A BETTER WAY TO FARM

The benefits of integrated pest management
School education kit

The Port Phillip & Westernport CMA works on the lands, waters and seas of the Bunurong, Wadawurrung and Wurundjeri peoples and acknowledges them as Traditional Owners.

It recognises and respects the diversity of their cultures and the deep connections they have with Country. It values partnerships with their communities and organisations to improve the health of Indigenous people and Country.

The Board and staff of the Port Phillip & Westernport CMA pay their respects to Elders, past and present, and acknowledge and recognise the primacy of Traditional Owners' obligations, rights and responsibilities to use and care for their traditional lands, waters and seas.

Acknowledgements:

This resource is part of the Farms2Schools program, delivered by the Port Phillip & Westernport CMA in partnership with AUSVEG Victoria and supported by the Victorian Government.

This resource was written and designed by PeeKdesigns (peekdesigns.com.au) for Port Phillip & Westernport CMA. All illustrations within the resource have been created by PeeKdesigns.

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ABOUT THIS RESOURCE

A Better Way To Farm is an education resource developed for the Port Phillip and Westernport Catchment Management Authority as part of the Farms2Schools project. The resource provides a series of fact and activity sheets that introduce students to the idea that we can use a variety of better, more sustainable methods to help control pests in our farms and gardens.

The basic message of Integrated Pest Management (IPM) is that the regular use of many pesticides is unsustainable. Synthetic pesticides have been widely used and seen as a solution to pest control as they were reasonably cheap and achieved quick results.

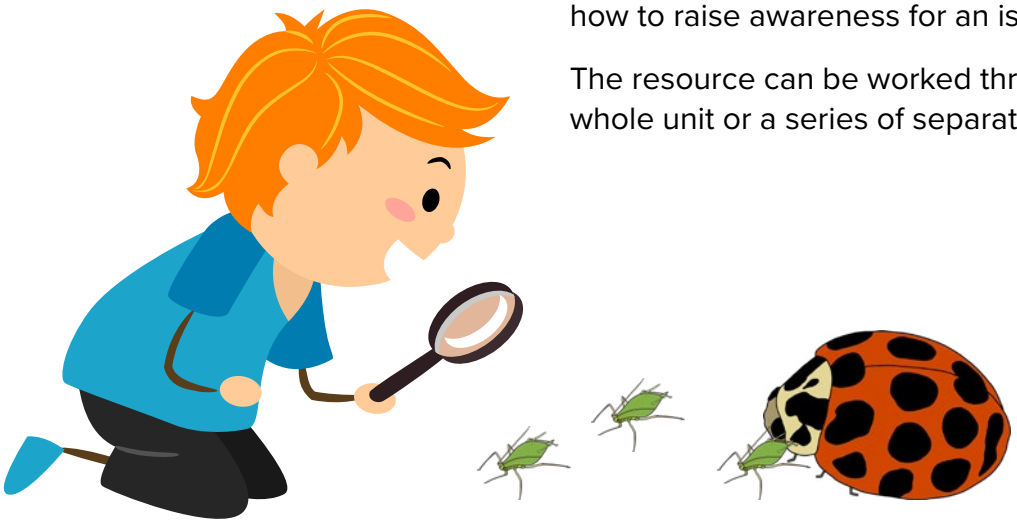
This resource, which is aimed at Levels 5 – 8 of the Victorian curriculum, breaks down the technical sounding topic of IPM into lessons and ideas that are manageable by students in this range. The cross-curriculum priorities 'Learning about sustainability' enables the resource to be used at any level.

By introducing these topics at a relatively young age we hope to inspire a sense of wonder and curiosity about the farms and gardens around them. This will create a life-long learning experience for the students by giving them the understanding that being more sustainable and environmentally friendly is achievable and has huge benefits.

A Better Way To Farm covers many topics related to sustainability and IPM including pest species identification, beneficial species identification, agriculture types, recycling nutrients, predator/prey relationships, life cycles, native vegetation, echolocation, revegetation, adaptations, sustainability, flower parts, pollination, habitats, layers of the bush, and feral animals.

The resource uses fact sheets to provide background information and a range of activities/tasks that employ learning strategies, including Q&As, cryptic questions, monitoring and graphing populations, conducting surveys, design and planning, experimentation, using data tables, art, making an action plan and how to raise awareness for an issue.

The resource can be worked through as a whole unit or a series of separate activities.



BROWN LACEWING AH

Curriculum

Science

Science as a human endeavour

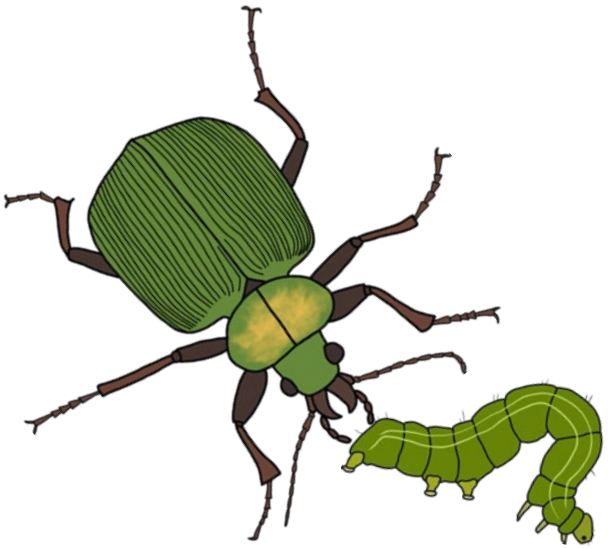
Levels 5 & 6 content descriptions

Scientific understandings, discoveries and inventions are used to inform personal and community decisions and to solve problems that directly affect people's lives (VCSSU073)

Levels 7 & 8 content descriptions

Scientific knowledge and understanding of the world changes as new evidence becomes available; science knowledge can develop through collaboration and connecting ideas across the disciplines and practice of science (VCSSU089)

Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations (VCSSU090)



Biological sciences

Levels 5 & 6 content descriptions

Living things have structural features and adaptations that help them to survive in their environment (VCSSU074)

The growth and survival of living things are affected by the physical conditions of their environment (VCSSU075)

Levels 7 & 8 content descriptions

Interactions between organisms can be described in terms of food chains and food webs and can be affected by human activity (VCSSU093)

Cross-curriculum Priorities

Learning about sustainability

Organising ideas

Systems – explores the interdependent and dynamic nature of systems that support all life on Earth and our collective wellbeing

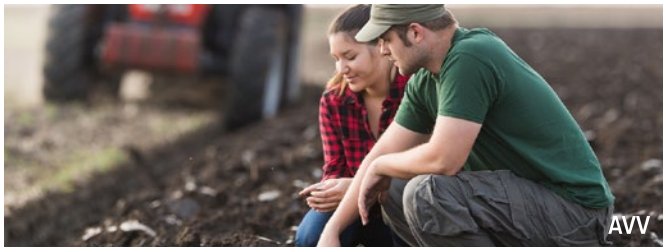
World views – enables a diversity of world views on ecosystems, values and social justice to be discussed and recognised when determining individual and community actions for sustainability

Futures – aimed at building capacities for thinking and acting in ways that are necessary to create a more sustainable future

INTEGRATED PEST MANAGEMENT

Farms and Pests

The Port Phillip and Western Port region contains prime agricultural land that plays an important role in providing food and fibre for local, national and international markets. The goal of our farmers is to create healthy, sustainable farms that enable them to grow great produce for their customers, so their business can maximise its profits and be successful.



Our farms can be grouped into three broad classifications: horticulture, pasture and broadacre crops.

Horticulture include orchards (fruit and nut), flowers, vineyards and vegetable growers.

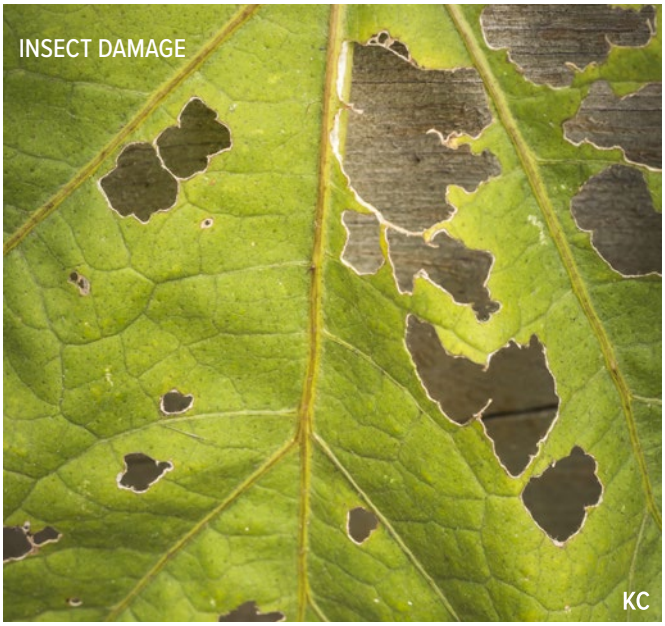
Pasture include grasses and legumes that are grown to mainly feed livestock animals.

Broadacre are large farms that produce grains, oilseeds and other crops.

Pests on farms

Managing pests in horticulture, pasture and broadacre crops is an essential step in working towards making our farms healthy.

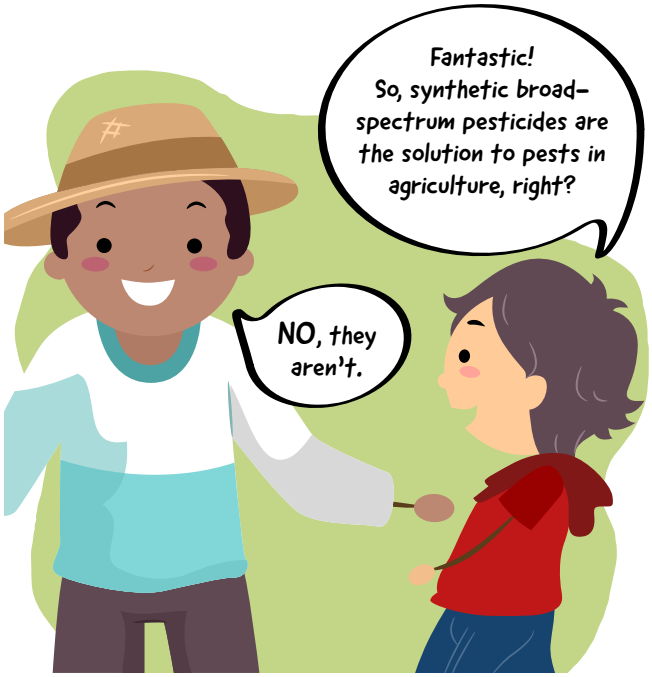
Most often, these pests are insects that attack the plants by eating the leaves or fruit, boring into the trunks or stems, sucking out the sap, or damaging the soil and roots. Pests can also include mice, rats, possums and birds, as well as other local wildlife.



LADYBIRD BEETLE AND APHIDS HL

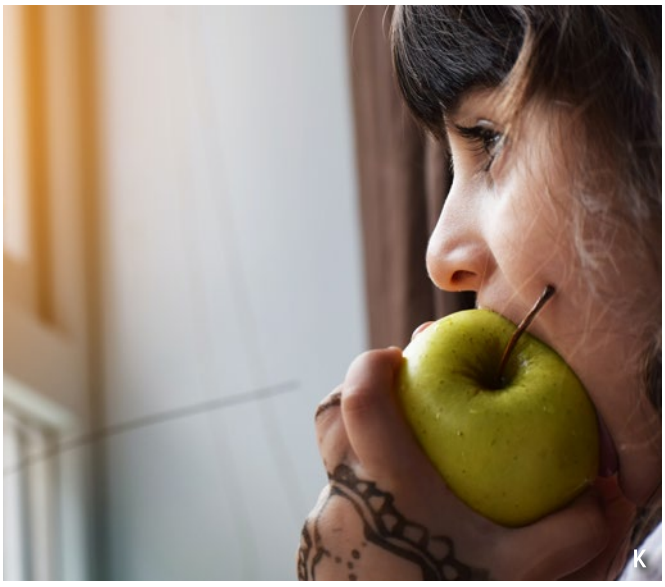
Pest control

During the last century, the development of synthetic pesticides was seen as the solution to any pest problems. These synthetic pesticides were reasonably cheap and broad-spectrum, meaning they could target a number of pest species all at once.



Experts in agriculture have now shown that the long term use of many pesticides is not sustainable. It has been found that continued use can cause problems such as:

- Beneficial insects and other wildlife that help control pests are killed or can become very sick from eating pests covered in chemicals. This means the pests have no natural enemies.
- Secondary pest outbreaks can occur if beneficial insects have been killed and their populations struggle to recover before the pest returns, or other pests move in. This results in an increased reliance on using pesticides to control more pest problems.
- Some pests can build up a resistance to the pesticides, making the chemicals less effective. This can lead to more and more of the chemical being needed to have the same effect.
- Pesticide chemicals are not good for human health, whether during the application process on the farm or eating produce that has been covered in chemicals.



So the question is...

If the use of many pesticides is not sustainable, then what can be done?

GREEN VEGETABLE BUG KC

What is Integrated Pest Management?

Integrated Pest Management, or IPM, is a better way of farming so that we are not reliant on pesticides. It means having a better understanding of what pests are impacting our horticulture, pasture and broadacre crops, and working out how to fix the problem in a more natural, integrated and sustainable way.

IPM uses a variety of tools and best practice approaches in the fight against pests on farms. It uses biological, cultural, physical, and chemical controls in combination with expert knowledge, monitoring and reporting. By using this combination of approaches, it allows our farmers to make the most informed control decisions on how to manage pests and keep their farms healthy.

Biological controls

Involves using natural predatory and parasitic species, known as 'beneficials'. This is because they provide a beneficial service to farmers by keeping the insects, and other pests, under control. Beneficials include insects, birds and micro-bats.

When controlling insect pests, a farmer's arsenal can also include bacterial, fungal and viral diseases that can kill pests and control outbreaks. This form of biological control is best practiced under the guidance from professionals.

Cultural controls

Involves making the conditions unsuitable for the pests by leaving them vulnerable to predators or destroying/disrupting their food, shelter and breeding areas. Cultural controls use methods such as crop choice, planting location, timing, crop rotation and cultivation techniques.

Physical controls

Uses physical methods to restrict pest movements or remove them from the area. They include preventative barriers, traps and manual removal of pests.

Chemical controls

Sometimes the biological, cultural and physical controls are not enough and chemical pesticides need to support them. In these situations, IPM uses a minimum amount of host specific pesticides in targeted applications so the beneficial species are not harmed.

Expert knowledge, monitoring and reporting

IPM requires learning about the relationship between pests and beneficial species. Planning, monitoring and reporting are important tools to manage pests so we understand when it is best to use the different control methods and in what combination.

ACTIVITY: TESTING THE MEMORY

Answer the following questions to revise what you have learnt about farms, pests and integrated pest management.

1 Brainstorm a list of words that you think describes the goal of our farmers.

2 Label the pictures below to show whether they are examples of horticulture, pasture or broadacre crops.

a .....

b .....

c .....

d .....

Keep on... Testing the Memory

3 How do pests, particularly insects, damage plants on our farms?

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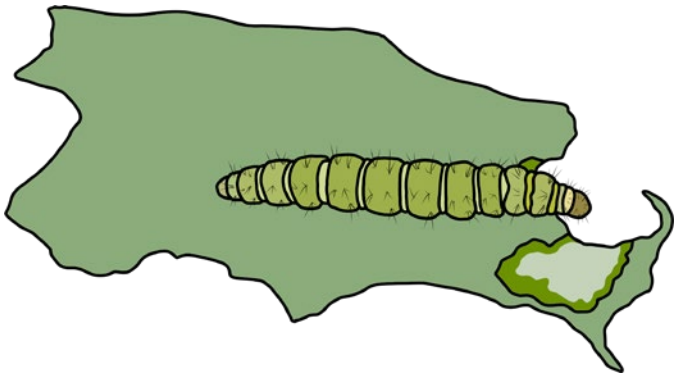

4 What are some of the problems with long-term use of pesticides?

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.....

.....

5 What does IPM stand for?

I .....

P .....

M .....

6 Label the four statements about IPM controls with their correct name: biological, physical, chemical or cultural.

Uses minimum amount of selected pesticides in a targeted application to control pests.

.....

Uses beneficial species and bacterial, fungal and viral diseases to control pests.

.....

Uses informed decisions about crop choice, planting location, timing, crop rotation and cultivation techniques to control pests.

.....

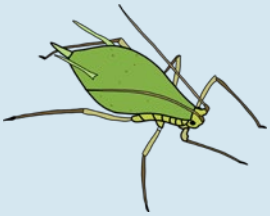
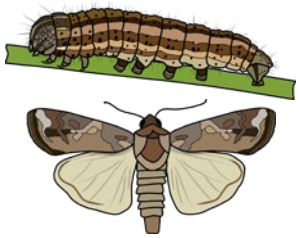
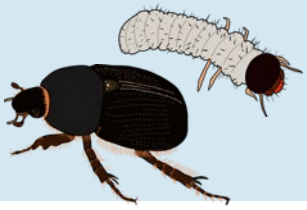
Uses preventative barriers, traps and manual removal to control pests.

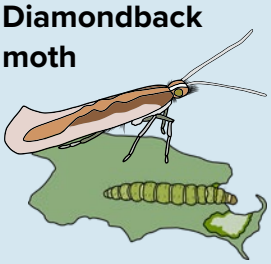
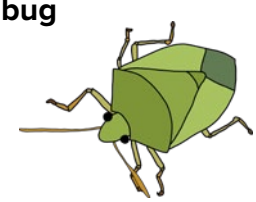
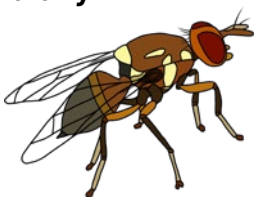
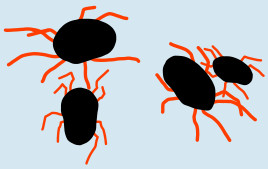
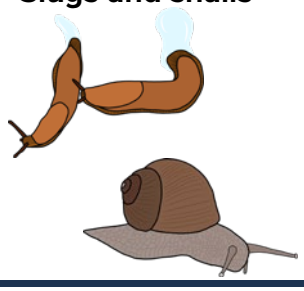
.....

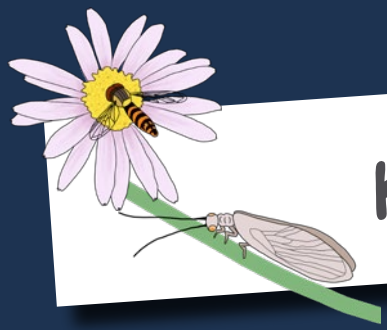
KNOW YOUR ENEMIES

Pest invertebrates (insects) cause huge amounts of damage to our agricultural industry each year, costing billions in lost produce and investment in trying to eradicate them.

They can cause problems to horticulture, pasture and broadacre crops.

ENEMY	DESCRIPTION	DAMAGE CAUSED	CONTROL METHODS
Aphid 	Aphids are small insect pests with oval-shaped green, brown or black bodies. They commonly occur in colonies.	Suck on plant sap. Plant parts can become yellow and stunted or distorted. Honeydew secreted by aphids can cause sooty mould. Aphids can transmit viruses that affect plant health.	Preyed on by hoverfly larvae, lacewings, ladybird beetles, damsel bugs and parasitic wasps. Control weeds to reduce alternate hosts. Pesticide treatments available for severe infestations.
Armyworm 	Caterpillars to 40mm have smooth, green, brown or yellow bodies striped with 3 parallel stripes from 'collar' to tail. Moths are grey-brown, wingspan to 40-45mm.	Damage to crops in late autumn-winter and late spring. Caterpillars eat seedlings as they grow. Known to attack barley and chew through stems below the seedhead, leading to loss of production.	Beneficial insects include parasitic flies and wasps, predatory beetles and diseases. Pesticide treatments available.
Blackheaded cockchafer 	Beetles are 10mm long, dark brown to black, shovel-like head and clubbed antennae. Larvae are white or grey grubs with a black head.	Attack young seedlings, severing leaves and causing bare patches in paddocks. Tunnels in the soil can be extensive in large infestations.	Birds, parasitic wasps, flies and pathogenic fungi prey on larvae. Cultivation exposes larvae to predators. Maintain pasture cover. Pesticide can be effective on larvae but harmful to predators.
Cabbage white butterfly 	Adult butterflies have white wings with small black corner spots and are 40mm long. Caterpillars are bluish-green and smooth in appearance.	They eat the outer leaves of cabbages and other brassica vegetables before boring inside to eat the inner heart. Brassicas include broccoli, brussels sprouts, rocket, and many other leafy greens.	Parasitic wasps lay eggs inside the larvae. Old crop residues should be ploughed in as soon as harvesting is finished.

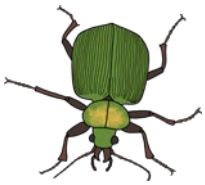
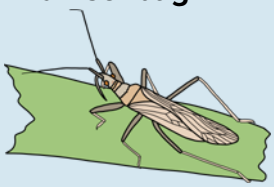
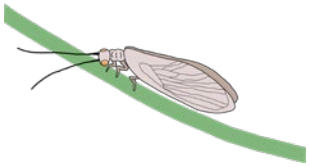
ENEMY	DESCRIPTION	DAMAGE CAUSED	CONTROL METHODS
Diamondback moth 	10mm long moths are grey-brown with a white uneven stripe down their back. Larvae are yellow-green up to 10mm.	 Larvae attack canola and brassica crops, feeding mainly on the underside of leaves. Older larvae graze on stems and pods.	Preyed on by small parasitic wasps, brown lacewings, spiders and damsel bugs. Control summer/autumn weeds around paddocks. Highly resistant to pesticides.
Green vegetable bug 	Adults are bright green, shield-shaped bugs, 13-15mm long with 3 white spots between their shoulders.	 Sucks the sap from fruit, vegetable and legume crops, which can spread viruses and diseases.	Preyed on by small parasitic wasps and spined predatory and glossy shield bugs. Control broadleaf weeds around paddocks and along fencelines.
Lucerne flea 	These 3mm long, green-yellow globular insects have a 'spring-tail', or furcula, that helps them jump away when under threat.	 Eat by rasping off the underside of leaves leaving a thin, clear membrane behind.	Pasture and spiny snout mites, spiders and ground beetles prey on them. Grazing management. Pesticide application around paddocks.
Queensland fruit fly 	Reddish-brown fly about 7mm long with distinct yellow markings.	 Lay eggs in fruit which hatch into larvae (5-8mm). The larvae eat rotting flesh inside the fruit. Wide host range of fruit susceptible to attack. Active when fruit is ripening.	Collect and destroy rotting, overripe or unwanted produce. Regularly inspect fruit. Capture fruit flies with traps. Avoid transporting infected fruit. Remove unwanted host plants.
Redlegged earth mite 	Tiny insects, 1mm in length, have a black velvety body with bright red legs.	 Feed on leaves of plants causing silvering and reduced palatability for livestock. Can kill seedlings at emergence. Reduces seed yield of legumes in spring.	Preyed on by French *anystis* mite and spiny snout mites. Leaving shelterbelts or refuges between paddocks will help maintain natural enemy populations. Highly resistant to pesticides.
Slugs and snails 	Slugs and snails can vary in size and colour. They all leave a filmy trial where they have been.	 Rasping and shredding of leaves, even eating whole plants, especially seedlings.	Carabid beetles, birds and lizards prey on them. Allow ducks and geese to graze in orchards. Manage stubble left in paddocks. Baits can be used but may harm predators.

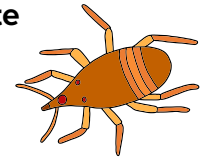


KNOW YOUR FRIENDS

Beneficial invertebrates that prey on pest invertebrates are known as biological controls within Integrated Pest Management (IPM). They are our friends in the garden or on the farm. By attracting these beneficials, farmers and gardeners can reduce their reliance on broad-spectrum pesticides.

How can we attract more beneficials? We can plant flowering native vegetation to provide nectar and habitat for beneficial insects. This is a simple farm practice that can be achieved at relatively low cost and doesn't interfere with a productive farm.

FRIEND	DESCRIPTION	PESTS THEY PREY ON
Carabid beetle 	Commonly known as ground beetles. Many varieties ranging from 1-60mm. Colours can range from black, to brown, to iridescent green. Have a flattened body shape and ridged forewing.	Caterpillars Aphids Wireworms Earwigs Slugs
Damsel bug 	Narrow brown bug 8-12mm long with large, protruding eyes and long antennae.	Aphids Moth eggs Small caterpillars Leafhoppers Mites
Dung beetle 	There are 3 main species in Melbourne region. Oval in shape, 8-25mm long, black and males can have horns.	By removing and decomposing animal dung (faeces), they remove breeding and feeding grounds for flies.
Hoverfly 	Dark, flattened 4-7mm long bodies with yellow marking, making them similar to bees. Unlike bees, they only have one set of wings. Larvae are 8-10mm long, green and appear grub-like – often mistaken for caterpillars.	Aphids Scale Mites Thrips Small caterpillars
Lacewing 	Brown lacewings are small 6-10mm and both adults and larvae are predatory. Green lacewings are large 15-20mm and only the larvae are predatory. Both have big eyes, glass-like wings giving a lacy appearance.	Aphids Thrips Mites Caterpillars Moth eggs

FRIEND	DESCRIPTION	PESTS THEY PREY ON
Ladybird beetle 	Adults are oval shaped and can be black or the familiar black spots on a red, orange or yellow shell. Larvae are grey-black with orange markings looking similar to a slater. Often covered in waxy coating.	Aphids Leafhoppers Thrips Mites Moth eggs Small caterpillars
Parasitic wasp 	A variety of species that range from 2-80mm long and have different colouring. All have slender bodies with a long abdomen used for laying eggs inside other insects. Some can also be ant-like. Wasp larvae feed on the host pest.	Aphids Caterpillars Moths Green vegetable bug Cockchafers Scale Whitefly
Pasture snout mite 	Bright orange-red bodies 2-3mm long with eight legs. Feature a pointed snout or mouth-part.	Earth mites Lucerne flea Springtails
Spiders 	Common spiders include wolf, huntsman, trapdoor, jewel, flower and jumping varieties.	Flies Crickets Aphids Caterpillars Moths

What is a farm insectary?

An insectary is a group of plants that provide a protective niche for natural predators by providing shelter, a regular supply of pollen and nectar and a water source for a range of beneficial arthropod species. A good insectary follows the SNAP method:

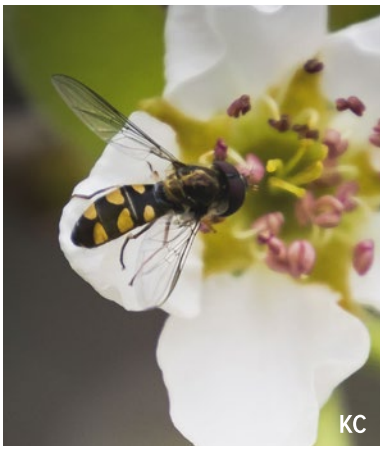
S shelter for overwintering and safety from weather and higher order predators

N nectar to provide a source of carbohydrate energy

A alternative source of prey to maintain beneficial populations until needed in-crop

P pollen which provides the protein necessary for egg production

(RETALLACK VITICULTURE, 2011)



ACTIVITY: BUG IDENTIFICATION

When using IPM on a farm or in your garden, it is important to be able to identify insects correctly so we know whether they are a pest or a beneficial species.

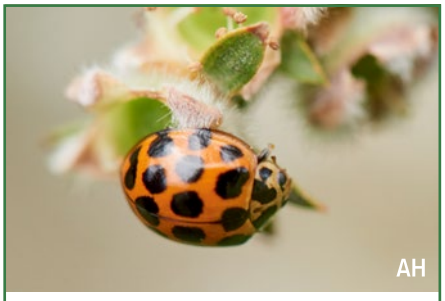
Use the **Know Your Enemies** and **Know Your Friends** fact sheets to identify the insects shown in the photos below. Write the **name** of the insect in the space provided. Circle the word **pest** or **beneficial** to show whether they are bad or good insects to have on farms and in our gardens.

PEST or BENEFICIAL

PEST or BENEFICIAL

PEST or BENEFICIAL

PEST or BENEFICIAL



PEST or BENEFICIAL

PEST or BENEFICIAL

PEST or BENEFICIAL

PEST or BENEFICIAL

PEST or BENEFICIAL

ACTIVITY: WHO AM I?

Identify the pest or beneficial species using the cryptic clues provided and the **Know Your Enemies** and **Know Your Friends** fact sheets. Write the species' name and draw your insect in the spaces provided.

A: Collecting and destroying rotting, overripe or unwanted fruit is a control method for this reddish-brown fly.

I am a: .....

B: Named for what I eat, I am a great recycler as I remove and help decompose animal waste.

I am a: .....

C: 'Mmm mmm!' I love to suck the sweet sap from fruit, vegetables and legume crops. I get my name from my colour.

I am a: .....

D: Caterpillars, aphids, wireworms, earwigs and slugs are on the menu for this ground beetle.

I am a: .....

More cyrptic clues... Who am I?

Keep using the cryptic clues provided to identify the pest or beneficial species. Write the species' name and draw your insect in the spaces provided.

E: I really like my own kind so I hang out with loads of my friends in colonies whilst sucking on plant sap and secreting honeydew which can cause sooty mould.

I am a: .....

F: I am not picky, I leave my slimy trails all through horticulture, pasture and broadacre crops as I rasp and shred leaves.

I am a: .....

G: Although I may occasionally give you a fright, I am a group of important long legged predators including wolf, jumping and trapdoor that can help control pests.

I am a: .....

H: With a name that sounds like I am in the military, I hide from parasitic flies, wasps and predatory beetles while I chew through the stem of a farmers barley crop.

I am a: .....

ACTIVITY: INSECTS IN THE GARDEN

Background

We can learn a lot from the way our farmers manage their horticulture, pasture and broadacre crops that we can put into place at home or school. Pests can also cause lots of problems in our gardens, especially to vegetable gardens and fruit trees (orchards).

Why not do things a better way by putting IPM into place at your home or school?

An important part of IPM is monitoring what is happening in your garden so you can identify and gain an understanding of both any pests causing problems and any beneficial species that are working to your advantage.

Conduct an insect count in your home/school veggie garden and fruit trees to identify the number of pest and beneficial species you can find.

Hint

During the day some insects will be found in cooler damper areas. Look for them:

- under the leaves of plants or trees
- in shaded areas of joints of stems and branches
- on the shady side of garden beds and structures
- underneath anything lying in or near the garden

Helpful equipment

- Magnifying glass
- Camera
- Gloves
- Notebook

Warning

Do not touch any insects as they often have ways of defending themselves, such as bites and stings.

Worksheet: Insects in the garden

1 Complete the table below tallying the number of pest species, beneficial species and then working out the total of each and the total insect species. Use the **Know Your Enemies** and **Know Your Friends** fact sheets to help identify the insect and whether it is a pest or beneficial.

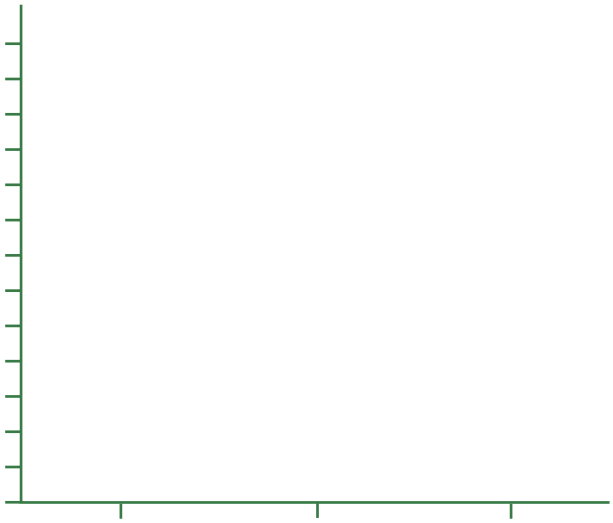
If you find a species that is not on the fact sheet, try and photograph or quickly sketch it so you can look it up later on the internet.

HINT – search words such as: 'common garden insects', 'beneficial garden insects', 'good bugs in the garden', 'identifying garden pests', 'are spiders good for the garden?' etc.

SPECIES	TALLY	TOTAL
Pest		
Beneficial		
TOTAL		

2 Compare the population dynamics by creating a bar / column graph showing pest species, beneficial species and total species. Give your graph a suitable title and label the x-axis and y-axis.

Title: . . . . . .



3 Were you surprised by the number of pest insects in your garden?

. . . . . .

4 Were you surprised by the number of beneficial insects in your garden?

. . . . . .

5 What could you do in your garden to help attract more beneficial species?

. . . . . .

. . . . . .

. . . . . .

ACTIVITY: A SLIMY TRAP

IPM is a better way of farming that integrates various tools and approaches in the fight against pests. These are called biological, cultural, physical and chemical controls.

Physical controls use physical methods to restrict pest movements or remove them from the area. They include preventative barriers, traps and manual removal of pests.

Snails and slugs are common garden pests.

You are going to show that you can use IPM in your school or home garden by building some snail and slug traps.

A SLIMY TRAP EXPERIMENT

Aim

To practice IPM by designing and installing traps in the veggie garden to physically remove snails and slugs.

Observation and hypothesis

A good scientist always observes things and makes predictions before conducting an experiment.

Go to the veggie garden you are going to set your traps in and take a good look around.

- Can you see any snails or slugs?
- Can you see any evidence that pests have been eating your plants? Look for eaten leaves and stems or slime trails, especially in leafy greens.
- If you see some evidence of snails or slugs, do you think that there is a lot of pests for a garden that size?
- If there's no evidence of slugs or snails, could they still be there, hidden?

Background research

It may help to watch a couple of videos to see how others make their traps and install them in the garden. If you do your own research you will find lots of videos and websites that will give you some ideas.

- Project Diaries, How to: Make Free Slug Traps
  youtu.be/wlo0WW1CU-8
- Burke's Backyard, Beer Snail Trap
  youtu.be/oixnmtH2-w0
- OYR Frugal & Sustainable Organic Gardening, DIY Slug Trap
  youtu.be/Y8kzTfxX9Pk

Materials

Scissors, utility knife, gloves, 500mL container to mix bait in, Vegemite™, sugar, warm water, texta, a range of plastic containers you can find for your trap (make sure they are smooth inside).


GR

Your bait solution

Many of the videos and websites use beer or alcoholic cider as bait for their traps. This is because they have good amounts of yeast and sugar in them. You are going to make your own non-alcoholic yeast solution with Vegemite™ that you can use at school or home.

Recipe

Mix 2 teaspoons of Vegemite™ (contains lots of yeast) into 500mL of warm water. Add 2 teaspoons of sugar (or honey) into the mix. This will create a solution that has yeast and is sweet, which will attract the snails and slugs.

You may have to create a few batches depending on how many traps you make, and the depth of the container used. Your bait should be changed every 3-4 days so it doesn't go off.

Alternate recipe

Mix 2 teaspoons of vegetable oil (or linseed oil), 2 teaspoons of sugar and 1 teaspoon of yeast powder in 500mL of warm water.

Designing your trap

After doing some background research you should have an idea of the types of containers that you can make traps out of. You can use plastic bottles, yoghurt containers, coffee cups, ice-cream containers or any other plastic containers with smooth insides.

When designing an experiment, it often helps to visualise what you are planning to do. Complete a sketch of the trap you are going to make. Make notes on your sketch to mark the important parts.

Making your traps

Use the background research, materials and your design to construct your traps.

Write some notes on the type of containers you are using and each step that you used to make your traps. Good scientists always keep notes so they can make improvements if they repeat the experiment.

Installing your traps

Your traps will be most effective if installed in a shady, damp area of your garden. Dig your trap into the garden making sure the opening for the slugs and snails is at the level of the soil. Fill your trap up to desired level with your bait solution.

Results

Check your trap at the same time every day to see how many slugs and snails you have caught. It is best to do this for at least 1 week.

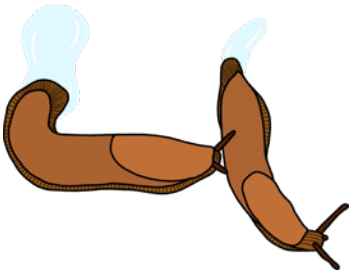
Tally your daily results on the **Worksheet: A Slimy Trap**.

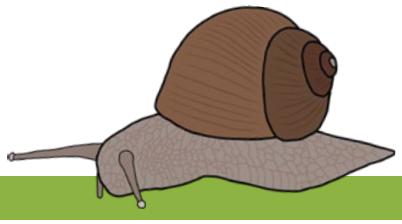
You should consult your teacher or parents/ guardians on how and where they want you to dispose of any slugs and snails.


GREY FIELD SLUG

DP

Worksheet: A slimy trap





Record your slug and snail trap experiment results in the table.

Days checked	Slugs	Snails	Daily Total
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
		End Total	

Discussion questions

1 How many slugs and snails did you capture in total?

. . . . . .

2 Were there more slugs or snails?

. . . . . .

3 On which day did you capture the most?

. . . . . .

4 Did you notice a trend in how many you caught? *E.g. an even amount each day, or all on day 1-3 then very few afterwards.*

. . . . . .

. . . . . .

5 What do you think these results tell us about the slug and snail populations in your garden?

. . . . . .

. . . . . .

6 Was this a good way of controlling slugs and snails without using pesticides?

. . . . . .

7 Do you think IPM can be effectively used at home/school to help manage pests?

. . . . . .

8 Are you going to continue with your traps?

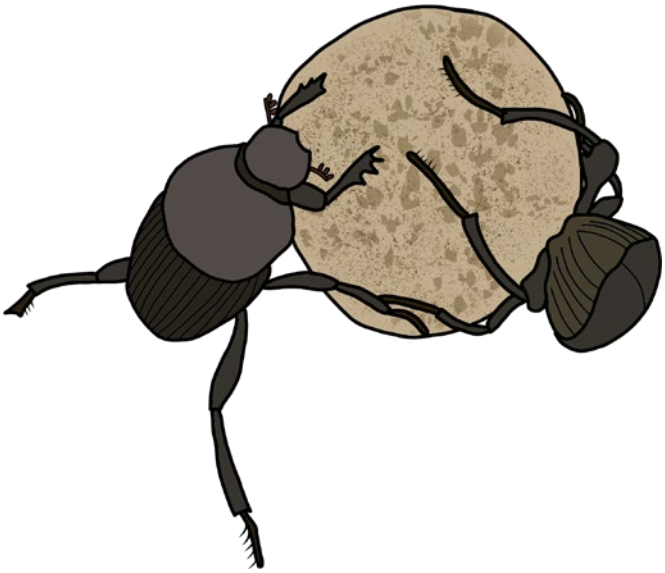
. . . . . .

ACTIVITY: A VERY GOOD BUG

The Dung Beetle

It is strange to think one of the most beneficial insects in our rural areas is one that lives on other animals' faeces. The dung beetle, as its name suggests, is a beetle that is one of nature's best processors of animal waste.

In Australia, where a large amount of agricultural land is dedicated to grazing cattle, sheep, goats and other livestock, the dung beetle plays a very important role. Dung beetles rapidly increase the ability of an animals' dung to be recycled into precious nutrients for plants. Whilst they feed on faeces, a dung beetle also digs faeces into the ground. Australia has several native and introduced dung beetle species that all help the environment by recycling animal pats.



It is in the ground where microscopic organisms go to work and totally decompose the faeces into nutrients for plant roots. This burial of faeces also prevents the nutrients from washing away into rivers and streams, which can pollute our waterways. Excess nutrients in waterways can lead to problems like increased algae blooms that take the oxygen out of the water and harm species living there.

The dung beetle also plays a major role in parasite control. Burying the faeces means that it has destroyed breeding sites for some fly pests and other parasites. Without as many places to breed the number of these pests is controlled. This is an extremely important natural protection against fly problems in agricultural zones.

ADAPTED FROM 'ENVIRO-STORIES: SOIL EDUCATION MODULE'

Worksheet: Dung Beetle Poster

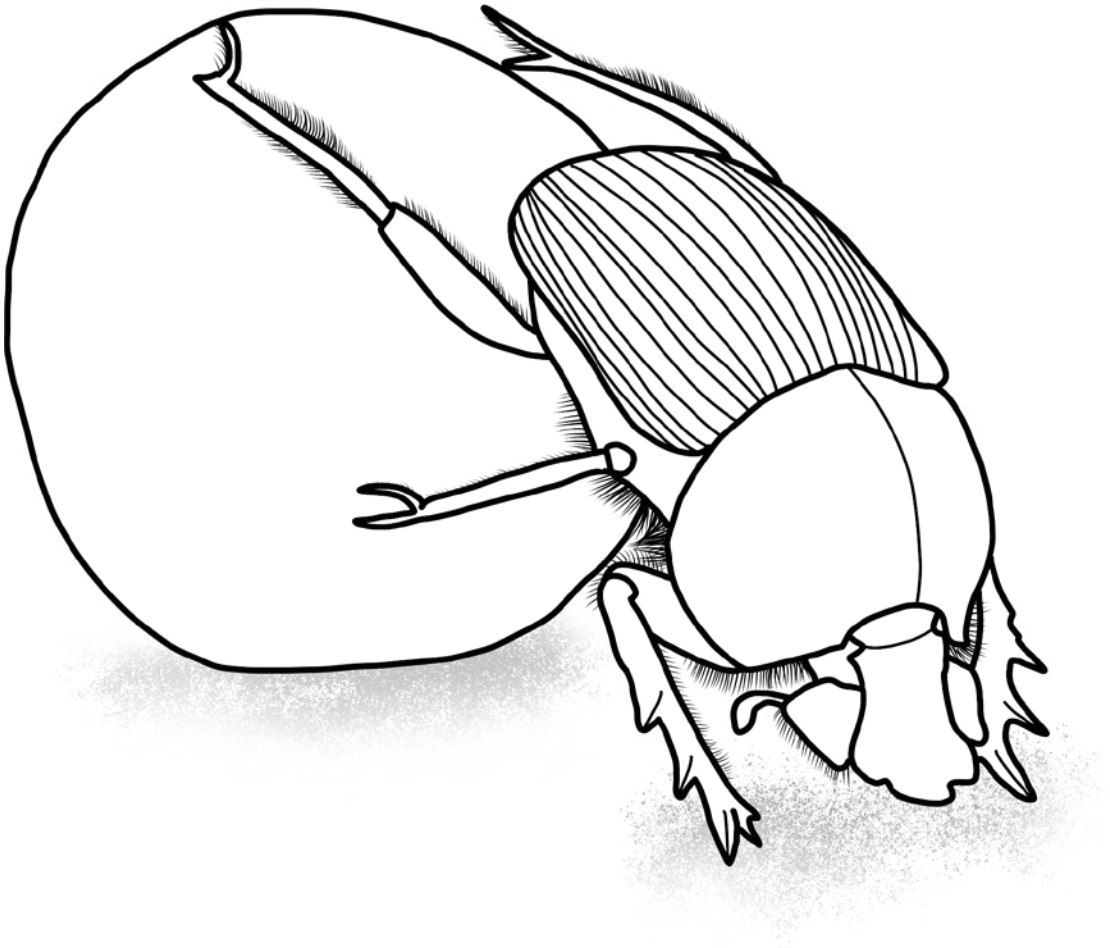
You are an expert in agriculture and Integrated Pest Management (IPM). You know that knowledge is a key tool in IPM, so you decide to show people a better way of doing things by raising awareness about the benefits of dung beetles to the farms of the region.

Create a poster showing off the dung beetle and how it is a beneficial insect to our farms.

You can use the dung beetle drawing below on your poster, or to help you draw your own dung beetle diagram.

Some ideas for your poster are:

- Have a catchy and original title
- Draw, sketch or paint (or use a photo) a large dung beetle that should be centre piece for your poster
- Label some of the dung beetles' physical features
- Explain why dung beetles are a beneficial species to our farms (could be short statements, word clouds or anything that you think delivers the message)
- Promote things farmers can do to both protect dung beetles as a resource on their properties and encourage more dung beetles to their properties



ACTIVITY: HUNGRY LITTLE HELPERS

Adaptations

Biological controls in Integrated Pest Management (IPM) encourage using natural predatory and parasitic species, known as 'beneficials', to help control pests on our farms. This means that we should use good species (beneficial) to hunt down and prey upon bad species (pests).

Let's take a closer look at some of the special characteristics that make these beneficial species such great predators and also help to protect themselves from their predators. These special characteristics that have developed over time are called adaptations.

Adaptations can be:

- **Behavioural adaptations** - things they do (behaviours) to give them the best chance to survive
- **Structural adaptations** - physical characteristics developed over time through evolution

Lady Beetle or Ladybird beetle

FAMILY COCCINELLIDAE

Both ladybird adults and larvae are predators with voracious (excessively greedy) appetites, that can help control a range of pests including aphids, leafhoppers, thrips, mites, moth eggs and small insect larvae.

Ladybird adaptations

- Hard shells to protect them from predators
- Bright colours to warn others they are poisonous, when in fact they aren't
- Six short little legs to walk around. Their leg joints also secrete an oily, yellow fluid when they are threatened that tastes bad to predators
- They play dead if threatened
- Little claws on their feet to grip their prey
- Strong jaws called mandibles that hold and chew from side to side
- Smell with their feet and antenna
- Two pairs of wings - hard red outer wings called elytra that protect their bodies and transparent inner wings used for flight
- Wings so they can be mobile and access pests
- Antenna so they can smell, taste and feel their way around
- Big appetites - can eat 75 aphids a day
- Lay their eggs in amongst aphid or other pest colonies so their larvae have a great food source when they hatch
- Larvae look fearsome covered with spines and bumps to ward off predators
- Larvae have large sickle shaped jaws that can bite and hold prey
- Larvae are very fast so they can move around quickly and catch their prey

Worksheet: The best beneficial beastie

You are going to design a beneficial beastie. This bug will include features, or adaptations, that you think would make the perfect predator of pests in horticulture, pastures and broadacre crops.

Use your knowledge of ladybird beetles, as well as research into other beneficial insect species, to help you. Some other species you may wish to research are parasitic wasps, predatory mites, carabid beetles, lacewings, hoverflies and spiders.

Physical (structural) adaptations to consider would be stings, pincers, claws, legs, disposable limbs, body casing, armour, strength, horns, antenna, sensitive hairs (to detect trouble), eyes, teeth, mandibles, claws, speed, body segments, venom, poison and size.

Give your beneficial beastie a species name and label your diagram to point out some of its important features.

ACTIVITY: MULTI-TASKING MARVEL

Background

A major part of IPM is to encourage beneficial species to our farms and gardens.

A multi-tasking insect that provides a number benefits in our gardens and on our farms is the marvelous hoverfly.

Hoverfly larvae are important pest controllers. The larvae, otherwise known as maggots, have a huge appetite for aphids. Adult hoverflies often choose to lay their eggs amongst aphid colonies so when they hatch, the larvae have an instant food source. The larvae also eat other soft-bodied pests like scale, mites, thrips and some small caterpillars.

Adult hoverflies are important pollinators. They drink nectar and eat pollen from plants and as they move from flower to flower, they carry tiny pollen grains that stick to their limbs and bodies. Pollination allows plants to fruit and produce seeds that will produce more plants.

These fruits and seeds are an essential part of agricultural crops and gardens. Hoverflies are considered the second most important natural pollinator after bees.

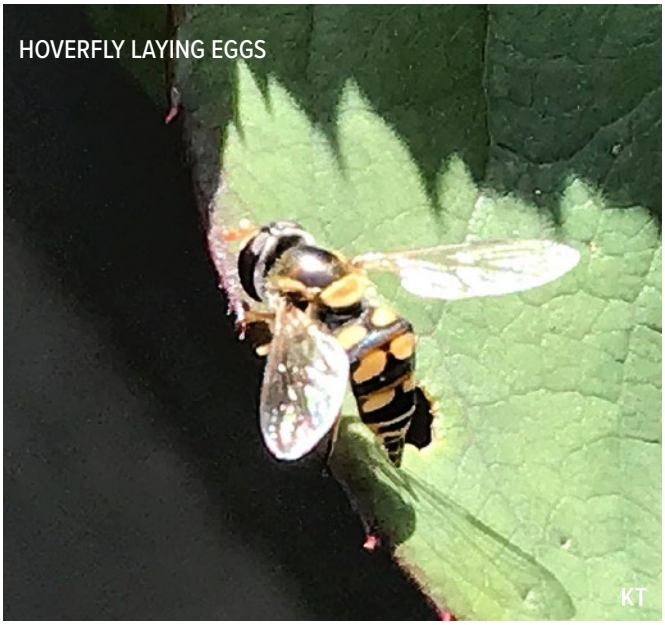
Adult hoverflies can help plant health. While they don't eat the aphids themselves, many species of hoverflies will eat the sweet honeydew that is secreted by aphids and other insect pests. By sucking up the sugary honey dew they are providing a benefit to plant health as they are preventing diseases like black sooty mould taking hold.


POLLINATING AN ORCHARD

KC


VISITING A NATIVE FLOWER

AH


HOVERFLY LAYING EGGS

KT

Worksheet: Hoverfly life cycle

You are going to **construct a hoverfly's life cycle** that shows the different stages during its life. Read through the following text and use the information to guide you.

An adult hoverfly knows the time is right for her to reproduce as she can smell lots of aphids in the apple tree. She zooms down and lays her white, oval eggs right in the middle of the aphid colony. After a few days, the eggs hatch and small pale green larvae (maggots) crawl out to find they have a juicy food source nearby. The larvae go through several stages of growth, moulting their skin as they get larger by gorging themselves on the aphids. Their natural instinct is to eat as much as they can, building up energy for their big transformation.

When the time is right the larvae attach themselves under a leaf and swell up as their skin hardens to form a tear-drop shaped pupa. The pupa is where some insects undergo a metamorphosis between immature and mature stages. Depending on the weather, after a few days the adult hoverfly emerges from the pupa. The adults search for sweet food like nectar and pollen to feed on and pollinate the plants along the way. They then try to find a mate so they can reproduce and the cycle can start all over again

FRUIT FLY INVADER

Significant pests

Queensland fruit fly (QFF) is a pest of Eastern Australia that has been declared an endemic pest in Victoria since 2013. Suburban Melbourne has been grappling with the pest since 2008. QFF has been absent from the Yarra Valley for decades before it was detected in 2018.

It is difficult to manage QFF without the use of pesticides. If pesticides are used as a cover spray, then all the good work of beneficial insects in a production system is compromised.

These small insects are one of Australia's most significant horticultural pests. There are interstate and international trade restrictions in place to prevent the import of the pest from areas with QFF, to areas with no QFF.

What do they look like?

Adult QFF are about 7mm long and are reddish-brown in colour, with distinct yellow markings.

Laying eggs of destruction

The female QFF creates a tiny pin sized hole in the host fruit. Through this hole she lays her eggs and, along with other microorganisms, the fruit starts to rot. The growing larvae take over a week to develop. They will eat the rotten flesh inside the fruit, whilst the outside of the fruit can seem unharmed.

The lifecycle of a QFF egg through to an adult that is ready to lay eggs again can take as little as 28 days in warm weather. A female fly can lay up to 800 eggs in her 3-4 month lifetime. This means a population of QFF can grow very quickly and threaten host fruit production.

Once the larvae are big enough, they drop to the ground and bury themselves. They form a hard casing around their bodies and pupate, emerging from the ground as young flies. After a good feed, they're ready to mate and the female starts the cycle all over again.

Check out this Agriculture Victoria video on Queensland fruit fly and their life cycle:

https://youtu.be/5xhwjA5FbAM


DAMAGE ON CITRUS AYV


LARVAE IN AN APRICOT AYV


ROTTING FRUIT AYV

Controlling the pest

Breeding events occur on evenings where the temperature at sunset is 15 degrees celsius or greater. Once the egg and larvae are safely inside the fruit, it is impossible to use pesticides to kill the pest. Adults don't always hang around a fruit crop either, so using a cover spray is not always successful. Instead, an IPM approach is preferred, but it does require a proactive approach and an area wide management application.


QUEENSLAND FRUIT FLY ARE VERY SMALL JN

Detect and trap

Fruit can be protected by preventing QFF reaching the crop. Traps are used to detect if QFF are around or active.

Male traps – are traps with Cue-Lure attractant and kill male QFF. They are good for surveillance of the QFF population in an area. Male lures with pesticide can also be used over large area to disrupt mating.

Protein traps – are food based traps that attract hungry flies, mostly females who require protein for egg production.

Protein baiting – fruit areas can be actively protected with the use of a protein gel with pesticide. The bait is distributed as droplets over a large area, like having feed stations everywhere. Bait needs to be applied weekly, and reapplied after rain to continue to attract any QFF in the area.

Exclusion nets

Fruit producers who can't use bait or pesticide need to use physical exclusion such as insect mesh to prevent QFF laying eggs in fruit.

Good hygiene

Production area hygiene is particularly important in the prevention and management of QFF. Fruit needs to be picked before it falls so that any larvae inside the fruit is prevented from reaching the ground, pupating and emerging again as a young fly.

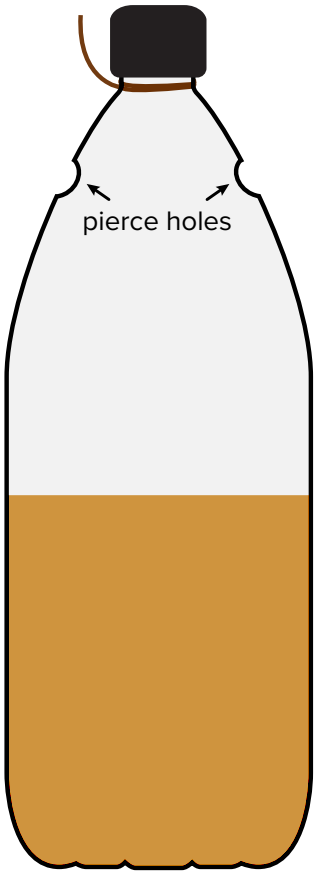
Infested fruit needs to be destroyed by freezing or boiling to kill larvae and eggs inside the fruit. This can greatly increase the cost of harvesting and handling unsaleable fruit. Unharvested and unmanaged fruit is a serious threat to successful QFF management.

Working with your neighbours

Area wide management is essential for QFF prevention and management. A neighbour's actions can impact an area and even a region. Flies can spread from one crop to another crop and continue to be a problem. As long as the weather allows for the insect to move and grow, and there is fruit around to act as a host, QFF will remain in the area.

ACTIVITY: MAKE A FRUIT FLY TRAP

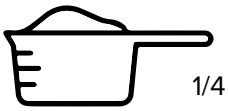
STEPS FOR MAKING YOUR TRAP



Ingredients for 3 traps

1 tablespoon of Vegemite™

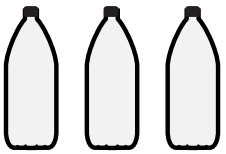
1 litre of water



1/4 cup of sugar

5 drops of unscented or lemon scented dishwashing liquid

Materials you need



3 x 1.25 litre plastic bottles

Scissors

String

1. Combine all ingredients in mixing bowl.
2. Pierce two holes in neck of each 1.25 litre plastic bottle as shown in diagram.
3. Remove lid and pour 1/3 of mixture into the plastic bottle.
4. Top up with cold water until the bottle is half full.
5. Replace lid.
6. Attach string under lip of lid to prevent string slipping off.
7. Hang securely in vulnerable trees and garden beds.
8. Check the trap and replace liquid regularly.

ADAPTED WITH PERMISSION FROM MOIRA SHIRE COUNCIL AND AGRIBUSINESS YARRA VALLEY

FEATHERED FRIENDS

When controlling pests on farms, there are many other beneficial animals not just beneficial insects. We should try to do things a better way by implementing IPM strategies that utilise all these species to our advantage. It can lead to a more sustainable, healthy farm that produces a quality harvest.

Native birds, micro-bats, frogs, lizards, fish and snakes can all have a beneficial effect on pests on farms. They can help control insects by preying upon the insects themselves, their larvae and/or their eggs. Small pest mammals like mice, rats and rabbits, as well as pest birds can also be better controlled by having some of these predators on our farms.

Beneficial Birds

When managing pests, some birds can be extremely beneficial species to our pasture and broadacre crops.

Large birds of prey – the raptors

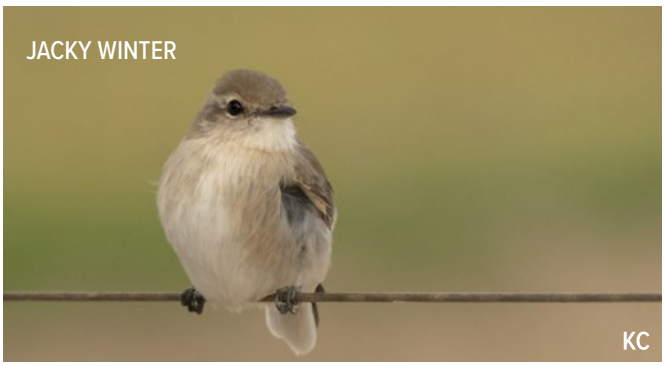
Rabbits are a major pest on farms, especially in pastures where they eat the grasses and damage the land with their warrens and burrows. Native raptors, like whistling kites, wedge-tailed eagles and little eagles, have a significant effect on pest rabbit populations with case studies showing that numbers can be reduced by anywhere up to 100% (Dr. Rebecca Peisley, Charles Sturt University). The presence of these raptors and lack of rabbits as a food source reduces the numbers of foxes in the area. Raptors also provide an extra service by keeping farms clean; disposing of rotting carcasses reducing the spread of disease on a property.

Leaving large, lone paddock trees is essential for encouraging large raptors as they like to nest high in old trees or just use them as perches to survey their territory for food.

The smaller insect eaters

Australia has a lot of native birds that eat pest insects. Jacky winters, thornbills, flycatchers, honeyeaters, fantails, wrens, willy wagtails, robins and pardalotes are all types of birds that prey on pest insects like aphids, scale, caterpillars and grasshoppers. These birds are quick and efficient, allowing them to consume large amounts of pest insects.

These smaller shrub dwelling birds need messy native shrubs and bushes close by to hide from their predators. Leaving stands of native bush close to our agricultural crops or revegetation areas, with small to mid-range native shrubs, helps attract these busy little pest insect munchers.



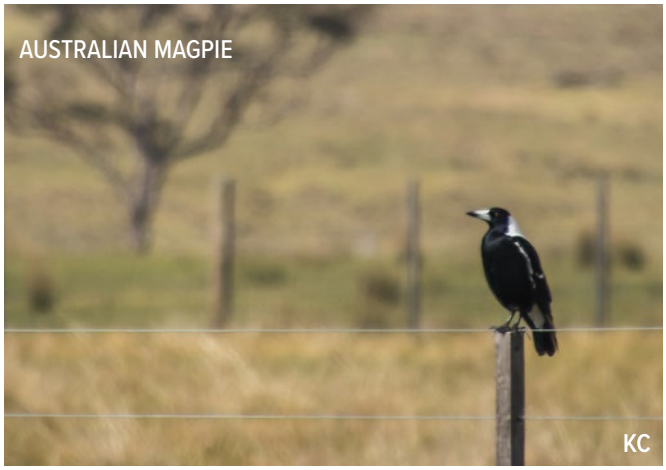

EASTERN YELLOW ROBIN

KC

This territory is mine!

Medium to larger birds like magpies, currawongs, butcher birds, wattlebirds and magpie-larks (mudlarks) can help with pest insect control. Attracting these birds also has an extra advantage as they can be fiercely territorial. By protecting their territory, they can intimidate pest birds like common starlings and European blackbirds, leading to a reduction of numbers in the area.

Close stands of medium to large native trees will help attract these birds.


AUSTRALIAN MAGPIE

KC

Mmm... that's a tasty rodent treat

Medium sized predators like owls, falcons, hawks and kookaburras have fantastic vision and often prey on pest mice and rats as well as larger insects. Having these hunters around can help control rodent populations.

These predators often need large trees close to farms to be effective as pest controllers as they use them as a vantage point to spot their prey. Hollows and large branches and messy areas on the ground should be left to encourage these species.

Domestic birds have their role too

Chickens, turkeys, ducks and geese can all play a role in controlling pest insects on farms. They are voracious predators who love nothing better that munching down insects or digging up grubs, slugs and snails. It is advised to restrict movements of domestic birds from certain areas as they can also cause damage to horticulture, pasture or broadacre crops. It is best to use them in orchards where they can't easily reach fruit, or to clean up pests after crops and gardens have been harvested.


FARM GEESE

MH


EASTERN BARN OWL WITH A SNACK

B

HELPING OUR BENEFICIAL BIRDS

Why not do things a better way and get beneficial birds working to help you sustainably manage your farm, school or home gardens.

Protect existing vegetation

The first step in attracting beneficial birds is to protect existing stands of native vegetation. These areas are extremely valuable as they are already attracting native beneficial birds, insects, lizards, frogs, micro-bats and snakes. Fencing off these areas from stock will help preserve them from being eaten, trampled and compacted. Leaving dead trees, fallen limbs and messy vegetation will encourage native species of all types. Protecting lone paddock trees, leaving large branches and preserving hollows will help give birds and other beneficials a place to hunt and live. Working to rid these areas of weeds will allow the existing native vegetation to flourish.

Revegetation

An important part of integrated pest management is improving the farm or garden's ability to attract beneficials. Revegetating areas that have very few native plants (if any) attracts these beneficials so they can assist in pest control.

When revegetating an area with native plants for attracting beneficials, we need to consider:

Where to plant – identify areas on the farm or in the garden that you think need help from beneficial birds. Some birds have the greatest benefits as pest controllers when their native habitat is close to their food source. Plan to revegetate places that are near the areas you are trying to help.

The range of plant species – different beneficial birds have different needs. Have a range of plant heights to create the best habitat. Include grasses and ground covers, small and medium shrubs and bushes, and medium and tall canopy trees.

Choose local species – talk with experts from a local Landcare group or indigenous plant nursery about plants that are local to your region. Local plants have the best chance of both attracting local beneficial birds and being suitable to thrive in the local climate.

What soil is that - different plants like different types of soil. Identifying the soil type/s in your revegetation site will guide you on the best native species to plant. Knowing the soil type will also show whether extra nutrients need to be added to help the plants flourish.

Water will help – having access to water for your revegetation site helps to keep the soil moist for young seedlings and plants as they are susceptible to drying out. Available water enables the plants to be protected during hot weather and times of drought.

Protect your investment – planting native vegetation is an investment in a sustainable future. Fencing off revegetation sites, installing garden barriers and diverting livestock or people away will help to protect the revegetation plot and give your native plants the best chance to survive.

FOREST GROUNDCOVER FILLED WITH BULBINE LILLIES AND GRASSES

KC

Layers of bushland

Canopy (trees)

Examples:

- Eucalypts
- Acacia (wattle)
- Melaleuca
- Banksia
- Tea tree

Understorey (shrubs)

Examples:

- Hopbush
- Correas
- Grevillea
- Callistemon (bottlebrush)
- Acacia (wattle)
- Sweet bursaria
- Tea tree

Groundcover (grasses and herbs)

Examples:

- Common Tussock grass
- Kangaroo and Wallaby grasses
- Everlasting daisies
- Kidney weed
- Flax lily
- Chocolate lily
- Bulbine lily
- Billy buttons


MUDLARK WITH AN INSECT IN ITS BILL

KC

KC

Artificial help

We can also help to attract beneficial birds and other species by installing artificial habitat and modifying our impact on their lives.

Nests and perches

Some of our native birds need tree hollows to nest in. These hollows usually only form in old trees and can take decades to form. Building and installing nest boxes can provide necessary habitat in environments where the number of old trees bearing hollows is limited. By encouraging the native birds to nest in artificial hollows close to farms or gardens, their ability to work for us as pest controllers is increased.

In a similar way, some of our native birds need lots of branches to use as perches so they can survey the area for food and keep an eye out for predators. Installing artificial perches will encourage native birds to use the area to find food and work for us as pest controllers.

Water

To keep native birds close to farms and gardens, it is important they have access to water. If they have to fly away to get a drink, they may not return. By having bird baths or other water sources easily accessible the native birds will remain in the area and hunt more pests.

Turn off the lights

Native birds have their own schedule based around the time of day they hunt. Some hunt mainly during the day (diurnal), and some hunt mainly at night (nocturnal). If we interfere with their cycles by having things like flood lights on, then they will be less likely to hunt pests in the area. We can minimise this interference by using timers on outdoor lights.

Keep pets under control

Pet (domestic) cats and dogs are predators and can hunt native birds. Restricting your dog's movements to keep them away from native vegetation will encourage native birds to continue hunting pests for longer.

Cats have evolved to become ultimate predators which makes them devastating to native bird populations. They are quick, flexible, stealthy and excellent climbers in combination with being armed with razor sharp claws and teeth. The only way to truly control a pet cat and protect your native birds is by keeping them inside and only letting them outside when in an enclosed cat run.

Feral pests

Foxes and feral cats are the two biggest killers of native birds in Australia. It is estimated that they kill over one million native birds, reptiles and marsupials each night. To attract native fauna to a farm or garden it is recommended that control methods be put in place for foxes and feral cats.

ACTIVITY: SCHOOL ACTION PLAN

Beneficial birds can help control pests in gardens and on farms. They play an important role in integrated pest management. We can attract beneficial birds with stands of native vegetation.

In this activity, you will examine the amount of existing native vegetation in your school grounds and then design a new native garden area that could attract more beneficial birds to the school.

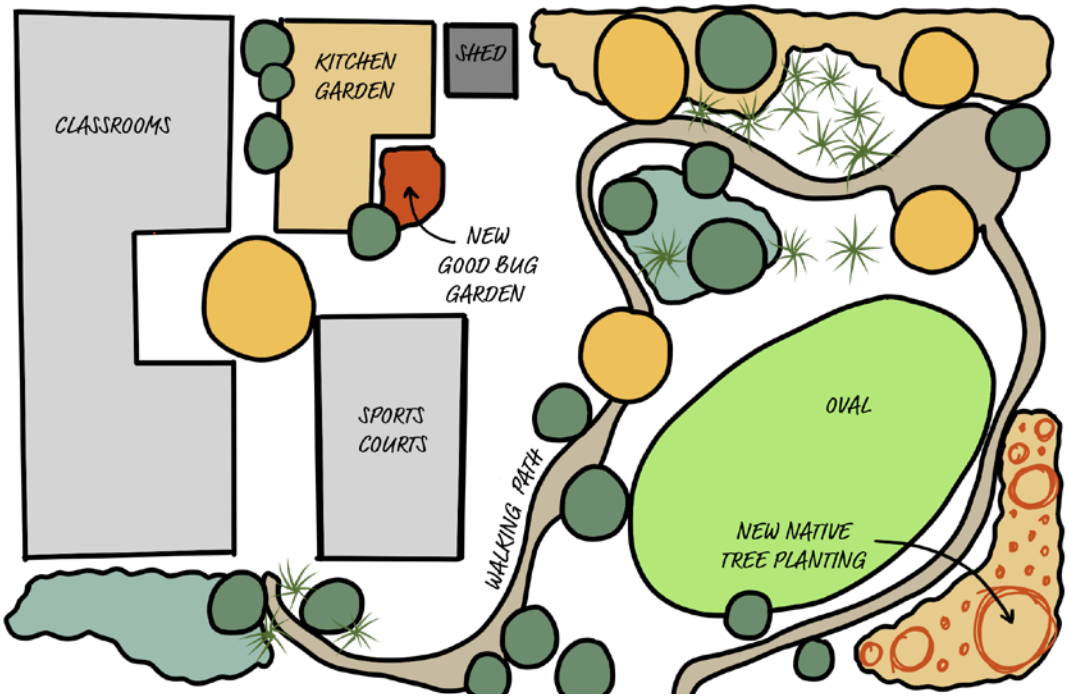
1 Select an area in your school yard that you think would benefit from having more beneficial native birds to control pests. Consider using an area that includes the vegetable garden or fruit trees (orchard). The area should preferably have some open space or garden beds that could be revegetated with native plants to attract beneficial birds.

2 On a full sheet of A4 (or A3) paper, sketch a rough mud-map of your area of the school yard. Mark in the main features including buildings, paths, seats, garden beds and trees. See example below.

3 Do an audit of your area to identify any existing native vegetation (gardens or trees). You may need to ask your teacher to help you to identify which are the native plants. A plant ID app or indigenous plant guide from your local council is also a useful resource for identifying plants.

Highlight the places in green that native plants occur on your mud-map. Highlight the places in yellow that non-native plants occur on your mud-map.

See the example below of a school ground with some buildings, sporting areas, gardens, walking paths and revegetation areas. The **green** trees and garden beds are natives; the **yellow** trees and garden beds are non-natives. The **orange** areas are new garden beds that will be part of your action plan.



Activity: School action plan continued...

4 Does the area in your school yard contain any native plants?

. . . . . .

5 Do you think there are enough native plants to attract beneficial birds to the area? Why/Why not?

. . . . . .

. . . . . .

. . . . . .

6 Does your area contain any places that show a variety of native plants that represent the different layers of a forest? Circle which layer is present:

- Canopy (trees)
- Understorey (shrubs and bushes)
- Ground layer (grasses)

7 Identify a part of your area that you think could be improved by planting native plants to attract more beneficial birds. This should be a space where a new garden could be made, or an existing garden could be revegetated. Mark this space on your mud-map.

8 On a separate sheet of paper sketch a larger scale version of your revegetation space. Make a plan showing how you would revegetate this space to attract beneficial birds.

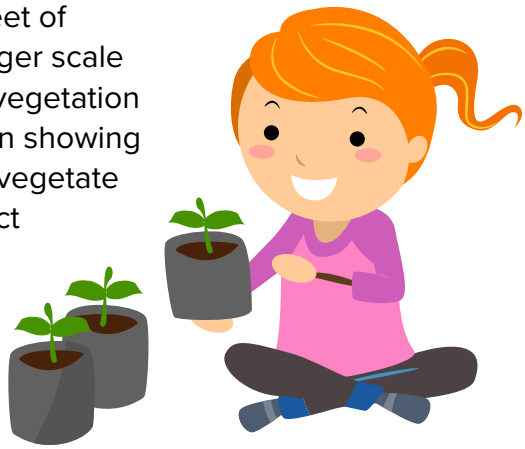
Things to consider for your plan:

- Does the space contain any existing native vegetation that you can protect and use in your design?
- What types of native plants would you use?
- What native plants would combine to represent the different layers of the forest?
- Are the new plants local to your area?
- What other interesting features could you put in the garden (large rocks or stones, water features, artificial perches or hollows)? These features should only ever be bought from a supplier not removed from other natural areas
- How will you protect your revegetation space (fencing, garden edging etc)?

Extension

Come together as a class and compare your revegetation plans. Hold a vote to choose the best plan, or choose the best elements from everyone's suggestions and design a class plan.

As a class, write a letter to your principal explaining why you think the school should consider going ahead with the plan to create your revegetation space.



You never know, if the plan shows potential then your school may seek some funds to let your class go ahead and create this new habitat for your school.

ACTIVITY: A SCARE GOES A LONG WAY

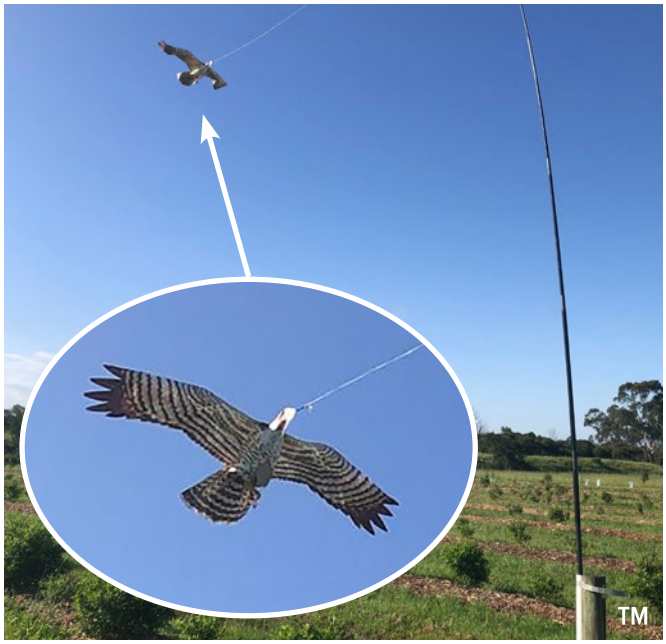
Keeping pest birds away

In Australia, pest birds cause millions of dollars of damage to agriculture each year. They can be devastating to horticulture and broadacre crops by completely stripping or damaging produce in a very short time. Pest birds include any fruit or seed eating birds that have a negative effect on farms or gardens. They can be either introduced or native species.

Using Integrated Pest Management means we try to do things a better way and become more sustainable by using a range of tools to try and protect our produce.

Sometimes a little scare goes a long way...

We are all familiar with the use of scarecrows as a traditional method for trying to frighten birds out of crops and orchards. This is an example of a physical control that is used to try intimidate pests.



Pest birds, like most animals, have a natural instinct to survive, which means they are always on the lookout for predators. One of their major threats are larger birds known as raptors or birds of prey. These include eagles, kites, falcons, goshawks and harriers.

'Bird of prey' kites are increasingly being used to scare smaller pest birds out of crops and gardens. The kites are made to look like a raptor (bird of prey) flying through the area looking for food. Bird of prey kites usually consist of a long telescopic pole with a string that keeps the kite in the air. A swivel head allows the kite to swing around and catch the breeze from any direction. The kites are designed to hover, flap and dive through the air to make any pest birds feel unsafe.

These non-lethal control methods ensure pest birds can be kept away from crops at harvest time but allow them to return when they are no longer a threat to production.

See a kite in action

youtu.be/Rcu3g8BdzYI

Make your own bird of prey

Origami Tutorials, easy origami eagle
origami-tutorial.com/origami-eagle.html

Kite Lover, newspaper eagle kite
youtu.be/o3kMHCEvvvM

BENEFICIAL BATS

Nocturnal insect hunters

Micro-bats are the small, insect eating bats you may see flying at night. These bats are not blind, they just don't use their eyes to find food at night. Instead they use a form of radar, called **echolocation**.

Echolocation works by the micro-bat creating a sound that they use to bounce off objects in front of them. Micro-bats listen to the echoes that bounce back and can 'see' what is ahead of them.

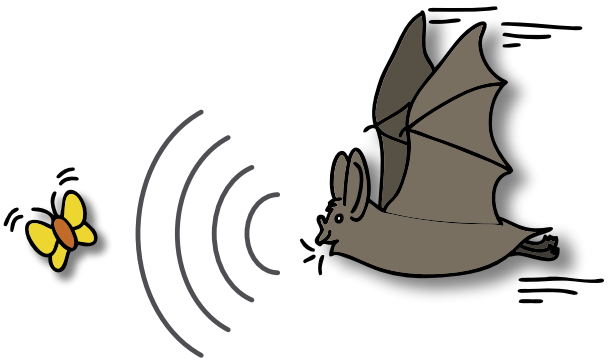
The sound that micro-bats emit is normally too high for human hearing. Sometimes we can hear micro-bat sounds, but these are usually social chatter and alarm calls. What we might hear is a regular tick... tick... tick. Echolocation can usually only be heard using an 'ultrasonic bat detector'.

Echolocation, combined with speed and agility, make the micro-bat a very efficient and accurate hunter. **They can consume up to 300 insects in an hour, having a significant effect reducing pest insect numbers**.

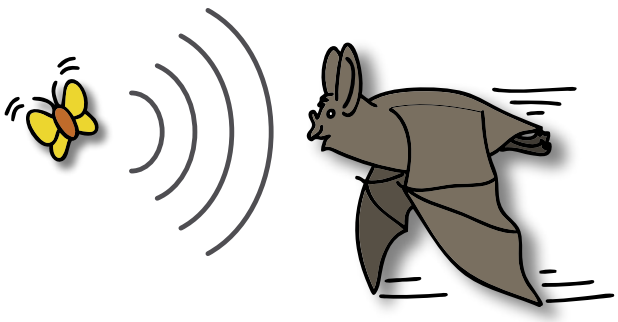
GOULD'S WATTLED BATS WEIGH ABOUT 14 GRAMS AND ARE FOUND ACROSS AUSTRALIA. THEY EAT SCARAB BEETLES, CATERPILLARS, CRICKETS AND MOTHS. (MP)

Bat boxes and small hollows

Micro-bats can be encouraged to your farm or garden by installing bat boxes and retaining tree hollows (even very small ones). Micro-bats will help keep pest numbers down and reduce the need for pesticides.



Echolocation in action



Bat echolocation youtu.be/kp5jyZtoTIg

Echolocation song youtu.be/5mwoOyOleGc

ACTIVITY: A BATTY MEAL

Micro-bats may be little but they have enormous appetites.
These hungry bats can eat up to 300 insects in an hour.

1 If Minnie the micro-bat leaves her Healesville home at dusk (7:00pm) and returns at dawn (5:00am) how many hours does she spend hunting?

1

2 On Monday night, Minnie catches 200 insects every hour. What is the total amount of insects she catches for the night (using your previous answer)?

2 HINT = hours x insects

On Tuesday night, Minnie's big insect hunt was very successful. The table below shows how many insects she caught every hour that she was out hunting.

TIME	INSECT COUNT	TIME	INSECT COUNT
7:00pm - 8:00pm	110	12:00am - 1:00am	360
8:00pm - 9:00pm	150	1:00am - 2:00am	230
9:00pm - 10:00pm	180	2:00am - 3:00am	200
10:00pm - 11:00pm	230	3:00am - 4:00am	150
11:00pm - 12:00am	300	4:00am - 5:00am	100

3 How many hours does Minnie hunt for on Tuesday night?

3

4 How many insects in total does Minnie eat on Tuesday night?

5 What is the average number of insects that Minnie eats in an hour on Tuesday night?

4

6 Minnie lives in a cave in the nearby hills with her colony of 2300 bats. If all 2300 bats catch as many insects as Minnie did on Tuesday night, how many insects would they have caught in total?

5 Average = total insects ÷ total hours

7 Using your answer from question 6, calculate how many insects the colony would eat in a year?

6

8 Why do you think having a healthy population of micro-bats in your area is an important natural pest control method?

7

8

POLLINATION

Helping our produce grow

Beneficial species that we can encourage to our farms and gardens can also play an essential role in pollination. Pollination is how flowering plants create fruits and seeds so they can reproduce. These fruits and seeds are also a major part of agriculture as we harvest them to feed our population.

ORANGE PALM-DART SKIPPER FEEDING ON A FLOWER AS POLLEN IS DEPOSITED ON ITS HEAD

KC

EUROPEAN HONEY BEE FEASTING ON A PASSION FLOWER

KC

The beneficial pollinators, like birds and insects, drink nectar and eat pollen from plants or come into contact with them as they search for their prey. As they move from flower to flower, they carry tiny pollen grains that stick to their limbs and bodies. These pollen grains come into contact with other flowers and pollination occurs.

In fact, the whole reason that plants have evolved to have flowers is to attract pollinators so they can reproduce successfully. That is why flowers are so bright and colourful with lots of variations as they try to attract the best pollinator for them.

Some flowers have a particular scent that attracts a particular pollinator. Others have unique patterns to make the insect pollinator think the flower is another insect they can mate with. The complexity of some plants to target pollinators is quite incredible.

A buzz about bees

Bees are our most important pollinators. They have special hairs on their undersides that allow them to collect and carry large amounts of pollen. We rely on both the introduced European honey bee and around 2,000 known native bee species to pollinate our agricultural crops and native plant species.

Pollination of crops by bees is integral to Victorian agriculture and horticulture. Without bee pollination some crops would suffer greatly reduced yields. (Agriculture Victoria)

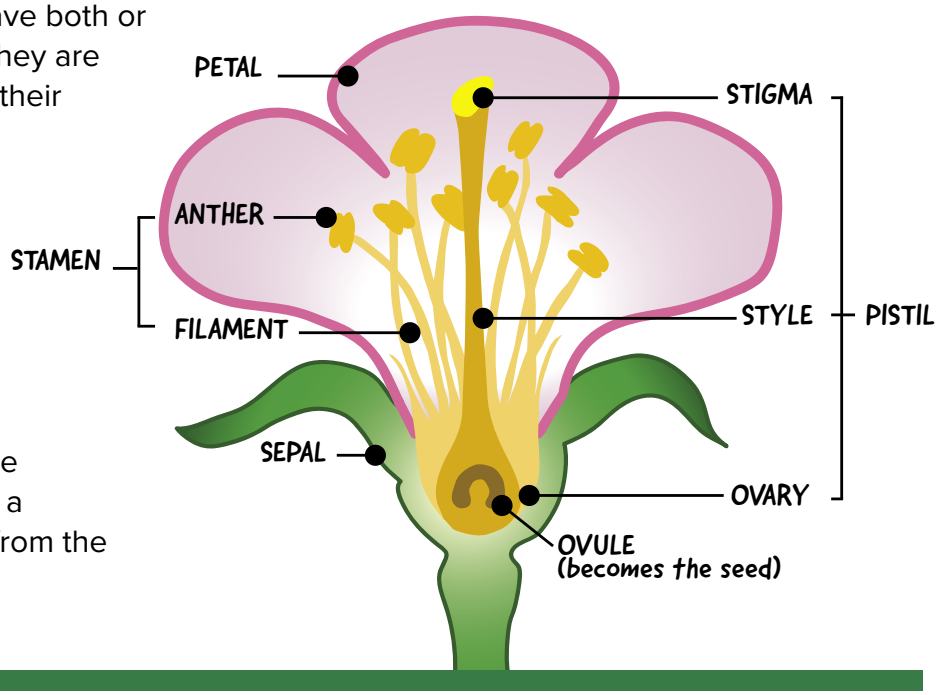
Common Pollinator and Beneficial Insects of Victoria: bit.ly/pollinator-guide

ACTIVITY: PARTS OF A FLOWER

In order to reproduce, plants have both or either male and female parts. They are usually located in the centre of their flowers.

Some species of plants have flowers that contain both female and male parts and need a pollinator to spread the pollen to another plant flower of the same species.

Other plants have separate male and female flowers which need a pollinator to spread the pollen from the male flower to a female flower.



YOUR TASK

Select 2 or 3 flowers from different plants in your school or home garden.

Gently break the flowers apart so you can see the different parts of a flower. You might like to ask your teacher to cut your flowers through the middle using a knife or scissors.

How many parts of your flowers can you identify?

Sketch a picture of your flowers and label the different parts you can identify.

Label your sketch showing whether it is a male flower, female flower or contains both parts.

FOR MORE INFORMATION

Port Phillip & Westernport CMA . . . . . ppwcma.vic.gov.au

Farms2Schools ppwcma.vic.gov.au/farms2schools

AUSVEG Victoria . . . . . ausvegvic.com.au

Cesar Australia . . . . . .cesaraustralia.com

Agriculture Victoria . . . . . agriculture.vic.gov.au/biosecurity/pest-insects-and-mites

Bugs for Bugs . . . . . bugsforbugs.com.au

Grains Development Research Council
Beneficial Insects - the back pocket guide . . . . . bit.ly/grdc-beneficial

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TMDP	T. Meredith & D. Papacek (Bugs for Bugs)
JP	J. Parsons (Fraser Coast Micro-bat Group)
GF	Gazzola Farms
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MP	M. Pennay (Flickr CC BY-NC-ND)
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