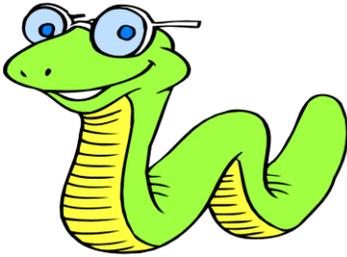


# Vermiculture: Composting with Redworms

With home "vermiculture", kitchen wastes can be converted to a rich humus with the help of redworms. Children find worms fascinating. They are very well behaved "pets," and also help with household chores!



Home vermiculture consists of:

- A **physical structure**: a redworm box or container
- **Biological organisms**: redworms and microorganisms & macroorganisms
- A **controlled environment**: temperature, moisture, acidity
- A **maintenance program**: bedding preparation, food waste burying, separating redworms from compost and using compost

## Where to Put Your Bin?

Redworms need controlled temperature, moisture content, aeration and proper pH.

### Temperature:

Redworms tolerate a wide range of temperatures. The ideal temperature is between 55 – 80° F. Bedding with a temperature above 84°F is harmful, sometimes fatal, to redworms. The temperature should be measured inside the box, because the temperature in the moist bedding is usually lower than the outside air. Protect redworms from freezing temperatures. Temperatures below 50° F. slow down worm activity.

### Moisture Content:

Redworms need a moist environment. Worms breathe through their skin, which must be kept moist to breathe.

### Aeration:

Redworms need oxygen to live. Air circulation is a must in and around a worm box.

### pH level:

Redworms do best if the pH is around 7.0, however, they can tolerate levels from 4.2 to 8.0 or higher. Lime (calcium carbonate) may be mixed with the bedding material to correct acidity or to maintain a more favorable pH. Pulverized egg shells also correct acidity. (**Warning!** Use only limestone and never hydrated lime. The wrong kind of lime will kill the worms!)

## What Kind & Size Container?

### Shape:

The box or container should be shallow, not more than 1 1/2' deep. Redworms tend to feed in the top layers of bedding. Materials may pack down if spread too deep.

## Size:

Size depends on the average pounds of kitchen waste per week. A box measuring 1' by 2' by 3' can handle 6 pounds of kitchen waste, which is the average for families from 4 to 6 people. A smaller sized box, 1' by 2' by 2', can handle kitchen waste for 2 people.

## Material:

Never use a recycled container that might have been used for chemicals! Treated wood could be harmful, also. Plywood, wooden pallets and old rubbermaid containers make good worm bins.

## Bedding:

1. **Corrugated cardboard** is an excellent material for bedding. Corrugated cardboard holds moisture better than any other material. Some people use a piece of corrugated cardboard to cover their bedding. In a "wet" environment, it can help to absorb some liquid, and will eventually disintegrate.
2. **Shredded newspaper** is the most economic material. Make the strips from one to two' long by ½ to 1" wide. Redworms will eat the paper after it has softened. It's easily moistened, but the strips don't keep the moisture as well. Strips provide more surface area from which the water can evaporate. They require frequent moistening. The black ink used for printing the newspaper is not toxic to redworms. Colored ink should be avoided. There used to be heavy metals, such as lead and chrome, in colored ink. Federal regulations now forbid the use of heavy metals in colored ink for printing newspapers.
3. Old decaying **leaves** are a good source of bedding. Some leaves are better than others are. For example, maple leaves are preferred over oak leaves, because the latter take longer to break down. Leaves from trees growing along heavily traveled roads could be dangerous because of possible lead accumulation on the leaves.
4. **Peat moss** can be used if mixed with other bedding materials. It has an excellent moisture holding capacity; however it provides no nutrients for the worms, and can be expensive.
5. A handful of **soil** provides the grit worms need for breaking down food particles within the gizzard. Since worms don't have teeth, their food must be broken down by muscle action in their gizzards. Fine sand is also a good addition.

# Worms With "The Right Stuff"

## Eisenia Foetida

This variety is the best redworm for home composting. They produce a large amount of compost in their natural habitats of leaves, manure, compost piles and in many other decaying organic materials.

## Lumbricus Rebellus

This variety will adapt to the worm box environment, but they are really a soil earthworm. Their natural habitat is in soils which contain a lot of organic matter.

Redworms are on the market under many different common names. Some people call them "red wigglers," or "manure worms." Fishing suppliers may call them "red hybrid," "dungworm," or "striped worm." All these names are for the same kind of redworms. If you order from commercial breeders, your best choice is Eisenia Foetida. This variety is used by many for worm composting projects.

### ***Worms NOT to use: Lumbricus terrestris***

This is the night crawler. They are important for soil improvements and are widely raised for that purpose. They like to tunnel in the soil, sometimes 3 feet deep. Their burrows aid in soil aeration and allow for better water penetration. Nightcrawlers have a very important role in our ecosystem but don't adapt to the shallow worm box environment.

## **The Sex Life of a Redworm**

### **Hermaphroditic:**

Redworms have both sexes, but mating is still necessary. If the worm has a swollen band, called the clitellum, at about one third between head and tail, this means that the worm is sexually mature. Redworms mate in their bedding at different levels, sometimes even on the surface. They may mate at any time of the year. Their mating produces a cocoon in which the eggs are fertilized and baby worms hatch.

Redworm cocoons are round shaped and small. They change color during their development, first white, becoming yellow, later brown. When new worms are ready to emerge, the cocoons are turning red. It takes at least three weeks for the worms to develop in the cocoon. Temperature and other conditions are factors in the development of the hatchlings. Although a cocoon might hold as many as 20 eggs, usually only 3 or 4 worms will emerge.

## **Population Control**

If worms have to compete for food, the population will go down. If there is a lot of food available for a time, then worms multiply at a high rate and more young worms then compete with their parents. Then this greater population produces more castings. To solve the problem you can feed them more food, but you might also need a larger box for the greater numbers of worms. It's important to note that castings are toxic to their own species, so it is advisable to harvest the castings regularly.

### **How many worms to start with?**

The number of redworms needed depends on the daily food waste. There is a worm to daily food ratio. The ratio is 2 pounds of earthworms for each pound of food, in short: 2:1. For example, 1 lb. Worms can eat 3.5 lbs. Food waste per week, or .5 lb. per day.

How many redworms there are in a pound of worms depends on the size of the worms. Commercial growers estimate that there are 1000 breeders (sexually mature) in one pound of worms. New hatchlings are very small, and sometimes 150,000 are needed to make one pound.

## **Setting up a Worm System**

You need:

1. A worm box or bucket
2. Bedding
3. A couple of handfuls of soil or sand
4. Moisture. Worms' bodies & the bedding should have the same amount of moisture content. This amounts to 75% to 90% moisture content.

Water: Bedding ration = 3:1 by weight. Three pounds water to one pound bedding.

If using dry bedding such as shredded paper, newspaper strips or cardboard, you need to wet it. One way is to put the material in a bucket and add water to it, until it is saturated. (That would be about a minute or two.) A few drops of moisture released by squeezing could be a guideline for the right amount. If five or more drops are produced the material is too wet.

### **Adding worms to bedding:**

When bedding is ready for the worms place the worms on top. They will disappear in a short time in the bedding. They don't like light. By keeping some bright light close by the box the worms will disappear faster in the bedding. If some stay on the surface after some time, assume that they are unhealthy or maybe dead, and remove them.

### **Food:**

Most kitchen waste or table scraps, any vegetables, apple peels, lettuce and cabbage, celery ends, spoiled food from the refrigerator, coffee grounds, tea bags, egg shells are all suitable worm meals. Worms don't like too much citrus, so don't overload them with grapefruit or orange rinds.

**Don't use meat or milk products in the worm bin.** Mice and rats could be attracted to the odors! Also, non-biodegradable materials don't belong in a worm box.

Cat litter should not be used, either. The odor of cat urine is intolerable to worms, plus the ammonia in the urine could kill the worms!

### **Burying kitchen waste:**

One way to manage a worm box is to pick a different spot to bury kitchen waste in the box. A 2'x2' box has approximately nine locations where you can bury wastes. That gives you nine feedings before you have to repeat the cycle.

You need some air circulating in the box, or bad odors could occur.

Worms will usually like the earlier buried food wastes. They like decaying organic wastes best. They do not always wiggle to the newly added fresh food waste. They like the bacteria, fungi, and protozoa to break it down first! Worms help keep the decaying material aerobic and help keep conditions free of odors. They produce castings at the same time.

There are many other techniques for adding kitchen wastes, which vary with owner preference and the type of box or container. Just be sure not to fill it too high with food and bedding, or it will pack down and may become anaerobic. Whatever works for the specific situation is fine—provided there are no odors or other problems.

### **Grind food waste?**

Grinding food waste is extra work. These kitchen wastes break down in a very short time. Eggshells should be pulverized. Although redworms have very tiny mouths, and ground food would be easier for them, we want them to help us with kitchen waste!

### **Overloading the system**

The size of box and amount of worms are deciding factors for how much food should be put in the box. Remember the 2:1 ratio for worms. Two pounds of worms is needed for one pound of food per 24 hours. The surface area of the box should be 7 square feet if 7 pounds of waste in one week is consumed.

If too much kitchen waste is produced on certain occasions, the wastes could be temporarily stored in another container for use later. An overloaded worm box can become anaerobic, and stinky! If that happens, don't add any fresh kitchen waste. If you leave it alone for a while, the situation will correct itself.

### **Do I need a worm sitter?**

If you're going on a vacation, you could feed the worms a little extra just before you leave. This is the best part of having worms as pets! Feed them and leave them undisturbed. If you leave for longer than 3 weeks, it might be good to have a worm loving friend come and feed them once.

### **Observe the worms**

The less you disturb worms, the better off they are. However, you should make regular observations to know what is going on in the box. The best time to do this is at feeding time. Is the bedding still moist? Is the temperature inside the box between 55-80°F? Sometimes you find many worms at one spot in a feeding frenzy. Note what they like and don't like. Look for worm eggs and baby worms. Are there any mating worms? Worms usually fascinate children. It is a good science project for children. However, point out to the children that the worms don't like to be too much or too often disturbed. They can't tolerate bright light.

### **Harvesting castings and changing bedding**

After weeks of adding food wastes the bedding goes down. This is a combination of worm activity and the microorganism activities. Decomposition and composting are taking place. The color of bedding becomes darker. The favorable environment for the worms decreases. The large amounts of castings might become harmful to the worms. Castings of one worm are toxic to another worm.

When to change the bedding depends on the bedding used, the quantity of the earthworms in the box, temperature and moisture conditions. Four to six months is a good guess for keeping the same bedding, if the worm boxes are correctly maintained.

### **Let the worms do the sorting**

If you prefer only to add some new fresh bedding, carefully move the old bedding to one side of the box. Add the fresh bedding in the open space and start feeding in the new bedding.

### **Divide and dump technique**

To divide the worms from the old bedding, dump the contents of the worm box on a sheet of plastic or a table. The worms will go down in the pile if you expose them to light. After a short time remove the top layer of the bedding up to the point you encounter worms. Wait a short time, and continue removing the bedding. You will end up with lots of worms in a small pile. If too many worms are left, some could be supplied for starting another box.

## **Frequently Asked Questions**

### **Can they see?**

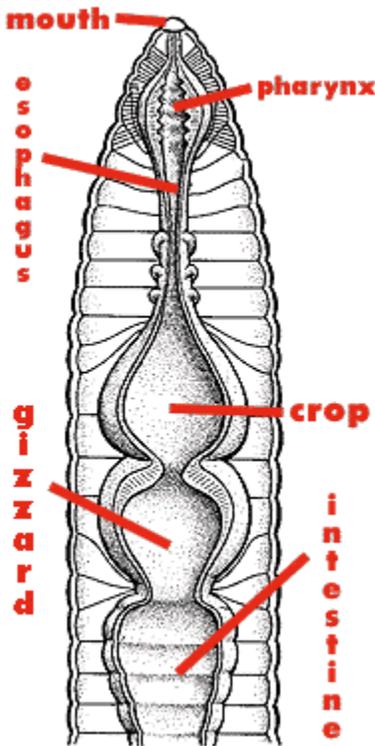
No, worms don't have eyes. However, they must have some kind of light sensor. They are very sensitive to bright light. They will try to hide as soon as exposed. It's odd that anglers use a flashlight to catch night crawlers, since they retract in their burrows if you shine lights on them.

## Where is the mouth?

The worm's mouth is in the first anterior segment. There is a small protruding lip just over the mouth, called prostomium. When the worm is foraging, this lip is stretching out. The prostomium is for sensing food.

## Do they have teeth?

Worms have no teeth for chewing food. They grind food in their gizzard by muscle action



## How do they grind food?

Worms can only take small particles in their small mouths. Microorganisms soften the food before worms will eat it. Worms have a muscular gizzard. Small parts of food mixed with some grinding material such as sand, topsoil or limestone is ingested. The contractions from the muscles in the gizzard compress those particles against each other, mix it with fluid, and grind it to smaller pieces.

## What happens to food once it leaves the gizzard?

The ground up food is mixed with enzymes in the worm's intestine. This mixture breaks down the food, molecules pass through the intestine wall into the bloodstream for use where needed. Undigested material, including sand soil, bacterial and plant residues passes out of the worm as a worm casting.

## If a worm is cut in two, will it grow back?

It depends on where the cut took place. If a worm is cut at the posterior end, sometimes a new tail will grow back on. Sometimes a second tail will appear next to a damaged tail. However, the posterior half of the worm can't grow a new anterior (head.)

## Do worms die in the box?

It's hard to find dead worms in a worm box, but they do die in the box. Dead worm bodies decompose very quickly, because their bodies are between 75%-90% water. If you find many dead worms you should find out the cause. High heat (above 84 degrees) is fatal to them. Too much salt or acidic food waste can kill them. It's best to change the bedding with fresh materials to solve the problem. Sometimes, partially replacing bedding may solve the problem.

## How long do worms live?

Often, worms live and die in the same year. They are exposed to hazards, dryness, too hot or too cold weather. *Eisenia foetida* can live for as long as four years.

## Do worms need air?

Worms need oxygen to live, just like us. A constant supply of fresh air throughout the bedding helps this desirable exchange take place.

Adapted from Washington State University Cooperative Extension, Whatcom County.