your local waterways are given below. Beside each is an indication of the quality of the water that they require. Some animals are particularly sensitive to water quality. The kit contains a slide of some insect larvae. This can be viewed in the classroom and compared with samples from your survey.

<table>
<thead>
<tr>
<th>Water Quality Rating</th>
<th>Examples of Macro-Invertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Very Sensitive animals:</td>
</tr>
<tr>
<td></td>
<td>Stonefly nymphs</td>
</tr>
<tr>
<td></td>
<td>Mayfly nymphs</td>
</tr>
<tr>
<td></td>
<td>Freshwater shrimps</td>
</tr>
<tr>
<td>Good</td>
<td>Sensitive animals:</td>
</tr>
<tr>
<td></td>
<td>Mussels</td>
</tr>
<tr>
<td></td>
<td>Freshwater prawns</td>
</tr>
<tr>
<td></td>
<td>Freshwater crayfish</td>
</tr>
<tr>
<td></td>
<td>Dragonfly nymphs</td>
</tr>
<tr>
<td></td>
<td>Damselfly nymphs</td>
</tr>
<tr>
<td></td>
<td>Caddis fly nymphs</td>
</tr>
<tr>
<td></td>
<td>Water mites</td>
</tr>
<tr>
<td>Fair</td>
<td>Tolerant animals:</td>
</tr>
<tr>
<td></td>
<td>Beetles</td>
</tr>
<tr>
<td></td>
<td>True bugs</td>
</tr>
<tr>
<td></td>
<td>Leeches</td>
</tr>
<tr>
<td></td>
<td>Freshwater snails</td>
</tr>
<tr>
<td></td>
<td>Flatworms</td>
</tr>
<tr>
<td>Poor</td>
<td>Very Tolerant animals:</td>
</tr>
<tr>
<td></td>
<td>Black fly larvae</td>
</tr>
<tr>
<td></td>
<td>Mosquito larvae</td>
</tr>
<tr>
<td></td>
<td>Fly larvae</td>
</tr>
<tr>
<td></td>
<td>Non-biting midges</td>
</tr>
<tr>
<td></td>
<td>Freshwater worms</td>
</tr>
</tbody>
</table>

Biological assessments include identifying the animals that live in and along waterways.

Chemical tests can be performed to record the abiotic (physical) conditions at each survey site. Such tests often include: temperature, salinity, pH, turbidity, dissolved oxygen, and nitrogen and phosphorous levels.

Habitat assessments involve surveying the types of plants that live along the waterway and the stability of the stream banks.

All these tests give an indication of the health of a waterway.

Students can select one of the organisms found in their sample and research how it is able to live in its environment. i.e. investigate its adaptations and the physical conditions that affect its survival. Compare this to the abiotic data that you collected.
CLASSIFICATION

Organisms are grouped into categories for ease of communicating amongst scientists and the general public. Organisms grouped into a category also share similar features.

The broadest grouping of organisms is at the Kingdom level. There are six Kingdoms:

1. **Archaeabacteria** - the Archaea bacteria; primitive bacteria or prokaryotes that have DNA sequences different from other bacteria.
2. **Eubacteria** - true bacteria and cyanobacteria.
3. **Protista** - single-celled organisms such as algae and Protozoans.
4. **Fungi** - uni-cellular and multicellular fungi, yeasts and moulds.
5. **Plantae** - multicellular plants.
6. **Animalia** - multicellular animals.

At the most specific level is the **Species**. Similar species are grouped into the same genus. Similar general are grouped into the same family and so on.

Therefore the levels of classification from most different to most alike are:

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Phylum</th>
<th>Class</th>
<th>Order</th>
<th>Family</th>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least alike</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most alike</td>
</tr>
</tbody>
</table>

(Memory jingle to help remember the sequence: **Kings Play Chess On Funny Green Squares**)

One of these groups is the **Vertebrates** (Phylum Chordata, Sub-phylum Vertebrata).

Many features are used to classify animals. The type of external covering is one of many features used to separate vertebrates into different classes: Fish; Amphibians; Reptiles; Birds; and Mammals.

Student can use the digital microscope to look more closely at the specimens in the **Coverings** box and examine the differences between fish and snake scales.

Reptilian scales are made of keratin, like hair, and are found in an overlapping arrangement. This creates a sort of environmental shield. Snakes have special elongated scales on their belly to help them crawl and climb. Some reptilian scales are modified into sharp spines or have bony plates under their scales (called osteoderms) for extra protection. Scales can be found in many colours to aid in camouflage and warning colouration (to serve as a warning to other organisms of their venomous nature.)

Fish scales are smooth to help them glide through the water. Some reflect light to aid in camouflage underwater. Unlike reptiles, the scales of bony fish are made of enamel and dentine (like teeth) and they can be detached individually from the skin. The scales overlap to protect the fish and provide greater flexibility. There are different types of fish scales that give different patterns. Some are: Cycloid; Ganoid; and Placoid scales. Student may like to investigate these further and draw what the snake skin and fish skin look like when magnified (30x lens.)

Animals that do not have a notochord or one that develops into a vertebral column (backbone) are called invertebrates.

**Invertebrates** include many phyla such as:

- Phylum Arthropoda (insects, spiders, mites, ticks, scorpions, centipedes and millipedes, crustaceans, barnacles and slaters)
- Phylum Mollusca (mainly shelled animals such as snails, slugs, chitons, oysters, mussels, squid and octopi)
- Phylum Echinodermata (spiny-skinned animals such as starfish, sea urchins, brittle stars and sea cucumbers)
- Phylum Nematoda (roundworms many or which are found in the soil; some are parasitic)
- Phylum Annelida (segmented worms such as earthworms, marine worms and leeches)
- Phylum Platylhelminthes (flat worms, many of which are parasites like flukes and tapeworms)
- Phylum Porifera (sponges)
- Phylum Cnidaria (sea anemones, hydroids, jellyfish, soft and hard corals)

Students can examine the specimens in the **Invertebrates** box of the **Micro Marvels** kit and complete the classification activities.
The *Micro Marvels* kit contains a tray of insects (*Insect Classification Tray*) that contains insects that have been classified down to Order level.

Students may like to collect some invertebrates and insect specimens and try to classify them using the CSIRO online interactive key which can be accessed at


To help with classifying insects, students can get some hints from Dr Christine Lambkin when viewing the video *Hints on Identifying Insects* available on Queensland Museums’ website at


Student that would like to make permanent displays of their insects can get some tips from Noel Starick when viewing the video *Displaying Insects* available on Queensland Museum’s website at


**ADAPTATIONS**

The Adaptations Teaching Unit may also be useful for this topic. The booklet is available to download from


It focuses on Year 5 of the Australian Science Curriculum.

Adaptations increase an organism’s chances of survival. They can be *structural* (physical features); *functional* (how their body works); *behavioural* (what they do); or *reproductive* (how they reproduce).

Students can examine the specimens embedded in the *resin block* of the *Micro Marvels* kit. This contains insect *mouthparts* adapted for chewing and sucking; and insect *legs* adapted for running, jumping, grasping, digging, and swimming.

In the small container in the kit there are permanent *microscope slides* of a *freshwater mite* and a *brine shrimp*. There is a temporary mount of some *mosquito larvae*. These slides can be examined using the digital microscope in the kit or powerful hand lenses. Care needs to be taken in handling microscope slides which are fragile. It is recommended that teachers set these up for student use.

Students can make their own temporary mounts by collecting small insect larvae. e.g. mosquito wrigglers. The specimen can be placed on a microscope slide using an eye dropper and then left to dry. A drop of nail polish remover can be added, then several drops of clear nail polish added to completely cover the specimen. A coverslip is placed then over the top. The nail polish will set and the coverslip will adhere to the slide. These slides will keep for several weeks but will become discoloured over time. Slightly larger specimens may need cavity microscope slides. If specimens are more than approximately 1-1.5 millimetres thick, they are probably too large to mount on slides.

Students can also examine the adaptations shown by the different stages in an insect life cycle. Raising mosquito larvae (wrigglers) is fairly easy and instructions for this are at the following link:


This worksheet also looks at the effect of physical conditions on the survival of mosquito wrigglers and so can be used with Year 6 of the Australian Science Curriculum.
STUDENT WORKSHEETS

ABIOTIC FACTORS

DISSOLVED OXYGEN

Aim: To measure the amount of dissolved oxygen in a water sample.

Materials:
- jars with lids to collect water samples
- 250 ml measuring cup or beaker or measuring cylinder
- methylene blue in a dropper bottle
- glass rod or spoon
- oxygen-removing solution in a dropper bottle (50g/L of sodium dithionite [hydrosulphite], prepared just before using)

Method:
1. Measure 200 ml of your water sample
2. Add 3 drops of methylene blue to the water and stir gently with a stirring rod or spoon
3. While stirring, add a drop at a time of oxygen-removing solution until the blue colour just disappears.
4. Record the number of drops you added. This gives you a measure of the amount of dissolved oxygen in the water. The greater the number of drops, the more oxygen in the water sample.
5. Wash out the beaker and take another 200 ml of water from another sample location.
6. Repeat the steps above with other water samples.

Draw a graph of the data below. Put Temperature (independent variable) on the horizontal axis and Dissolved Oxygen (measured or dependent variable) on the vertical axis.

<table>
<thead>
<tr>
<th>Temp. (°C)</th>
<th>Vol. Of Dissolved Oxygen (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>13.5</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>20</td>
<td>9.5</td>
</tr>
<tr>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>35</td>
<td>6.5</td>
</tr>
<tr>
<td>40</td>
<td>5.5</td>
</tr>
</tbody>
</table>

What happens to the amount of dissolved oxygen as the temperature increases? How would this affect organisms in the creek?

SALINITY

Using the TDS (total dissolved solids) method to compare salinity: filter the creek water and collect 100 ml of the filtrate; leave in a shallow tray until all the water has evaporated; place the salts on a piece of filter paper and weigh using electronic scales. (Remember to subtract the weight of the filter paper to find the TDS.)

TEMPERATURE and pH

Use a thermometer to measure the air temperature and the water temperature at the different locations in your study area.

Use pH paper or a probe to measure the pH of the water the different locations in your study area.

Note
1 - 6 is acidic    7 is neutral    7 - 14 is basic
TURBIDITY

**Aim:** To measure the turbidity of the water in the creek using a Secchi disc.

**Materials:**
- tin lid of a food can (e.g. spaghetti or baked beans can) without sharp edges
- black and white paint
- paint brush
- nail and hammer (to make holes in the tin lid)
- string or fishing line
- metre ruler

**Method:**
1. Colour alternate quarters of a tin lid black and white. Leave to dry.
2. Make 3 holes spaced equidistantly around the circumference of the tin lid. (A teacher or adult should use the nail and hammer to pierce holes in the tin lid.)
3. Tie string or fishing line to the disc by attaching it to the 3 holes. Join the three pieces together at a distance of approximately one metre.
4. Lower the Secchi disc into the water and record the depth (using the metre ruler) at which you can no longer clearly see the black and white markings on the disc. The greater the distance recorded the clearer and therefore less turbid is the water.
5. Repeat this procedure at other sampling locations.

TEST FOR POLLUTANTS

**Ammonia**

**Aim:** To test for the presence of ammonia in the water sample.

**Materials:**
- strips of paper (normal photocopy paper is fine)
- turmeric (this is a type of spice available in most grocery stores)
- water

**Method:**
1. Make up a solution of turmeric in water so that the water is a yellow colour.
2. Dip a piece of paper in the turmeric water. Allow to dry completely.
3. Dip the turmeric paper into the water samples.
4. Note the colour of the paper. A change in colour to reddish-brown indicates the presence of ammonia.
5. Record your results for each sampling point.

**Sulphates**

**Aim:** To test for the presence of sulphate in the water samples.

**Materials:**
- barium chloride powder
- electronic scales
- distilled water
- measuring cylinder
- 250ml beaker
- filter funnel filter paper
- test tubes
- 1ml pipette

**Method:**
1. Measure 2 grams of barium chloride into a 250 ml beaker.
2. Add 100 ml distilled water and stir until dissolved.
3. Pour into a clean bottle and place a stopper in the top. Label ‘Barium Chloride Solution’.
4. Measure 5 ml of filtered water sample with a measuring cylinder and put this in the first test tube.
5. Put another 5 ml into the second test tube. This is the control set-up.
6. To the first test tube add 1 ml of barium chloride solution using the pipette and mix it with the water.
7. Compare the two tubes. Any cloudiness in the first tube indicates the presence of sulphate ions. The cloudier the solution, the more sulphate is present. A large quantity of white solid is an indication that pollution with sulphate has occurred.
8. Record your results at different sampling points.
### SUMMARY OF ABIOTIC DATA

<table>
<thead>
<tr>
<th>LOCALITY</th>
<th>Dissolved Oxygen (DO)</th>
<th>Temperature (ºC)</th>
<th>Turbidity</th>
<th>pH</th>
<th>Salinity</th>
<th>Ammonia</th>
<th>Sulphates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amongst bank vegetation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Stream bed close to bank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stream bed further out</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### BIOTIC DATA

See the tables on the next two pages to help you identify the specimens found in your survey.

<table>
<thead>
<tr>
<th>LOCALITY</th>
<th>SPECIMENS FOUND</th>
<th>WATER QUALITY RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amongst bank vegetation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Stream bed close to bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stream bed further out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
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<tr>
<td>5.</td>
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</tbody>
</table>

Select one of the organisms found in your sample and research how it is able to live in its environment. i.e. investigate its adaptations and the physical conditions that affect its survival. Compare this to the abiotic data that you collected.
Benthic Macro-Invertebrate Assessment Key

Water quality assessment information courtesy of Queensland Department of Natural Resources and Mines.

<table>
<thead>
<tr>
<th>Water Quality Rating</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent 4</td>
<td>Very sensitive animals</td>
</tr>
<tr>
<td></td>
<td>Stonefly nymphs</td>
</tr>
<tr>
<td></td>
<td>Mayfly nymphs</td>
</tr>
<tr>
<td></td>
<td>Freshwater shrimps</td>
</tr>
<tr>
<td>Good 3</td>
<td>Sensitive animals</td>
</tr>
<tr>
<td></td>
<td>Mussels</td>
</tr>
<tr>
<td></td>
<td>Freshwater prawns</td>
</tr>
<tr>
<td></td>
<td>Freshwater crayfish</td>
</tr>
<tr>
<td></td>
<td>Dragonfly nymphs</td>
</tr>
<tr>
<td></td>
<td>Damsel fly nymphs</td>
</tr>
<tr>
<td></td>
<td>Caddis fly nymphs</td>
</tr>
<tr>
<td></td>
<td>Water mites</td>
</tr>
<tr>
<td></td>
<td>Tolerant animals</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
<td>Beetles</td>
</tr>
<tr>
<td></td>
<td>True bugs</td>
</tr>
<tr>
<td></td>
<td>Leech</td>
</tr>
<tr>
<td></td>
<td>Freshwater snail</td>
</tr>
<tr>
<td></td>
<td>Flatworm</td>
</tr>
</tbody>
</table>

CLASSIFICATION

MATCHING ACTIVITY

Examine the specimens in the Animal Coverings box of the Micro Marvels kit.
Match each animal and class on the left, with the type of body covering on the right. Draw a line to connect each.

Bird (Class Aves) exoskeleton

Wombat (Class Mammalia) skin covered with similar-sized, separate scales

Snake (Class Reptilia) feathers

Fish (Class Pisces) hair or fur

Cicada (Class Insecta) dry skin; scales of different sizes and shapes, and forming a single, continuous layer

List and describe some exceptions to the above. i.e. are there any of that class that do not have the body covering suggested. Think of both terrestrial (land) and aquatic (freshwater and marine) examples.

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Further Investigation

Research each of the five classes of vertebrates and complete the table below. There may be some exceptions but record data for the majority of animals in each class.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Classes of Vertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pisces (Fish)</td>
</tr>
<tr>
<td></td>
<td>Amphibia (Frogs, Toads and Salamanders)</td>
</tr>
<tr>
<td></td>
<td>Reptilia (Snakes, lizards, turtles, crocodiles)</td>
</tr>
<tr>
<td></td>
<td>Aves (Birds)</td>
</tr>
<tr>
<td></td>
<td>Mammalia (Mammals)</td>
</tr>
<tr>
<td>Feature</td>
<td>Classes of Vertebrates</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>Pisces (Fish)</td>
</tr>
<tr>
<td>Reproduction</td>
<td></td>
</tr>
<tr>
<td>(shell-less eggs, shelled eggs, live birth)</td>
<td></td>
</tr>
<tr>
<td>Fertilisation</td>
<td></td>
</tr>
<tr>
<td>(External or internal)</td>
<td></td>
</tr>
<tr>
<td>Number of heart chambers</td>
<td></td>
</tr>
<tr>
<td>Habitats</td>
<td></td>
</tr>
</tbody>
</table>

Discuss any exceptions to what you have written above. Note these in your science journals.

Note: Reptile scales are made of keratin and are not detachable; bony fish scales are made of enamel and dentine and detach individually from the skin.

Examine the specimens in the Invertebrates box of the Micro Marvels kit. Use the dichotomous key on the next page to identify each specimen in the kit. In some cases only part of the animal may be seen in the specimen. For example, as well as a shell, snails have a slimy muscular body; as well as the hard chalk-like structure, corals have tiny polyps that stick out of their hard, external covering.

Collect additional specimens from the school grounds and identify them too.
## SORTING ACTIVITY

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Features selected from the key</th>
<th>Animal Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea Star</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venus clam</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THE ANIMAL KINGDOM

Macroscopic (can be seen without a microscope)

Internal Skeleton

VERTEBRATES

‘Cold-blooded’ or changing body temperature

Feathers

Hair/Fur

No internal Skeleton

INVERTEBRATES

‘Warm-blooded’ or fairly constant body temperature

No jointed legs

Jointed legs

Microscopic (can’t be seen without a microscope)

MICROSCOPIC ANIMALS

External fertilisation or fertilisation in a watery medium

MAMMALS

(e.g. humans, possums, dolphins, whales)

Internal fertilisation and no water required for fertilisation

AVES

(e.g. birds)

Soft body usually with a shell or spiny skin

Soft body without a shell or spiny skin

ARTHROPODS

(e.g. insects, crabs, spiders, scorpions, millipedes)

Usually with one or two shells or can be shell-less

Spiny outer skin

MOUSCUS

(e.g. snails, oysters, mussels, slugs, squid and octopus)

ECHINODERMS

(e.g. starfish, sea urchins, sea cucumbers, feather stars)

WORMS

(e.g. earthworms, roundworms and flatworms)

Body is tubular and bilaterally symmetrical usually with a mouth and anus

Cnidarians

(e.g. jellyfish, sea anemones, hydroids, soft and hard corals)

Poriferans

(e.g. sponges)

Body is not tubular and the gut has only one opening or is absent

Gut has only one opening

Gut is absent

AMPHIBIANS

(e.g. frog and toads)

FISH

(e.g. bony fish, sharks and rays)

REPTILES

(e.g. snakes, lizards, crocodiles and turtles)

Moist, smooth skin

Moist, scaly skin

External fertilisation or fertilisation in a watery medium

Internal fertilisation and no water required for fertilisation

Soft body usually with a shell or spiny skin

Soft body without a shell or spiny skin

Body is tubular and bilaterally symmetrical usually with a mouth and anus

Body is not tubular and the gut has only one opening or is absent

Gut has only one opening

Gut is absent

Cnidarians

(e.g. jellyfish, sea anemones, hydroids, soft and hard corals)

Poriferans

(e.g. sponges)
INSECT ADAPTATIONS & IDENTIFICATION ACTIVITY

Before you try to identify your insect, observe the insect and research features about insects in general. Answer the following questions in your science journals.

Explore:

1. What is the exoskeleton of an insect made from and how does this help it to survive in a land habitat?
2. What happens when an insect grows too large for its exoskeleton?
3. Investigate how insects eat their food. How are their mouthparts different from ours?
   Examine the mouthparts of your insect specimens. Mouthparts can be biting, piercing or sucking. What do you think the animal eats? (i.e. leaves, sap or nectar, other animals etc). What features help you to make this suggestion?
4. Do insects have lungs? Investigate how they breathe?
5. How are beetle wings different from those of a fly or wasp?
6. Examine each insect and note the compound eyes and number and type of wings.
   a. Are there one pair or two pairs of wings?
   b. Are the wings the same texture? i.e. are the wings see-through (membranous or transparent) or is there one pair that is hardened or partially hardened, and the other pair membranous?
   c. Do the wings have fine hairs or fur on them?
   d. Examine the mouthparts. Does the insect have a long sucking tube, a coiled tube or short biting mouthparts? What do you think it eats?
   e. Look at the rear end of the insect. Is there a pair of short ‘prongs’ (called cerci) sticking out of its abdomen?
7. Draw and label your specimen.

Explain:

1. Complete the data table on the next page by looking at each feature you have labelled and stating how it helps the organism to live and meet its needs.
2. How do some of these features help it to live in its environment?
3. Now connect to the internet and type in the URL for the on-line interactive key
   and see if you can identify what type of insect you have. Check with your teacher.

Elaborate:

Identifying insects can be very important. Find out how Fire Ants are different from our native ant and how scientists recognise them. Insects such as mosquitoes transmit diseases like malaria, dengue fever, yellow fever and many others. Investigate how these mosquitoes do this and how we may prevent the spread of these diseases.
<table>
<thead>
<tr>
<th>SPECIMEN</th>
<th>FEATURES</th>
<th>ADAPTATIONS</th>
<th>SKETCH</th>
<th>CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grasshopper</td>
<td>- Enlarged hind legs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Praying Mantis</td>
<td>- Grasping forelegs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Stick Insect</td>
<td>- Long, thin legs and body</td>
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</tbody>
</table>
Collect and identify some of the following Insects

Helpful sites found at:

<table>
<thead>
<tr>
<th>Common name</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Preying Mantis</td>
<td></td>
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<tr>
<td>2 Butterfly</td>
<td></td>
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<td>3 Moth</td>
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<tr>
<td>4 Ant</td>
<td></td>
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<tr>
<td>5 Weevil (Beetle)</td>
<td></td>
</tr>
<tr>
<td>6 Cockroach</td>
<td></td>
</tr>
<tr>
<td>7 Dragonfly</td>
<td></td>
</tr>
<tr>
<td>8 Grasshopper</td>
<td></td>
</tr>
<tr>
<td>9 Harlequin Bug</td>
<td></td>
</tr>
<tr>
<td>10 Lacewing</td>
<td></td>
</tr>
<tr>
<td>11 Cicada</td>
<td></td>
</tr>
<tr>
<td>12 Wasp</td>
<td></td>
</tr>
<tr>
<td>13 Mole Cricket</td>
<td></td>
</tr>
<tr>
<td>14 Stick Insect</td>
<td></td>
</tr>
</tbody>
</table>
ADAPTATIONS

Collect more animals from the school ground. Examine the microscope slides of the brine shrimp; freshwater mite; and insect larvae (e.g. mosquito wrigglers) in the *Micro Marvels* kit.

Use **hand lenses** or the **digital microscope** in the *Micro Marvels* kit and examine each of the specimens. List and explain why certain features are adaptations. You may like to use the digital microscope to take close-up images of the features under discussion. (For more activities, see the Adaptations Teaching Unit in the Learning Resources section of Queensland Museum’s website.)

<table>
<thead>
<tr>
<th>Animal</th>
<th>Feature</th>
<th>Why this is an adaptation</th>
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<tbody>
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</tbody>
</table>
USEFUL WEBLINKS

- Activities

- Background Information

- CSIRO Invertebrate Key

- Fun Activities - Help Freckles the Frog Now!

- **Health and safety guidelines for community-based waterway monitoring** (2006)

- **Queensland community waterway monitoring manual** (2007)

- **Record sheet – basic level** (PDF, 108 kB) — Use this sheet to record which water bugs have been found in the waterway you are monitoring. It also includes a simple method for deciding how polluted the waterway is.

- **Water bug & riparian vegetation snapshot** (PDF, 370 kB)

- **Water bug identification booklet** (PDF, 1.04 MB) — Guide to Identifying Macro-invertebrates.
  This booklet has been taken from the **Queensland community waterway monitoring manual**.

- **Water bugs and water scorpions** - Fact Sheet - available for download at

- **Waterwatch Queensland community estuarine monitoring manual** (2005)

- **Waterwatch Queensland stream quality slide** (2006)

Fact Sheets on Queensland Museum website:

- Bearded and Water Dragons – the City Slickers
- Cane Toads
- Cicadas – our Summer Singers
- Dragons in Brisbane
- Freshwater Crayfish
- Frogs in the Garden
- Water Bugs and Water Scorpions