# Animals in the classroom

Keeping live animals in the classroom encourages children to observe, discuss and record changes that occur as animals grow.

## What to do

Select a 'bug' project on which to keep an animal growth diary.

Record children's observations of the changes in size, shape, colour and movement.

### Hatching moths and butterflies

A small number of caterpillars can be collected from the school ground and raised if you have access to a continuous supply of their host plant. Caterpillars require specific food sources, so note which plant species they are feeding on when found. They also have huge appetites.

Butterfly eggs, and information about their care, can be purchased from the Zoo Education Service (ph. 9285 9355). Butterfly eggs and kits must be ordered prior to the start of terms 1 and 4. A source of citrus leaves is needed to raise the Orchard Swallowtail caterpillars that are supplied.

If you have access to a supply of Mulberry leaves, the silkworm is a wonderful species to maintain and observe in the classroom. Eggs hatch to coincide with new season's growth of Mulberry leaves. Eggs can be obtained from Monnie Fenner billmonniefenner@bigpond.com, subject to availability.

Plant a butterfly garden. Butterflies take nectar from a variety of flowers but lay their eggs on specific host plants that provide food for their caterpillars. Planting the host species of plant will encourage butterflies to lay eggs in your area.

Information about host plants can be found at www.museum.vic.gov.au/bioinformatics/butter/

### Keeping Phasmids (stick and leaf insects)

These creatures are fascinating animals to study – a supply of fresh gum leaves and suitable housing is all that is required. Detailed information about obtaining and caring for phasmids and other insects is available from The Australian Insect Farm. Full details at www.insectfarm.com.au

### Lifecycle in a jar

A simple lifecycle to observe is the mosquito. Collect some mosquito larvae (wrigglers) from a pool. These will quickly become tumblers (pupal form) before turning into adult mosquitoes. Refer to activities, *A Bugs Story* (prep-2) and *The Cycle of Life* (years 3 – 8) for an outline of the mosquito lifecycle.

# Insect body adaptation

Take a look at some of the insect body adaptations that have allowed insects to survive so successfully.

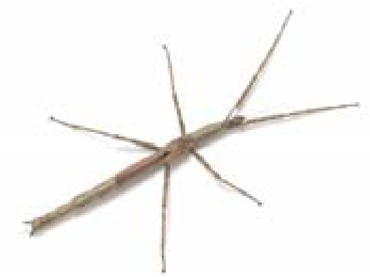
Refer to *Insect body adaptation - Student worksheet*

## Part 1: Amazing body adaptations that help bugs survive

Praying mantis – grasping forelegs indicate it is a predator

Grasshopper – enlarged hind legs indicate one mode of movement is by jumping

Giant burrowing cockroach – forelegs designed for digging indicate an underground habitat



Stick insect – long thin legs and body indicate a habitat among the branches

Spider – fangs indicate a carnivorous diet and use of poison to immobilise prey

Spiny leaf insect – body structures indicate it relies on camouflage in trees

# Insect body adaptation

## Part 2: Research questions

*What is an exoskeleton and how do you think it helps bugs to survive?*

An insect's skeleton is called an exoskeleton. It is made from a material called chiton, which is like a natural plastic. Chiton also forms the feelers, spines, hairs, jaws, pincers, wings and scales of insects. Chiton is covered in a thin layer of wax. This waterproofs the insects (like a raincoat) and also stops them from losing water from their bodies. It also helps to protect them from predators. An exoskeleton is like body armour. Bugs are always under attack so armour-plating and sharp spikes and spines help protect their small, delicate bodies. Unlike armour, exoskeletons are light and bend really easily. Insect exoskeletons have developed into a huge variety of shapes. In some species, extensions of the exoskeleton have developed into horns.

*What happens when an insect grows bigger than its exoskeleton?*

Having a hard outer covering means that insects cannot grow bigger unless they crawl out of it, which is exactly what they do. When an insect feels that it is getting too big for its armour, the armour cracks and the insect slowly comes out. This is called moulting. When an insect first emerges from its exoskeleton it is very soft and vulnerable to predators. Insects therefore usually find somewhere safe to hide before they moult. Once it is free of its tight clothes it stretches out, puffs itself up and grows a new exoskeleton. All insects do this many times throughout their lives.

*How are insect muscles different from our muscles?*

Insect muscles tire less quickly than human muscles. This is not because they are stronger, but because insects are small and their muscles are strong in relation to their body weight. A bee can haul 300 times its body weight and a flea can jump 200 times its own length.

*Find out about some of the different ways in which insects eat their food.*
*How are their mouthparts different from ours?*

Insects have a huge range of mouthparts. These approximate grabbers, biters, siphons, crushers, pincers, drills, saws, and pneumatic hammers.

*Do insects have lungs? How do they breathe?*

Insects do not have lungs or airsacs to breathe with. Insects breathe through tiny holes in their exoskeleton called spiracles. These holes can be sealed which allows them to stay dry and stops them losing too much moisture in dry conditions. The air that comes in through these holes then travels down tubes that are made from the same hard material as the exoskeleton. These tubes supply oxygen to all parts of the insect's body. This ingenious method of breathing is the breakthrough that allowed insects to move onto land. The system, however, is only efficient over very short distances, which is why insects do not get very big. If they were any bigger, they simply would not be able to breathe. The size of an insect is also limited by the weight of their exoskeleton. The exoskeleton of a large insect would have to be so heavy that the insect would not be able to walk.

# Insect body adaptation

*How does flying help insects to survive?*

Insects were the first animals to fly. They were flying millions of years before birds took to the air. Monster-sized dragonflies with wings 70cm across flew 300 million years ago – before the dinosaurs even existed. In fact, they are the only animals that developed wings from scratch – flying birds, pterosaurs and mammals (bats) all modified their front limbs into wings. Insect wings are made of the same material as their exoskeletons. They are so thin that you can see through them and are supported by a network of veins.

It is thought that wings were originally used for leg protection, camouflage (to break up the outline), thermoregulation or sexual display. Once insects, developed wings, however, a whole new world opened up for them. Flight enabled insects to escape predators, take advantage of seasonal food sources in distant locations, and migrate to new unexplored areas.

Insects can hover, fly backwards, accelerate suddenly to over 150 kilometres per hour, and perform acrobatics that would put a fighter pilot to shame. The best fliers are the House Flies. House flies have only one pair of wings (their back wings have reduced to tiny knobs and are used as stabilizers). They have special muscles that allow them to beat their wings 200 times a second, which is why they make a buzzing noise when they fly.

*What makes beetles the most successful insect group in the world?*

Beetles are the most successful insects in the world. Two in every three animals is an insect, and one in every three animals is a beetle. There are 300,000 different species of beetles so far recorded.

But what is the secret to their huge success? Beetles have wings, which gives them all the advantages that the other flying insects have, but insect wings are incredibly thin and tear easily. This means that insects with wings have to be very careful as they move around and they can't do any dirty work like digging tunnels underground, rolling dung balls or rummaging under leaf litter, let alone getting involved in duels with rival males. But not beetles – beetles can do whatever they want. This is because the front wings of beetles are hard wing cases (called elytra) which protect their fragile back wings. In flight these provide some lift, but they don't flap much. The wings can be several times larger than the elytra but fold neatly underneath. These special protective cases allows beetles to tuck their precious wings away when they are not in use and continue their lives as the tough guys of the insect world.

Beetles therefore have the best of both worlds and have been able to exploit many habitats that are not available to other flying insects. There are beetles living in trees, in rotten logs, underground and underwater.

# Insect body adaptation

Insects have been around for 400 million years. They have witnessed the rise and fall of the dinosaurs and were watching when a large-brained ape crawled out of the trees and stood up for the first time.

Let's have a look at some of the insect body adaptations that have allowed them to survive so successfully, for such a long time.

## Part 1: Amazing body adaptations that help bugs survive

What do the highlighted body structures indicate about the lifestyle of each bug?

Praying mantis

Grasshopper

Giant burrowing cockroach

Stick insect

# Insect body adaptation

Spider

Spiny leaf insect

## Part 2: Research questions

Use the Bugs Alive website: Bugs are Amazing! http://www.museum.vic.gov.au/bugs/amazingbugs/ or other books and resources to work in groups to research one or more of the following questions.

- What is an exoskeleton and how do you think it helps bugs to survive?
- What happens when an insect grows bigger than its exoskeleton?
- How are insect muscles different from our muscles?
- Find out about some of the different ways in which insects eat their food. How are their mouthparts different from ours?
- Do insects have lungs? How do they breathe?
- How does flying help insects to survive?
- What makes beetles the most successful insect group in the world?

# Bug challenges – friends and foe – what is your solution?

Research one of the following topics and find out how introduced bugs may be useful or harmful to the Australian environment.

## 1. A friendly introduction – decomposing Dung Beetles

Many bugs live by transforming dead plants and animals into nutrients. These decomposers are essential for healthy ecosystems, and are as important to natural environments as they are to suburban compost bins.

The dung beetle is an important decomposer. There are about 7000 species of dung beetles worldwide and between them they clean up the mess left behind by the rest of the animal kingdom. By burying dung, these beetles recycle nutrients, aerate the soil and reduce fly numbers.

Australia's 400 species of native dung beetles are efficient at cleaning up the small, dry dung pellets produced by kangaroos and wombats. Cowpats, however, are a different story! When cows were introduced to Australia, our native dung beetles could not cope with their huge, wet cowpats. Soon grazing land became fouled and fly numbers rocketed to plague proportions.

### Student Research

- What is a Dung Beetle?
- Describe their characteristics and life-cycle.
- Find out how Australian scientists attempted to solve the problem of grazing lands becoming fouled and fly numbers rocketing to plague proportions. Has the problem been solved?
- How would you attempt to solve this problem?

If you live in a rural area, dig around and under cow pats to see how many dung beetles are present. Even if you live in the city and don't have ready access to cow dung, read about the success of the dung beetle program by entering 'Dung Beetles Australia' into your Internet search engine. You will obtain many sites devoted to this topic, including accounts of schools that have become involved in dung beetle projects, eg. http://www.sofweb.vic.edu.au/edtimes/tandl5.htm

# Bug challenges – friends and foe – what is your solution?

## 2. Introduced Pests

When an animal (or plant) species arrives in a new place, it often leaves behind the parasites, predators and other factors that kept its population numbers in check in its native home. A species that was not a pest in its native land can become a significant pest in a new location.

It is likely that many bugs reached Australia by accident. They are small and can creep or fly undetected onto boats and aeroplanes. They can also hitch rides in food, furniture, building equipment, plants, and on animals, including humans. Many of the bug species that have invaded Australia are now well established and in some cases have become significant agricultural or urban pests. Such species include the many pests that farmers and agriculturalists must contend with, and an array of very recent arrivals like the European Wasp, Fire Ant, Elm Leaf Beetle and Bumblebee.

### Student Research

- Choose one of the following bugs – Introduced cockroaches, European Wasp, Fire Ant, Elm Leaf Beetle or Bumblebee.
- Describe the characteristics and life-cycle of the bug you have chosen.
- What impact has your bug had on the Australian environment? What problems has it caused?
- How are Australian scientists attempting to solve the problem created by this introduced species? Are the attempts working?
- How would you attempt to solve this problem?

## 3. A Native Pest

Not all pests are introduced. The Queensland Fruit Fly is a native pest rather than an introduced one. It is now a major problem throughout eastern Australia due to the planting of fruit trees along the east coast and inland river systems. Fruit flies are not strong fliers, but are spread by infested fruit being carelessly discarded in a fruit growing area.

### Student Research

- Do some research and describe the characteristics and life-cycle of the Queensland Fruit Fly.
- What factors have led to the Queensland Fruit Fly becoming a problem?
- How are Australian scientists attempting to solve the problem created by this native species? Are the attempts working?
- How would you attempt to solve this problem?

# Bug challenges – friends and foe – what is your solution?

## 4. Biological Control of Pests

Biological control is the use of natural enemies to keep in check pests such as invasive weeds and introduced bugs. The control bug often comes from the original home of the pest species and is often the most affordable and practical option for controlling the problem. They are certainly more environmentally friendly than using pesticides or herbicides. It is crucial, however, that strict testing and research be undertaken before introducing a new species into a local environment to ensure that the control species does not become a problem itself.

The Grapevine Mealybug is a major insect pest that attacks fruit, particularly apples. It had been causing problems in Australian fruit crops for 20 years until scientists researched and released an imported parasitic wasp *(Pseudaphycus flavidulus)*. The wasp was so successful at controlling the mealybug that it is now being used around Australia.

Australian scientists have also attempted to use biological control for other weed pests such as Paterson's Curse, Ragwort, Prickly Pear, Gorse and Thistles, and insect pests such as the European Wasp, Sirex Wasp and Elm Leaf Beetle.

### Student Research

- Choose one of the following introduced pests – Paterson's Curse, Ragwort, Prickly Pear, Gorse and Thistles, Grapevine Mealybug, European Wasp, Sirex Wasp or Elm Leaf Beetle and describe the characteristics and life-cycle of the control bug that has been investigated to control the pest.
- What impact has the introduced pest had on the Australian environment? What problems has it caused?
- Is the introduction of a biological control bug working?
- How would you attempt to solve this problem?

Visit the website of the Keith Turnbull Research Institute. Use your search engine to do this. Read some of the relevant Project Fact Sheets and use their Search facility to search for 'Biological Control'. Make a list of recent attempts to use insects and other invertebrates to control plant or insect pests. List the pests, the control agents and the degree of success achieved.

## 5. Other Research Ideas

The Honey Bee, and the honey industry – A good place to begin is the HoneyBee Australia website: http://www.honeybee.com.au/

Shellac-producing scale insects – Shellac is used for the production of varnishes and insulating materials. See http://www.antcons.com.au/Shellac.html

The production of cochineal dye from a scale insect that lives on cacti in Mexico. See http://www.botgard.ucla.edu/html/botanytextbooks/economicbotany/Cochineal/

# Pests or Pals

Many people believe that all bugs are pests. This is not so – in fact, the vast majority of bugs are either harmless or beneficial to humans. Insects and other bugs pollinate human crops, decompose dead plants and animals, and are a major source of food for other animals. Some are also effective biocontrol agents, used by humans to control plants or insects that are pests. Only about 1% of insects are classified as pests and compete with humans for food (both plant and animal), damage or destroy property, or spread diseases such as malaria, typhus, Murray Valley encephalitis or Ross River virus.

In this activity, students investigate bugs that assist humans, those that cause problems, those that both assist us and cause problems, and those bugs that don't seem to impact on us either way.

Consider each insect in the table below in turn, and place a tick in the box or boxes that indicate its status as a pest or a pal. You may need to do a small amount of research in some cases – begin at the relevant pages of this website: Friend or Foe? http://www.museum.vic.gov.au/bugs/friendorfoe/

| Insect | Destroys Crops | Carries Disease | Material Damage | Decomposer | Pollina | Food Producer | Biological Control of Pests |
|---|---|---|---|---|---|---|---|
| Honey Bee | | | | | | | |
| Bumble Bee | | | | | | | |
| Locusts | | | | | | | |
| Moths | | | | | | | |
| Butterflies | | | | | | | |
| Bogong Moths | | | | | | | |
| Parasitic Wasps | | | | | | | |
| Cactoblastis Moth | | | | | | | |
| Witchetty Grubs | | | | | | | |
| Fleas | | | | | | | |
| Flies | | | | | | | |
| Termites | | | | | | | |
| Dung Beetles | | | | | | | |
| Honey Ants | | | | | | | |
| Caterpillars | | | | | | | |
| European Wasp | | | | | | | |
| Lice | | | | | | | |
| Beetles | | | | | | | |
| Bugs | | | | | | | |
| Elm Leaf Beetle | | | | | | | |
| Silverfish | | | | | | | |
| Weevils | | | | | | | |
| Sirex Wasp | | | | | | | |
| Ladybird | | | | | | | |
| Blowflies | | | | | | | |
| Cockroaches | | | | | | | |
| Domestid Beetles | | | | | | | |
| Leaf Mining Moth | | | | | | | |