

## Composting At Home

Composting is a biological process during which naturally occurring micro-organisms, bacteria and insects break down organic materials such as leaves, grass clippings and certain kitchen scraps into a soil-like product called “compost”. It is a form of recycling, a natural way of returning needed nutrients to the soil.

By composting kitchen scraps and organic garden waste at home, you can conserve valuable landfill space normally used to dispose of this material. When this material goes to landfill it will break down, but as it is mixed with other materials and compacted, it rots anaerobically – without air. This means that methane gas is produced, rather than carbon dioxide. Methane is thought to be about twenty times a more potent greenhouse gas than carbon dioxide. Composting is practical, convenient and can as it is done in situ; there are no transportation costs to you, the local authority, and to the environment too.

By using compost you return organic matter and nutrients to the soil in a form readily usable to plants. Organic matter improves plant growth by helping to break heavy clay soils into a better texture, by adding water and nutrient-holding capacity to sandy soils, and by adding essential nutrients to any soil. Improving your soil is the first step toward improving the health of your plants. Healthy plants help clean our air and conserve our soil, and of course if these are fruit and vegetable plants, you can expect a better yield.

### How to Compost.

Composting is easy. You can compost in your garden by saving garden waste (e.g. leaves, grass clippings, prunings and twigs) and certain kitchen and meal scraps by preparing them properly and placing them in a compost pile. Just follow these easy, basic guidelines:

#### Choose the right materials

##### Do Compost

- Fruit and vegetable scraps
- Egg, peanut and nut shells
- Stalks, stems and vines
- Coffee grounds and filters, tea bags
- Bark
- Wood ashes (in limited amounts)
- Manure (horse, cow, chicken & rabbit)
- Garden clippings
- Leaves
- Grass clippings
- Apple cores and citrus rinds
- Scrunched up newspapers
- Cardboard (egg boxes, toilet roll tubes)

##### Do Not Compost

- Meat and fat
- Fish
- Poultry
- Bones
- Dairy products
- Plastic or synthetic fibres
- Diseased plants
- vegetable oils
- Dog and cat faeces
- Weeds which have gone to seed
- Invasive weeds
- Nappies (unless they are fully biodegradable)

Anything that was once alive will compost, but not everything belongs in a compost pile. In general, do not compost foods containing animal fats (such as meat, bones, cheese, grease and oils); plants infected with disease, invasive weeds, weeds that have gone to

seed, or dog and cat faeces. Garden trimmings, like leaves, grass clippings, prunings, garden debris, and most kitchen scraps make excellent compost.

### **Select and prepare a site**

First, choose a place in your garden to start your compost. It doesn't really matter if it is in the sun or shade, but a place that receives a little of both during the day would be ideal. Put your bin on a level, well-drained spot to allow water to drain out. Make sure worms can get in from below to help break down the contents. What's more important is that it is somewhere convenient to use. Then, decide what sort of container to use for your compost. There are many different options, and it's really personal preference which one you choose. You can choose to:

### **Build your own compost bin.**

Enclosed bins will typically have a neat appearance, help keep out pests, and hold in heat and moisture. You can assemble wooden stakes and chicken wire into a simple round enclosure; construct a wooden bin out of reclaimed timber or old pallets; or even drill holes in the bottom and sides of a rubbish bin.

### **Purchase a compost bin.**

You can get a ready-made compost bin from a garden centre or DIY / hardware store, or look in a mail order garden catalogue. There are many designs and models with different storage capacities, available, either made from plastic or from wood. Some models, such as the Green Johanna, are designed to accommodate cooked food, as the composting process is faster as it is more insulated than other plastic models.

### **Starting your compost heap**

It is not uncommon for gardening literature to state that a compost heap should be built up in layers, and many keen gardeners will insist that this is the correct way to build a heap. However, it is not necessary to build up your compost heap in layers. The basis for this advice is mainly to help the gardener attain the correct balance of 'greens' and 'browns', which is important in any compost bin. In reality, the waste of the average household may not be produced in sufficient quantities to allow layering to be carried out. This does not need to be a problem. Instead of using layers to measure equal volumes of greens and browns, why not just balance each bucket of kitchen waste with a bucket of cardboard or straw for example. In fact, because the bacteria in the compost need both greens and browns to prosper, the closer together these two types of material are the better.

One other thing to bear in mind is that a layer of twigs or branches at the bottom of a compost bin or heap can be a great way of helping to achieve a vertical flow of air through the material.

Make sure you keep your "greens" and "browns" properly balanced. If your compost is too wet, add more "browns". If it's too dry, add some "greens". Ensure there is enough air in the mixture. Adding scrunched up bits of cardboard is a simple way to create air pockets.

'Greens' (they rot quickly and provide important nitrogen and moisture):

- Fruit and vegetable peelings,
- Teabags;
- Plant prunings; and
- Grass cuttings.

'Browns' (they rot more slowly, provide fibre and carbon, and create air pockets):

- Cardboard egg boxes;
- Scrunched up paper; and
- Fallen leaves.

### **Keep it moist**

The pile should be kept moist, but not soggy, about the consistency of a wrung-out sponge. If it's not moist, it won't decompose.

### **Give it air**

Oxygen is essential to the organisms breaking down the materials. Fluff the pile with a garden fork or a special tool for the job – composting aerator (pictured - check gardening catalogues) every time you add material. If you can manage to do a more aggressive turning in the spring and autumn (so that the compost is turned completely inside out and upside down), you can usually get finished compost in one year. Less frequent turning results in slower composting.

### **Observe your compost**

As composting takes place, heat is generated. Don't be surprised if you see steam rising from the compost in the warmer months. This means the conditions for decomposition are at their best. If your compost heap is properly prepared, contains no animal fats and is turned periodically, it should not attract pests or create odours.

### **Test whether the compost is ready**

Decomposition will be complete anywhere from three months to two years depending on the materials used, the size of the pile, and how often it is turned. Your compost will most likely be ready in around 6-9 months to a year. Finished compost is dark brown, almost black in colour, has a spongy texture and a pleasant earthy smell.

### **Use the compost**

About one month before planting, apply 1-3 inches of the finished compost and work it into the top four inches of soil. Compost can also be used in the garden as a top dressing or mulch throughout the summer. Screened through a ½" sieve, compost can be used to create a potting compost mix by combining equal parts of compost, soil and leaf mould / coir. Large particles can be put back in the compost bin.



Compost Aerator

## Compost Troubleshooting

<b>Symptom</b>	<b>Probable Cause</b>	<b>Suggested Remedy</b>
The compost heap has a bad odour	Not enough air or too wet	Turn pile thoroughly
The centre of the compost heap is dry	Not enough water	Moisten materials while turning pile
The compost heap is damp and warm in the middle, but nowhere else	Pile is too small	Collect more material and mix old material into a new pile
The pile is sweet smelling, but still will not heat up	Lack of nitrogen	Mix in a nitrogen source such as fresh grass clippings, fresh manure, and urine.

## Composting with Worms

### Worm Composting / Vermicomposting

Composting is a natural process in which organic matter decomposes into a dark nutrient rich soil improver. In a natural setting, decomposition happens slowly, with the work being mainly done by microbes, bacteria and fungi, which breakdown organic matter into compost. Larger creatures in the soil such as worms, slugs, centipedes play a relatively small role. When we do normal composting at home or at school, we speed up this natural process by ensuring that the conditions are just right for the microbes to work efficiently. This means we need a good balance of carbon and nitrogen rich materials, the right moisture levels, and plenty of oxygen available in the form of trapped pockets of air, this can be aided by regular turning.

Composting with worms or “vermicomposting” concentrates the amount of worms to the point where they become the major players in the decomposition process. Microbes still play a role but are now overshadowed, so to speak, by the worms. As the worms burrow through the bedding and other organic matter they create the air spaces necessary for efficient decomposition. Therefore, turning is not required. Proper moisture levels must still be maintained and the right combinations of carbon and nitrogen materials must still be kept up. When proper conditions are created, composting with worms is simple, clean, and odour free. Worm composting is essentially an efficient method of turning ordinary organic kitchen food waste into nutrient rich products – either as a liquid feed or as compost, depending on the design of your wormery. Unlike garden composting, in which heat builds up, it is a cool process and works by the addition of food waste on the little and often basis. The end product is also far more nutrient rich than that from a common or garden composter.

There are many different styles of wormery, which you can either buy or make, and depending on style can be used either inside or outdoors. But first, more about worms!

### About worms

Worms are native to the UK and have a diet of dead organic matter. Their bodies are made up of rings or segments that shrink and stretch to help worms move through the ground. They do not have eyes, ears, teeth, lungs or legs but they do have five hearts. The main body parts are the mouth, head end, tail end, saddle and bristles. Setae (bristles) are tiny hairs that cover each segment to give the earthworm grip as it slides forward. Earthworms are composed mostly of water and have no bones. Earthworms take soil and organic material in through their mouth. This material then passes through the body and emerges through an opening in the tail end as castings. These castings make great fertiliser. Worms are hermaphroditic, which means they have both male and female reproductive organs. When worms mate they swap sperm to fertilise their eggs, which they lay in the soil.

They are prolific breeders and will produce a small amber-like bead that will hatch 3 to 5 baby worms. In three months these babies will mature and also reproduce. Worms have varying life expectancies and can live from several months to ten years.

Earthworms breathe through their skins and are very sensitive to sunlight so they must stay out of direct heat or light. They need to stay moist and like to come out on warm,

damp evenings. They are resilient and if they lose their tail or a chunk of their rear end they often recover to re-grow the lost part. Worms are great for the soil and help to increase the air and water content. They also help to “turn” the soil by taking down organic matter from the top and mixing it with the soil below. Their burrowing also creates natural drainage and air pockets.

## **Worm Farming**

Don't try to dig up worms from your garden for worm composting. You will not find enough to make the system work and most likely you will find species not suitable for vermicomposting. Two types of worms that make great composters are *Lumbricus rubellus* (also known as red wiggler, brandling, or manure worm) and *Eisenia foetida* (the tiger worm).

The red wiggler worm prefers the top five centimetres of soil, especially where there are lots of dead leaves on the ground, these worms are the ones generally found in cowpats and horse manure.

The tiger worm has red and yellow stripes on its body and prefers to work in surface areas under rotting vegetation, manure and in compost. They often wriggle vigorously when they are in your hand.

## **How to make a home for worms**

Several commercial wormeries are available and there are some details at the back of this pack on some of the retailers. However, it is easy and usually cheaper to find a suitable container for vermicomposting. There are some designs available that you can use, or providing you understand what conditions the worms need to do well, you can design your own wormery. First you need a container – it can be plastic, wood or metal. Do some creative recycling and use an old bathtub, wooden box, drawer, barrel or plastic bin. Wooden containers provide good insulation but plastic containers are lightweight and convenient.

You should ensure that you include a lid in your wormery design to give the worms the dark environment that they prefer and to protect your wormery from predators attracted to the food waste. Old carpet, hessian or some plywood can make a good cover. The tighter the seal on the lid the more likely your bin staying on the moist side. It is important that there be a large surface area for the worms to do their work. You may wish to measure your organic waste for a week or two first to find out how much waste you generate to ensure that you get the right size of wormery for your needs. In the book *Worms Eat My Garbage*, Mary Appelhof suggests providing one square foot of surface area per pound. The container depth should be between eight and twelve inches. She also suggests that the correct ratio of worms to food waste should be: for one pound per day of food waste, use two pounds of worms (roughly 2000). If you are unable to get this many worms to start with, reduce the amount of food waste accordingly and let the worm population steadily increase.

As usual there are different views on how much your worms will eat, some references state they will eat half their body weight per day, whereas others say up to their whole body weight per day. However you will generally find that these figures are only true in optimum conditions – gradually you will find a rate at which the worms will work through the food you give them.

When designing your wormery, you may wish to include some ventilation holes – particularly if you have opted for a plastic container. It is not recommended to punch holes in the bottom unless you plan to put a tray underneath. Some of the commercially produced bins have a drainage collection area at the bottom – sometimes with a tap for extracting the liquid.

Drainage is important in your wormery - some designs include the use of gravel and/or coarse sand in the bottom. Look at the different designs in the web links section.

Mesh or netting can be used also to separate the worms from the drainage medium and to protect your wormery from predators such as toads, frogs, mice, birds, rats, moles and hedgehogs.

In the early days after you have set your wormery up is vulnerable to extreme temperatures – full midday sun or severe frost. However as the wormery fills, it effectively self insulates against most normal temperature fluctuations.

### **Pick a Place**

Whether you have decided to keep it indoors or outside, you will need to locate your wormery where it will not freeze or overheat e.g. in a kitchen corner, laundry room, garage, patio, or in your garden.

### **Bedding & Other Materials to Add**

Bedding is the material you put in your bin for the worms to live in and move around in, they will also eat this material. The bedding should generally be high in carbon, examples of good bedding materials are brown leaves, paper, cardboard, shredded paper egg cartons, napkins, paper towels wood shavings and sawdust. All bedding materials should be shredded, light, fluffy, and moist. Shredded paper tends to mat down so it is best to use a combination of the above mentioned materials and any wood products should come from untreated timber. It is always best to mix and moisten your bedding materials before placing them into the worm bin. If you find your bin is too moist, simply add dry bedding materials to absorb the excess moisture. Don't forget to change your worm bedding every three to six months.

A worm's skin must be kept moist to enable it to absorb oxygen (it doesn't have any lungs), therefore the bedding must be damp. It should feel similar to a wrung out sponge when a handful is squeezed. If the worm bin is too wet or too dry the worms will suffer and possibly die. Experiment if you don't quite get the moisture content right first time.

Worms have a gizzard, so a handful of soil, compost, or grit on the brown leaves will provide the "roughage" they need for digestion. This only needs to be done when you are setting up the bin with new bedding. Adding compost or brown leaves also introduces microbes and larvae from the outside environment.

Worms also need calcium for reproduction. Finely crushed eggshells are a good source and, if available, should be added regularly. If eggshells are not available then a little calcitic lime (lime made from calcium) or rock phosphate can be sprinkled over the bedding on a weekly basis.

If you take good care of your worms you should never have to buy any more. Don't worry about too many worms! All populations are self-limiting – the worms will restrict their breeding to match the available food and the size of their enclosure.

### **What do worms like to eat?**

Earthworms will eat anything naturally organic as long as it can be broken down and is kept damp (they cannot eat dry food). Worms will eat organic kitchen waste such as fruit and vegetable peelings, left over food as well as newspaper, compost, dead leaves, crushed egg shells, vacuum cleaner dust, rolled oats, weeds, waste from vegetable juicers, and shredded cardboard packaging. Well-composted animal manures are also a great food source for earthworms, however chicken manure should be avoided. It is best if the food is in small pieces, so you may wish to chop it up before feeding it to your worms – remember that they have no teeth! They will be able to eat the food more quickly if it is presented to them in small chunks. Worms don't particularly like acidic foods such as oranges, lemons, grapefruit, tomatoes and strong-smelling foods such as onions and garlic. If conditions become uncomfortable they'll climb out of their wormery to escape!!

Some other things that definitely don't belong in a wormery are plastic bags, bottle caps, rubber bands, sponges, aluminium foil and glass. Also avoid putting in lots of grass mowings – this would generate too much heat for the worms comfort as it decomposes! (Some experts advocate adding small amounts of meat or fish to the wormery. However be aware, these types of food may attract pests).

You do not have to feed your worms everyday but it is best to bury food as soon as you have it rather than leave it sitting around getting mouldy and attracting fruit flies. It is better to under feed than over feed your worms.

### **Harvesting Finished Vermicompost**

The volume of materials in your wormery will be reduced by up to 90% during the process of decomposition. The vermicompost will look, smell, and feel like rich dark soil. It is dense and will accumulate in the bottom of the bin. Worms will not survive too long a period in pure castings as this is essentially their waste products and will eventually become toxic to them so ensure there is enough material in the wormery to allow them to move out of the castings. Worms are very sensitive to vibrations and light. Most of the time we keep worms in the dark but occasionally when we want to separate the worms from the compost they produce we use this aversion to light to our advantage. Place your bin in bright sunlight or under a bright lamp. The worms will start to move downward away from the light. Remove the worm free top layer of compost with your hands or a small scoop. As the next layer of worms is exposed to the light, they will continue to move to the bottom of the bin. When there is almost nothing left but worms in the bottom refill the bin with fresh moistened bedding and start the composting process all over again. Remember to put back any worms that may have been inadvertently scooped out. Use a similar technique if you have a smaller wormery, or when you want to harvest worms when there is still plenty of fresh bedding and food scraps in the wormery. Scoop out the compost, and place it in a pile or several piles (depending on how much you have) on a few sheets of newspaper in a well lit room. As the worms bury down to escape the light, scoop off the compost. Continue until you reach the bottom of the pile and the worms, then put the worms back.



## Using Vermicompost

Worm compost is extremely rich in nutrients; it also tends to be very moist and can be used like any other type of compost but perhaps more sparingly-

- Mix one part vermicompost with two parts potting soil for houseplants.
- Spread a thin layer as a top dressing on potted plants.
- Add a handful to the bottom of the hole when transplanting.
- Sprinkle a 1/4 inch into seed row when starting seeds.
- Place vermicompost into a burlap bag and soak in water over night. Use the compost "tea" as a tonic for your plants.

## Worm Composting Trouble Shooting

If something goes wrong, you miss the signs and notice the worms are not thriving you could end up with a smelly waterlogged mess to sort out – but even a messy failed wormery can readily be restored to excellent status with a little care!

Problem	Cause	Solution
<b>Worms are dying</b>	Food and bedding all eaten	Harvest compost, add fresh bedding and food
	Too dry	Add water until slightly damp
	Extreme temperatures	Move bin so temperature is between. 5-25 degrees C
<b>Wormery attracts flies</b>	Food exposed (overfeeding)	Add fresh layer of bedding & stop feeding for 2-3 weeks, avoid adding rotten food, which may have fly larvae present
	Non-compostables present	Remove problematic items from wormery
<b>Unpleasant smells</b>	Waterlogged	Add some fresh dry bedding; check that your ventilation holes are not blocked.
	Food exposed/over feeding	Add fresh layer of bedding or add a newspaper or card barrier on top Stop feeding for 2-3 weeks
<b>Worms are escaping</b>	Perhaps there is too much citrus fruit waste, tomatoes or smelly food stuffs like onions or garlic.	Avoid adding so much acidic items.

## Useful Resources

### Books:

- *Worms Eat Our Garbage – Classroom activities for a better environment*, Mary Appelhof, Mary Frances Fenton and Barbara Loss Harris, 1993
- *Worms Eat My Garbage (2nd edition)*, Mary Appelhof, 1997
- *Composting with worms – Why waste your waste*, George Pilkington, 2005

### Web links:

- <http://www.urbanext.uiuc.edu/worms/index.html> - An American site following the Adventures of Herman the Worm.
- <http://www.wormdigest.org> - US site - lots of articles about worm composting, including a young person's guide to worm composting, and "the mighty worm" (in the most popular sections)
- <http://www.wormwoman.com/acatalog/index.html> - An American website which is subtitled – "Mary Applehof's site for worm composting resources" from the author of the book "Worms ate my garbage" and "Worms eat our garbage". Video clips are available on this site Watch a worm's five pairs of hearts beat or see a baby worm hatch from its cocoon and see inside of a worm bin, as well as some articles about composting with worms.
- <http://www.queensbotanical.org/compost/vermi.html> - Queens Botanical Gardens vermicomposting site – plenty of details on composting with worms.
- <http://www.cityfarmer.org/wormcomp61.html> - Information on worm composting from Canada's Office of Urban Agriculture.
- <http://homepage.mac.com/cityfarmer/PhotoAlbum23.html> - City of Vancouver offers residents living in apartments information on indoor worm composting – a slide show is available on this site showing a simple plastic box vermicomposting system
- <http://www.dnr.mo.gov/env/swmp/worms/Worm1.htm> - Plans for building a wooden box worm farm
- <http://www.angelfire.com/mb/bjl/makingfarm.html> - Instructions on how to make a worm composter out of polystyrene fruit boxes
- [http://www.nrc.govt.nz/environmental.education/school.information.packs/worm\\_farming.shtml](http://www.nrc.govt.nz/environmental.education/school.information.packs/worm_farming.shtml) - A New Zealand School's site with a schools information pack on worm composting - lots of details on the different styles of wormery that have been used by schools (some of the pictures have been used in this pack).
- <http://www.huttcity.info/council/services/works/rubbish/worm-text.html> - A New Zealand local authority site on worm composting

### Suppliers of wormeries and worms:

- <http://www.originalorganics.co.uk/>
- <http://www.greengardener.co.uk/>
- <http://www.wigglywigglers.co.uk/>