



Composting and worm farms

Action projects that recycle your school's organic waste

Quality for Life



greater WELLINGTON
THE REGIONAL COUNCIL

Environment

This booklet offers practical advice on recycling waste through composting or worm bins in school.

By creating composting systems in your school you can:

- create healthy and productive soils in your school
- reduce the amount of waste going to our landfills
- prevent waste from entering our storm water systems and streams
- get students involved in environmental care
- increase the native biodiversity of your school grounds
- help conserve water in your school gardens.

Composting and worm bin projects provide an opportunity for students to do practical longer-term action projects that take action for the environment.

Environmental projects are excellent teaching tools that can enhance learning across the curriculum. More information about curriculum integration can be found at the end of this booklet.

The Greater Wellington Action Crew can help you and your class set up composting systems and give you plenty of advice about their longer term care.

This booklet is one of a series for teachers to help students do practical and effective action projects as part of *Take Action for Water*.

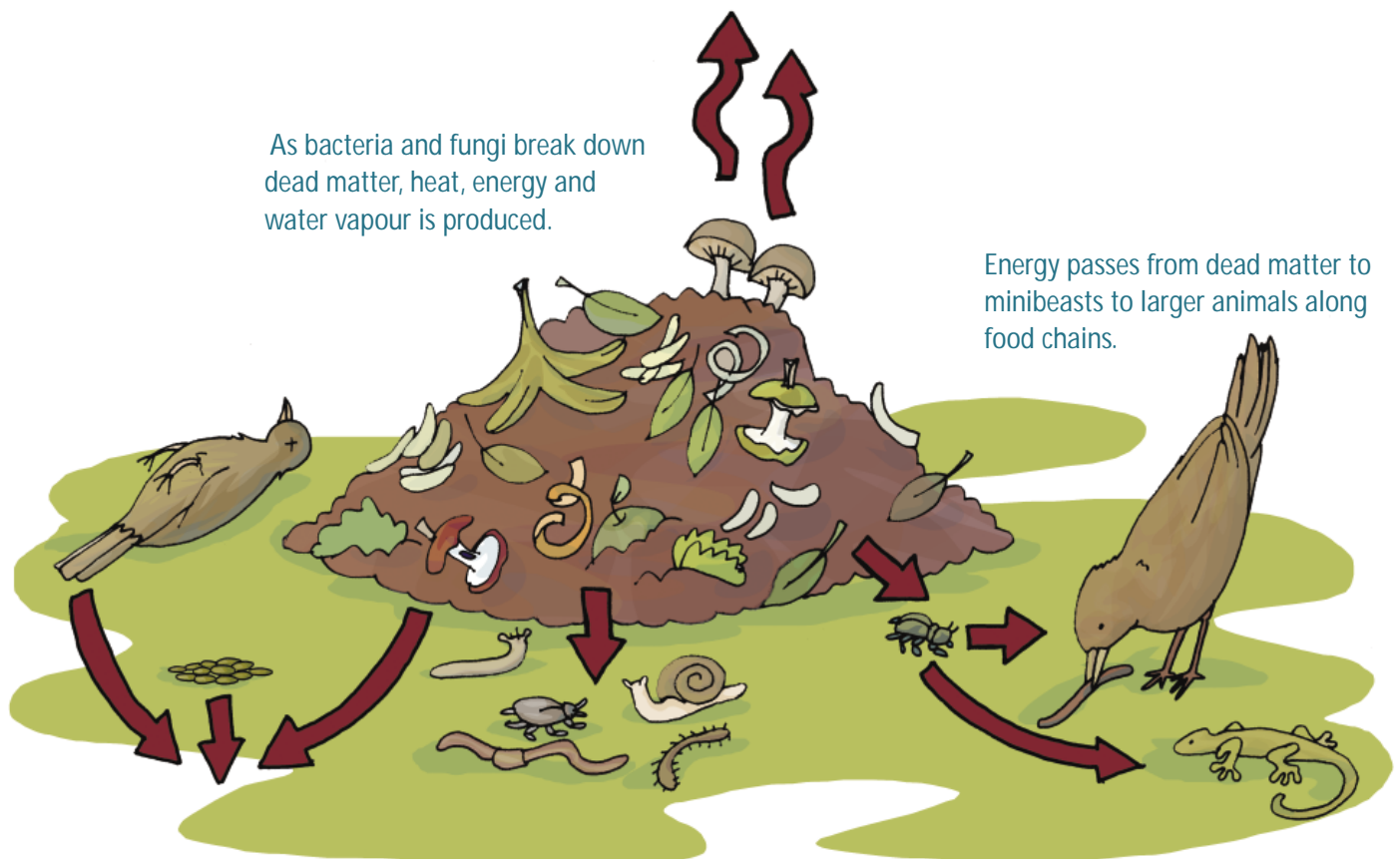
Teachers can use the action projects described in the series to tailor *Take Action* to the school's environmental interests and circumstances. This series can also be used to support long term environmental education in schools.



Take action!

Using a worm farm or compost system, you and your students can improve the health of the soil at your school and increase biodiversity. Biodiversity is the variety of life on earth – plants, animals, and micro-organisms, the genes they contain and the ecosystems they form.

Composting and worm farms replicate nature's recycling system. Slaters, worms, slugs and other animals, together with fungi and bacteria, naturally decompose or break down dead plant matter to produce humus. Humus is a rich, dark material similar to forest litter. This organic matter makes the soil healthy and productive. It improves aeration and assists mineral and water retention. Soils that are healthy contain about 10% organic matter (humus).



As bacteria and fungi break down dead matter, heat, energy and water vapour is produced.

Energy passes from dead matter to minibeasts to larger animals along food chains.

Bacteria and fungi release energy and nutrients trapped in dead plants, animals and faeces to the soil.

Dead matter is eaten by detritivores such as snails, worms, beetles and flatworms.

Why set up a worm farm or compost system?

- Using compost in school gardens increases the biodiversity of the soil. Although you can't see the microscopic organisms breaking down matter in the soil, you might be able to see these detritivores that eat dead matter in the compost:
 - centipedes, millipedes, worms, flatworms, springtails, flatworms, snails, beetles, and slaters
- Soil that is rich in life is vital to support a wide range of plants and animals above ground level. Birds and reptiles feed on soil insects and earthworms help aerate soil and improve drainage.
- The garden waste and food scraps that go into compost make up a large proportion of the waste schools send to landfills each week. As less rubbish is sent to the landfill, the school's waste removal costs will be reduced.
- If less waste is sent to the Region's landfills, their life expectancy will be extended, meaning fewer will need to be created in the future.
- If more waste is composted, fewer odours and gases will be released and the risk of polluting local waterways will be reduced.
- Compost makes perfect mulch. Mulching school gardens helps reduce the evaporation of water from the soil and inhibits the growth of weeds. Watering the grounds less often helps reduce the school's water bill.
- Worm bins and composting systems can be used as a basis for scientific experiments. Students can observe and study the entire cycle from "yucky" food scraps and other organic waste to something that is pleasant to use and is good for the soil.

Worm farms or compost?

The type of organic waste produced at your school will influence your decision whether to use worm farms or composting to recycle that waste into useful products.

If you want to recycle just food scraps, worm farming is the best option and is more interactive for students. The size of your worm farm will depend on the number of classrooms that will help feed the worms.

If you want to recycle mostly garden waste and some food scraps, then composting is the better option.

Alternatively you can use both systems, which will ensure that your school's organic waste going to landfill is as little as possible. Any organic waste that can't be recycled using a worm farm should be recyclable using composting.



Worm farms

Worm farming is fun for everyone. It is interactive, fascinating and an excellent way for children to become environmentally aware as worm farms replicate nature's recycling system. Properly maintained worm farms are odourless, can be kept inside or out, take up little space, and only need a small amount of time and effort to recycle food waste.

Worm farms produce three main products:

- Worm casts or faeces, which are high in nutrients. These can be mixed with potting mix, garden soil or used as a mulch.
- Vermi-liquid ("worm wees"), which is the liquid that drains through into the collection bin. This is very high in nutrients and can be used as a liquid fertiliser once it has been diluted with 10 equal parts of water. Diluted vermi-liquid can be used on houseplants and in the garden.
- More worms. Over time your worms will breed and outgrow the space available. You can then remove some worms and give them away to other people to start their own worm farms.

The basics

There are different types of worm farms available from shops around the Region. They are all based on a similar principle, which can be replicated using various recycled items, such as tyres, ice-cream containers, old baths and stackable plastic boxes.

The basic principle is illustrated on page 5. A simple worm farm consists of a 'collection container' (the bottom bin), one or more 'working bins' (you can have several of these), and a secure lid. The lid needs to have tiny holes to allow the worms to breathe but they must not be so large as to allow them to escape!

The working bins are stacked on top of the collection container.

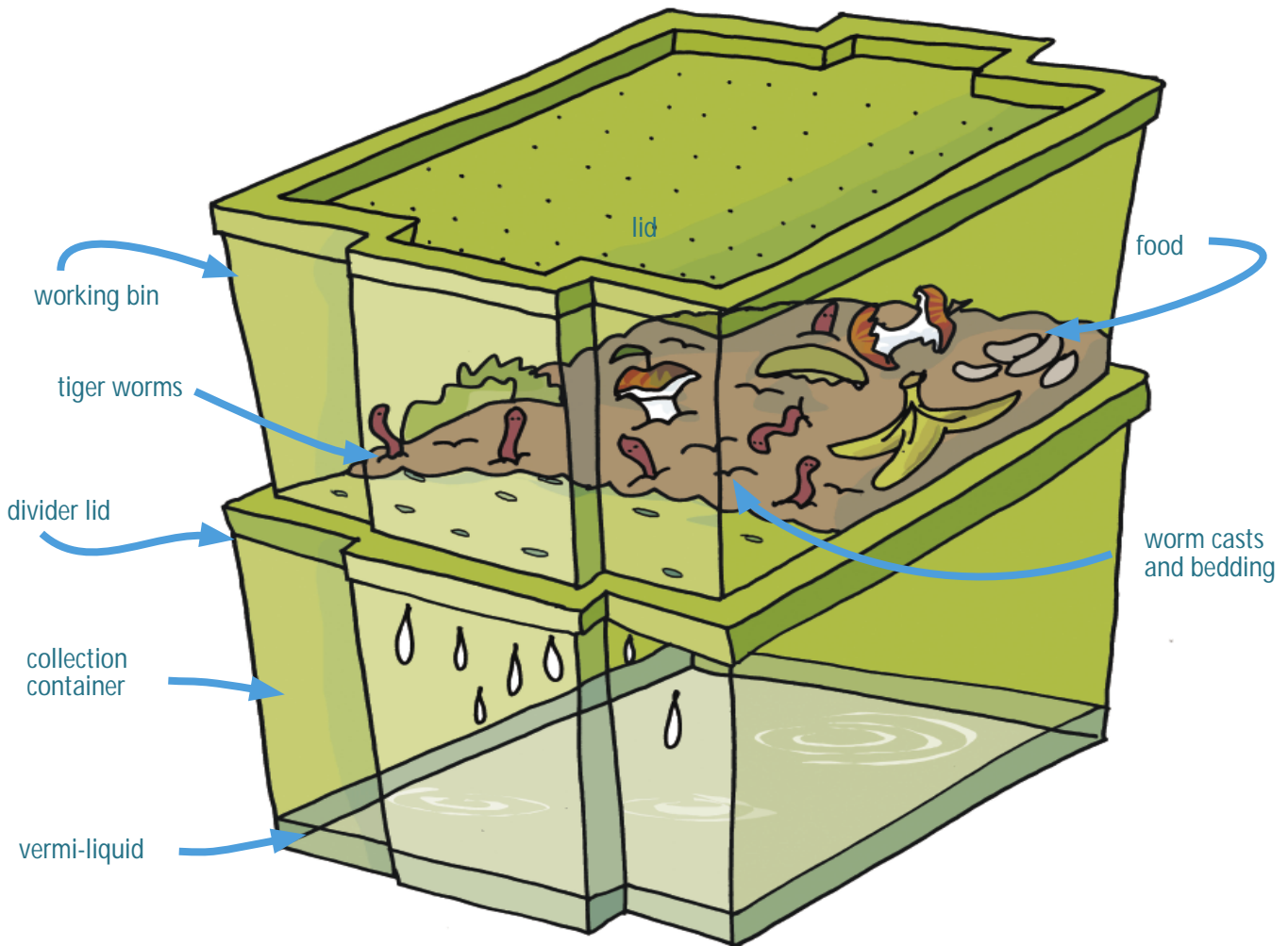
The collection bin needs a solid base so that the vermi-liquid can be stored. A tap can make it easy to collect this liquid. If this is not possible, you will need to take your worm farm apart to empty the liquid on a regular basis.

Divider lids separate and support the working bins. These have larger holes in them that allow the worms to move between the layers, and the vermi-liquid to drain through to the collection bin.

The Action Crew can give you plenty of help when making a worm farm.



Old baths can be used to make worm farms. They can be plumbed in to collect the vermi-liquid from the plug hole!



Setting up your worm farm

Worm farms can be set up indoors or outdoors. If outside, place your worm farm out of direct sunlight and heavy rain. It should be in a safe area that is easily accessible.

- Fill your working bin about 1/3 full of soil or potting mix.
- Place the working bin on top of the divider lid and collection container.
- Spray water over the soil or potting mix to moisten, add your tiger worms or red worms, and a little food.
- Place some form of bedding over the soil and worms. This can be damp newspaper, an old sack or carpet (newspaper will need to be replaced at a later date as the worms will eat it. It is a great source of fibre for them).
- Finally, place the lid on top of the working bin.



Where to get worms

Worm bins need hungry tiger worms to work well. They can be found in compost bins or at stables, but it is easier to buy them. The Action Crew can tell you where to find tiger worms. We may even be able to provide some out of our office worm farm!

Why tiger worms or red worms?

Tiger worms and red worms are especially suited to worm farming. Both these species of worms thrive on moist organic material, such as food scraps. The worms eat approximately their own weight in food everyday. This will give you an idea of the amount of food your worms will need.

It doesn't matter if you can't get enough worms to start with, simply reduce the amount of food being placed in the bin. In ideal conditions the worms will double in number about every 40 days.



What do worms eat?

Worms need to be regularly fed with small amounts of fresh, chopped, food scraps. These should be mixed into the worm's bedding area. Take care not to overfeed the worms. If rotting food accumulates on the top of the bedding mix you are giving too much food to the worms. Worms eat almost anything including newspaper, vegetables, fruit, and eggshells. They prefer not to eat spicy foods such as onions, garlic or curry, or acidic foods such as lemons, oranges and kiwifruit. Bones are too difficult for worms to eat, and meat, fats and oils should be avoided as these can attract vermin.

Maintenance

To prevent unwanted insects in your worm farm mix, the worms, their food and bedding in the working bin every few weeks. A layer of newspaper also helps prevent flies laying eggs on the food scraps.

Using the products of your worm farm

After a while (several months) the working bin will become full of worms and worm casts. At this stage you can collect your worm casts to use on your garden, but first you need to separate your worms from their casts. This can be done in one of the following ways:

- Add a second working bin on top of the existing one. As fresh food is placed in this top bin the worms will slowly crawl through the divider lid and come up from the lower bin.
- Manually separate the worms from their casts. To do this spread the contents of the working bin on a tarpaulin in a cool place and quickly pick out the worms! Children love this activity! The castings and worm eggs can be collected, leaving a small amount to go back with the worms into the working bin.

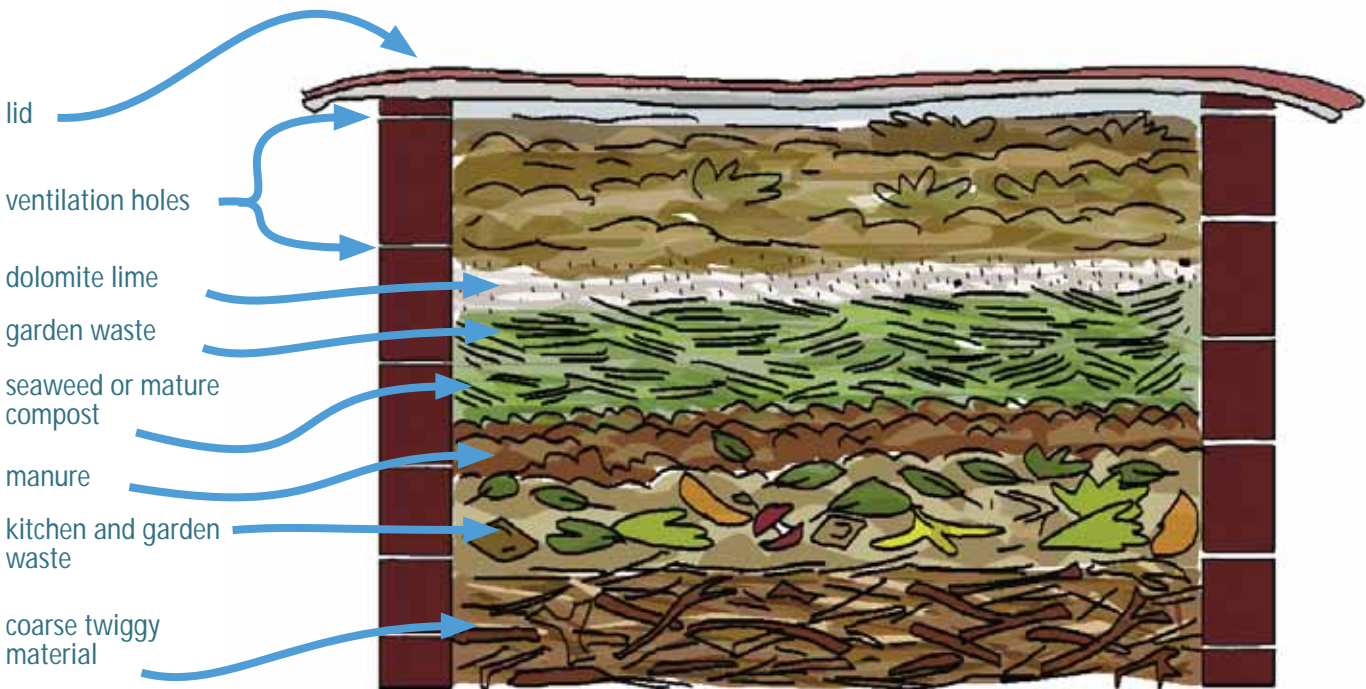
The vermi-liquid in the collection bin needs to be removed every few weeks. This can be used as a liquid fertiliser once diluted. Using vermi-liquid means gardeners do not need to use chemical fertilisers. Some schools have reused plastic containers to bottle up the vermiliquid and sell it as a fundraiser at school events!

Composting

There are many different ways of making compost but they all rely on micro-organisms to break down dead organic matter. Fungi and bacteria work best when the compost is well aerated (to provide oxygen), moist but not soggy, and warm. Successful composting takes time but by following the guidelines below your compost should be ready for use in 3-6 months.

How to make compost

Compost bins and heaps come in all shapes and sizes. Many different types of plastic bins can be purchased. Alternatively you can reuse wood to make a bin, or even start a simple pile against a fence or wall. To encourage invertebrate life avoid using painted or treated wood. The components of a successful heap are illustrated below.



Your compost bin or heap should be placed on a flat site in a sheltered area, close to the source of organic waste. Avoid making compost too close to classrooms, in case the heap gets smelly. The heap should not be placed where insecticide sprays might be used. These may kill off those helpful decomposing invertebrates.

Dig over the soil underneath your bin or heap, to aid drainage and encourage earthworms. Ensure adequate aeration is provided at the bottom. This may mean you need ventilation holes in the walls of the bin.

Begin by placing a 10-15cm layer of coarse twiggly material at the bottom to ensure good drainage and air circulation. Cover this with a 15-20cm layer of well mixed kitchen and garden waste. Use as wide a variety of materials as possible. Use shears or scissors to cut up large pieces. Do not compact materials after placing them in position. If materials are dry, lightly moisten them.

Next add a 5cm 'activator' layer of animal manure, seaweed, soil or mature compost. Alternatively, substitute a handful of blood and bone fertiliser. These materials provide readily available nitrogen, which will help accelerate the composting process.

The best possible decomposition takes place when there is slightly more carbon than nitrogen present. As a guide, dry, brown, woody materials are rich in carbon while soft green matter, fruit and animal manure are rich in nitrogen. Cutting up the larger pieces will help speed up the composting process.

Cover your completed compost system with a lid of cardboard, carpet or wood to retain the heat and moisture and keep out the rain. Continue to add layers of organic matter in the form of garden waste and food scraps when they are available. Sprinkle a little dolomite lime every few layers to prevent the composting system becoming too acidic.

Using the products of your compost bin or heap

Compost that is ready to use is fine, crumbly, dark in colour and has an 'earthy' smell. The finished compost may be passed through a 1 - 2cm mesh and any rejected larger particles can be returned to the heap. If enough compost is produced to meet the school's needs, the compost can be sold as a fundraiser.

If your composting system is a permanent structure, consider having one side that is removable to help take out the finished product. You may also want to consider having separate compartments so your system can continue working at all times. Once one compartment is full, you can start using the next one, leaving the compost in the original compartment to decompose and become ready for use.



Things to consider

It is best to discuss starting a compost heap or worm farm with your principal, board of trustees, caretaker and other teachers in your school. The location of the equipment will be important and it is good to make sure that a long-term care plan has been created. Your class could educate other students about their action project. This can be done using posters, signs, roll notices and assembly presentations. Other things to consider for worm farms are:

- location of the worm farm - avoid areas with any strong vibrations, smells or areas that are too wet
- temperature - worms prefer to be kept at between 10 and 25 degrees Celsius. Do not leave your worm bin in direct sunlight
- size - can you lift the containers easily? Can you create enough food for the worms?
- collection of materials - how close is the worm farm to your classroom?
- ongoing care and maintenance - who will feed the worms in the holidays?
- quantity of food - feed little and often (surplus food can be composted).

Chopping of food scraps speeds up the process. Add small amounts of food regularly, rather than large quantities. This will help deter flies.

There are some things that **should not** be put into compost bins or worm farms. These include:

- dog and cat faeces or cat litter
- metal, glass and plastic (these can be recycled separately)
- roots, flowers and seeds of persistent weeds such as Oxalis, Convolvulus (bindweed), Tradescantia (Wandering willie), docks, and dandelion.
- leaves with diseases or residues of chemical sprays, such as hormone type weedkillers
- fish and cheese
- cooked food, especially meat. Meat tends to attract rats and mice
- glossy paper brochures
- treated wood / sawdust
- bones
- coal ash.

Health and safety

Wear gloves when handling worm farms and compost heaps. Children should be taught how to handle organic waste and open and close containers safely. Hands should be washed after handling the equipment, especially before handling food. Care must be taken to avoid breathing in any particles from the top of the compost or worm farm.

Support material

Problem solving for composting systems

If your compost is not giving off heat or reducing in height, it may be because of one of the following reasons:

Problem	Cause	Solution
Heap slimy and smelly	Not enough air and too wet due to too much green waste	Turn compost to increase air circulation. Add brown, high carbon material such as straw, woody matter and leaves.
Heap moist, but the volume is not increasing, despite adding new material	Lack of nitrogen in waste causing 'pancaking'	Add green waste like grass cuttings, leaves, animal manure, prunings or blood and bone.
Heap is warm and moist in the middle only	Heap too small to insulate itself, or not enough air circulating in the heap	Increase the size of the heap, rebuild in a more sheltered area. Turn the heap to increase the air flow through it. This should help increase the temperature.
Layers of partially decomposed material	Large material has not been mixed with fine materials	Break up clumps of material with a garden fork. Make sure new material added is finely chopped.
Heap dry with poor decomposition	Not enough moisture, maybe too much coarse material	Turn heap, moisten and add more green material.

Problem solving for worm farms

If your worms start to die, it may be for one of the following reasons:

Problem	Solution
Bin is too wet and worms are drowning.	Drain excess moisture. Add layers of shredded newspaper or pea straw.
Bin is too dry and worms cannot move easily.	Spray the compost with a small amount of water.
Number of worms has reduced.	Monitor your worms carefully, as they will die quickly without food. Feed little and often, at least one handful of chopped waste per week.
Lots of white small thin worms, which indicate the contents of the worm farm may be too acidic.	Spread a little dolomite lime onto the bedding material.
Fruit flies appear. These look like sand flies, but they don't bite.	Use only fresh food and avoid rotting food. Do not overfeed the worms. Feed the worms a varied diet. A layer of damp newspaper and a lid over the contents of the working bin will reduce this problem.

Wormy facts - did you know?

- There are over 6000 species of worms in the world. We have over 170 species of worms in New Zealand.
- Worms have been around for 120 million years!
- The Latin name for tiger worms is *Eisenia fetida*.
- Worms don't have teeth. They take in oxygen from the air through their skin. They need a moist environment for this to take place
- The average life span of a worm is one year. They can reproduce up to three times a week. Worms are hermaphrodite - they have both male and female reproductive organs. They lay eggs that take 14-21 days to hatch.
- Worms can consume more than their weight in organic matter each day.
- The North Auckland worm reaches up to 1.4 m long and 11mm in width.



Curriculum integration

You can use environmental projects such as these to enhance learning across the curriculum. Please refer to p6 of the *Take Action for Water* teachers' book for information relating to curriculum links and learning opportunities for students doing action projects.

The curriculum links below are a few of the more specific achievement objectives that relate to worm farm and composting action projects:

Science

Making sense of planet earth and beyond

- Level 2 – students can investigate easily observable physical features and patterns and consider how the features are affected by people. e.g. comparing humus content of soils from the school grounds with those from a well composted garden.
- Level 3 – students can justify their personal involvement in a school or class initiated local environment project.
- Level 4 – students can investigate a local environmental issue and explain the reasons for the community's involvement e.g. gardeners making compost, Greater Wellington using worm bins in the office.

Making sense of the living world

- Level 4 – all objectives in this strand assist students to develop awareness of, sensitivity to, and knowledge and understanding of the natural environment.

Making sense of the material world

- Level 4 – students can investigate the positive and negative effects of substances on people and on the environment e.g. man-made fertilisers and compost.

Health and physical education

Personal health and physical development

- Level 2 – students can identify and use safe practices and basic risk management strategies, e.g. washing hands after touching waste or compost.

Water, air, earth and energy: elements in Greater Wellington's logo combine to create and sustain life. Greater Wellington promotes **Quality for Life** by ensuring our environment is protected while meeting the economic, cultural and social needs of the community.

Greater Wellington
Regional Council
Wellington Office
P O Box 11 646
T 04 384 5708
F 04 385 6960
W www.gw.govt.nz

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