

Composting with Worms



This guide was adapted by the Chittenden Solid Waste District from various sources. For information email the School Outreach Coordinator at schools@cswd.net Acknowledgments: Information in this document was adapted from a guide entitled, *More About Worms... And Related Classroom Activities*, which was created by Jen Fong and Paula Hewitt through the Cornell Cooperative Extension.

Worm Composting

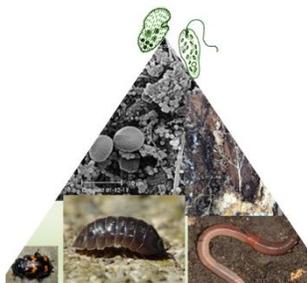
Why Worm Composting?

Research conducted in Chittenden County revealed that nearly 17% of the trash headed to the landfill could have been composted; that's 48 MILLION pounds of food scraps. This material, instead of being utilized as a valuable resource (compost), is buried in a landfill, where environmental conditions delay decomposition for decades (see picture) and decaying food scraps produce methane gas (more than 20 times stronger greenhouse gas than carbon dioxide). Furthermore, food scraps are generally high in moisture, and this liquid gradually leaches through the landfill, absorbing other toxins present in the waste. This potentially toxic liquid, called leachate, must be pumped out of the landfill and purified at waste water treatment plants, even 30 years after the landfill is closed.



10 year old carrots uncovered from a landfill in Arizona by William Laurens Rathje director of the Tucson Garbage Project.

What is Worm Composting?



Worm composting (or vermicomposting) is one method to recycle food scraps into a nutrient-rich soil amendment for gardens, yards or houseplants. Worms work with fungi, bacteria, and other invertebrates (FBI agents) to transform this organic matter into a usable material, which improves soil structure, nutrient storage and availability, and water retention of soils.

How is Worm Composting Relevant?

For millions of years, worms have been hard at work breaking down organic materials and returning nutrients to the soil. By bringing a worm bin into the home, you are simulating the worm's role in nature. This technique is simple, effective, and convenient. It saves water, energy, soil, and landfill space. Best of all, it's a fun, hands-on learning experience for all. And by composting with worms, you will ensure you are following [Vermont's Universal Recycling & Composting Law](#).

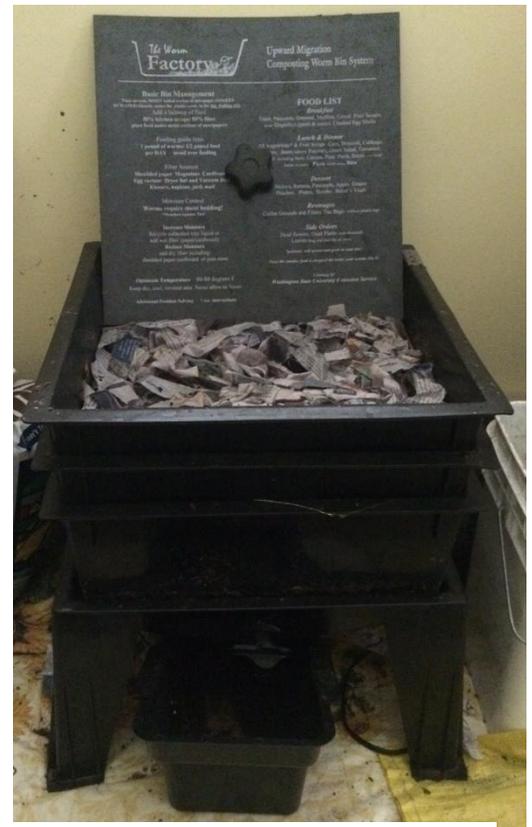


Worm Wrangling Checklist

- Weigh the amount of worm-friendly food scraps produced in the home for 2-3 weeks to determine the average per day. *See page 6 for approved menu.*
- Based on the average of worm-friendly food scraps generated per day, determine the amount of worms needed (2:1; worms:food scraps). You want enough space in the worm farm to house 1 pound of worms per square foot. Each tray of The Worm Factory is about 1.5 square feet. A 10-gallon container measuring 1.35 ft. (W) X 2.02 ft. (L) would comfortably house 2.7 pounds of worms.
- Order worms (see page 15 for list of worm farmers).
- Gather bedding: paper towels (no chemicals), newspaper or fall leaves (you may get wild critters using leaves).
- Once worms arrive, prepare worm farm by shredding paper, soaking in water, wringing out, then fluffing into tray for soft, cushy bed for worms.
- Add worms.
- Bury food scraps.
- Check moisture periodically; look for cocoons and young worms.
- Harvest worm castings (compost) and prepare new bedding.
- Use vermicompost (worm compost) for house plants or in the gardens.



This homemade bin system (2 5-gal containers) could house up to 2 pounds of worms; 1 pound per container.



Worm Factory: retail worm bin. 3 trays could support 4.5 pounds of worms.

Building Your Worm Bin

Red wigglers, the worms used for vermicomposting, are NOT the night crawler earthworms common in Vermont. *Eisenia fetida* (red wigglers) live in the upper layers of soil (epigeic), not deep in the ground like night crawlers (anecic) and will not survive most Vermont winters. The following worm bin set up is designed for the red wigglers; night crawlers will not fare well in this type of habitat nor will red wigglers thrive in an environment set up for night crawlers.



Single Bin System

Materials

1 10-gallon, opaque storage container with lid (Sterilite, Rubbermaid, etc.). The greater the surface area the better the worm bin.

1-pound worms (see last page for ordering worms)

Drill	Safety goggles
½ inch drill bit	½ cup soil/compost (from outside not sterilized potting soil)
20+ sheets of paper or paper towels	¼ - ½ cup water

Procedure

1. Rinse container and lid with water.
2. Drill ½ inch holes, 1 inch apart, around the top portion of the container for air circulation.
3. Tear paper into strips (hint: tear from the ridged side of newspaper for clean strips). Paper towels (no chemicals) work very well too.
4. Soak paper strips in water for at least 10-minutes (or overnight).
5. Squeeze out excess water from shredded paper (as moist as a wrung-out sponge).
6. Spread half the paper on bottom of the bin.
7. Add food scraps. You may want to wait a few days before adding food to allow the worms to acclimate to their new home.
8. Spread soil over the food. The soil helps to jump start the decomposition process and provides grit for worms.
9. Add worms, they will move where the food is, so it doesn't matter where they are placed.
10. Cover the food and worms with 2 inches of moist paper.
11. Place lid on container and place in dark place; 60-75°F temperature range.

Multi-tray Bin System

Materials

2 or more 10-gallon, opaque storage container with lid (Sterilite, Rubbermaid, etc.). The greater the surface area the better the worm bin.

1 or more pound of worms

Drill

¼ and ½ inch drill bit

20 sheets of paper

Safety goggles

½ cup soil/compost (from outside not sterilized potting soil)

¼ - ½ cup water

Procedure

1. Rinse containers and 1 lid with water.
2. Label containers (trays) starting with 1 using a sharpie. If using 3 containers, label the containers 1, 2, 3.
3. Drill ½ inch holes, 1 inch apart, around the top portion of each container for air circulation.
4. Drill ¼ inch holes in bottom of containers 2 and 3 (see photo to right). All containers except container 1 will have holes in the bottom. Tray 1 will be your base tray in this system.
5. Optional-drill 5, ½ inch holes in lid. Keep in mind, too many holes will cause increased drying conditions in worm farm so it is not recommended to drill more than 5 holes.
6. Tear paper into strips (hint: tear from the ridged side of paper for clean strips).
7. Soak paper strips in water for 10-20 minutes.
8. Squeeze out excess water from shredded paper (as moist as a wrung-out sponge).
9. Spread half the paper on bottom of tray 2.
10. Add food scraps. You may want to wait a few days before adding food to allow the worms to acclimate to their new home.
11. Spread soil over the food. The soil helps to jump start the decomposition process.
12. Add worms. They will move where the food is, so it doesn't matter where they are placed.
13. Cover the food and worms with 2 inches of damp paper.
14. Place lid on container and place in dark place; 60-75°F temperature range.



Worm Menu

Though worms can eat most organic material, certain foods are better for the worms than others. For best results, **cut up food scraps in little pieces before feeding the worms** (I run my worm food through a food processor; this is overkill but works well). Increased surface area of chopped up food speeds up decomposition by microbes and can decrease potential odor issues. Warning: broccoli and other cruciferous veggies tend to be very odiferous in a single bin set up. Limit or omit this group of veggies to avoid disgruntled students and custodians.

Main Course

apples	avocados
bananas	banana peels
berries	bell peppers
broccoli	cantaloupe
carrots	corn
eggplant	grapes
lettuce	mango
mushrooms	peaches
pears	potatoes
squash	spinach
tomatoes	tofu
watermelon	zucchini

Snacks

- coffee grounds
- coffee filters
- tea leaves
- tea bags
- pasta (no sauce)
- rice (no oils)
- breads (minimal)

Bedding

- shredded newspaper
- pieces of cardboard
- shredded office paper
- crushed, dried egg shells
- dried leaves
- paper egg cartons

Worms Should Not Eat

- glossy or shiny paper
- green grasses/yard waste
- meat or dairy products
- spicy or pickled foods
- oils, butter, vinegar
- garlic, onions, leeks
- hot peppers
- citrus rinds
- too much pineapple (the juice can kill them)

Worm Food



The above list is not comprehensive; there are plenty of exceptions. But here is one rule of thumb: If you're unsure about feeding a certain food to your worms, take a small sample of the food item in question, bury it under the paper and mark the location. Each day, check the food and give a progress report on whether the worms or other organisms are consuming it. My worms at work are not fond of any type of cabbage; it takes a long time for these food scraps to breakdown. But my worms at home like cabbage. Of the food scraps produced in your classroom, which will the worms enjoy eating, and which will the worms prefer not to eat?

Taking Care of Your Worms

Choose Your Worm-Feeding Day

Assign one day during the week to check on and, if necessary, feed your worms. Keep this same day from week to week. You may find that your worms won't need feeding every week, this may fluctuate as they adapt to their new home. Store your food scraps in a large, well-labeled yogurt container (or other container) in the fridge until feeding day.

Feed Your Worms

Refer to page 6 for a list of worm-friendly foods.

1. Roll back the covering of damp paper strips to expose the worms. Notice if and what material is remaining from prior weeks. Monitor the bin every week to see if the worms are eating the food or not. The worms will need a few weeks to settle into their new home; they may eat less than normal during this period of adjustment. **Keeping a record of what and how much you are feeding the worms will help.**
2. Place the food scraps on top the worms. In about one month, you should have a pretty good sense for how much food your worms can eat on a regular basis. Adjust feeding levels accordingly. If the food seems relatively untouched, you may want to forego feeding for one week; if much of it has disappeared or is clearly being eaten, feed them the same amount as the week before; if it is completely gone, increase the amount of food. In optimal conditions, worms can eat up to half their weight in food scraps per day.
3. Feed the worms once per week. Or as often as they need to eat. Some worms may not eat all of the food in one week. Only feed them when the previous meal has been consumed. Don't be alarmed if you find sprouts from seeds of earlier meals, have no fear, they will eat those too.
4. Sprinkle the food scraps with soil then cover with moist paper. This is one of the more important aspects of maintaining your home for worms. The microbes in the soil will kick start the decomposition process and the bedding will keep odors inside the bin, it will help regulate moisture levels and flow of oxygen within the bin, and it will help prevent fruit flies from making a home in the bin. Add more moist, shredded paper to the bin if the existing paper has disappeared. After several months, you will notice that the paper as well as the food is disappearing. In order to maintain proper moisture levels (paper should be moist, but there should be no standing water in the bin) and to keep decomposing food covered, you will need to add more strips of paper from time to time.
5. **Cover and Choose a Spot for the Bin. Keep the bin in a dark and well-ventilated place, away from windows and heaters.**



Using Worm Compost

Harvesting Worm Castings

If you take care of your worms and create a favorable environment for them, they will work tirelessly to eat your food scraps and produce compost. As time progresses, you will notice less and less bedding and more and more compost in your bin. After 3-5 months, when your bin is filled with compost (and very little bedding), it is time to harvest the bin. Removing the finished compost from the bin is called 'harvesting the worm castings'. After several months, worms need to be separated from their castings which, at high concentrations, create an unhealthy environment for them. To prepare for harvesting, don't add food to the bin for up to 1 month. Try these methods for harvesting.

Single Bin System

Hands-Off

Push all contents in your worm bin to one side of the bin, removing any large pieces of non-decomposed food or newspaper. Put fresh bedding and food scraps in empty side of bin. Continue burying food scraps only in freshly bedded half. Over the next 2-3 weeks, the worms will move over to the new side (where the food is), conveniently leaving their compost behind in one section. Remove the compost and replace it with fresh bedding. To facilitate worm migration, cover only the new side of the bin, causing the old side to dry out and movement.

Hands-On

Dump the entire contents of the worm bin onto a sheet of plastic or paper. Make several individual cone-shaped piles. Each pile will contain worms, compost and non-decomposed food and bedding. As the piles are exposed to light, the worms will migrate towards the bottom of the pile. Remove the top layer of compost from the pile, separating out pieces of non-decomposed food and newspaper. After removing the top layer, let the pile sit under the light for 2-3 minutes as the worms continue migrating downward. Then remove the next layer of compost. Repeat this process until all worms are left at the bottom of the pile. Collect the worms, weigh them (for your record keeping), and put them back in their bin with fresh bedding.

*For both methods, you may continue composting your food scraps after harvesting. Just add fresh bedding and more food scraps.

Multi-Tray System

Hands-Off

Using a multi-tray system makes harvesting castings a bit easier than the single bin system. Just stop feeding one tray while starting the next tray with new food. Place the old tray on top of the new tray; the worms will eventually move to the tray that contains food, leaving a nearly worm-free tray on the top. This process may take up to 2 months, depending on how much edible organic material remains in the old tray.

Hands-On

Once most of the worms move to the new tray, make a cone-shaped pile with the castings in the center of the tray. Let it sit for an hour, then start removing the top several inches. When you start seeing worms, repeat the mounding method and in no-time you will have worm free castings.

Regardless of which method you use, the compost you harvest will most likely contain some old food scraps and bedding. If you are using the compost outdoors, the food scraps and bedding will eventually decompose. If you are using the compost indoors, remove old bedding and food scraps for aesthetic purposes. Furthermore, though it is unlikely that you'll be able to remove every worm, please be aware that red worms cannot survive cold climates so will not fare well in the garden. For an explanation please refer to the Frequently Asked Questions section.

Using Worm Compost

Mix your worm compost with soil; no more than 1:4 (volume) castings to soil. Unlike backyard compost, worm castings provide a slow release of plant-ready nutrients. Worm castings provide sustenance that is directly available for plant uptake as well as more nutrients than conventional compost or chemical fertilizers. Experiment with planting seeds in containers with and without castings to observe growth rates and overall health!

Troubleshooting Worm Bin Issues

Issue	Causes	Solutions
Fruit Flies	<ol style="list-style-type: none"> 1. Exposed, easily accessible decomposing food 2. Too much food in bin 	<ol style="list-style-type: none"> 1. Cover food with 2 inches of moist, shredded newspaper 2. Remove excess food and/or reduce amount feeding
Odors	<ol style="list-style-type: none"> 1. Decomposing Food 2. Too wet 3. Not enough oxygen 4. Presence of meat, fatty foods, dairy 	<ol style="list-style-type: none"> 1. Chop up food to increase decomposition rate 2. Add dry, shredded paper to bin and remove lid to dry out 3. Add fluffy bedding and gently stir the bin 4. Remove any dairy, meat, and fatty foods
Worm Death	<ol style="list-style-type: none"> 1. Too hot or cold 2. Too wet or dry 3. Lack of oxygen 4. Not enough food 	<ol style="list-style-type: none"> 1. Ideal temperature: 60-75°F, move to accommodate or remove food if bin is too hot 2. Add dry paper (too wet) or spray down with water (65-75% moisture) (too dry) 3. Gently mix in fluffy, shredded paper OR harvest castings 4. Increase amount of food being fed
Mites	<ol style="list-style-type: none"> 1. Increased acidity in bin from added food 2. Introduced from leaf litter 	Add slices of watermelon or cantaloupe to bin for several hours. Rinse mites from slices and repeat until mite population decreases.

Fruit Flies: Though fruit flies do not pose any health hazards, these little creatures can be a nuisance. To help prevent these potentially prolific pests, do the following:

Prevention:

Bury food. Generally speaking, fruit flies are attracted to the odors of decomposing foods. Ensuring that all food scraps are sufficiently buried underneath strips of moist newspaper should contain these odors and keep unwanted pests from intruding on your bin.

Avoid putting rotting or rotten food in your worm bin. Fly larvae are more likely to be present on rotten food, especially fruits. Better yet, freeze over-ripe or rotten food to kill any flies present. Thaw before feeding bin.

Cut food scraps into small pieces. Worms will be able to eat smaller pieces more quickly, thereby limiting the possibility of fruit flies thriving on decomposing food.

Don't over-feed worms. Ripe food that sits around in the bin attracts (and may contain) flies.

Keep bedding material moist, but not too wet. Overly wet conditions encourage fruit fly proliferation.

Feed worms a varied diet. If citrus foods dominate the bin, the bin may become too acidic, which may attract fruit flies. Moreover, it is not uncommon for fruit flies to lay their eggs in citrus and banana peels prior to human consumption of the fruit. This helps to explain the occasional, sudden, and unexplainable infestation of fruit flies that many people are familiar with.

Loosely place a full sheet of newspaper on top of the worm bin contents. This newspaper cover will create another barrier to help prevent flies from getting in or out of the bin.

Eradication: Sometimes—in spite of these preventative efforts—outbreaks still occur. To help control an existing fruit fly problem, try the following:

Create a fly trap. Place a bowl of apple cider vinegar, mixed with a drop of dish detergent, near the bin. The fruit flies are attracted to the vinegar, and when they fly down for a sip, the detergent kills them. Change the liquid regularly to keep the trap potent. If the invertebrates buzzing around your room are, in fact, fruit flies, this solution should remedy the problem quite quickly. Or have your students engineer better fruit fly traps (and share if they work better than vinegar).

Take the bin outside and remove the cover. Undoubtedly, some fruit flies will alight into the surrounding environs while others remain in the bin. The primary goal here is to reduce the available population of fruit flies capable of reproducing. Its effectiveness is limited unless combined with the other techniques mentioned on these pages. (Remember to keep the bin out of direct sunlight so the bin doesn't get too hot).

Remove decomposing food. This is a drastic measure, but its aim is two-fold: Fruit flies feed off of and often lay their eggs on decomposing food. By removing decomposing food, you eliminate their food source and the medium on which their larvae mature.

Hang flypaper strips near the bin. Inexpensive flypaper can be purchased at hardware stores.

Odor Problems: If your worm bin has an unpleasant odor, one of the following may be the culprit:

Decomposing food is naturally smelly. For example, certain decomposing foods like cabbage, broccoli, and kale are known to produce unpleasant odors. If you think a particular food may be the culprit, remove it from the bin. Regardless, ensure that *all* food scraps remain covered by newspaper. This will suppress and contain odors inside the bin.

Bin is too wet. Solve this problem by adding dry bedding to absorb the excess moisture. Remove the top of the bin to allow some of the moisture to evaporate.

Bin is not getting enough air. Anaerobic bacteria produce strong odors and thrive in environments with little oxygen. Aerate the bin by adding fresh, fluffy bedding and gently mix the contents of the bin.

Bin contains meat, dairy, and oily products. It is recommended NOT to feed these items to your worms because they could become rancid and produce strong odors when decomposing.

Mites: Mites, 8-legged compost critters, will always be present in the worm bin; they are actually a good sign the system is working well since they are part of the compost process but sometimes they take over the worm bin, out-competing the worms for food.

Add a few slices of melon (watermelon and cantaloupe have been proven to work great) to the bin. Mites are especially fond of these fruits and will cover them in a short period of time. When the slices are covered, remove, rinse off or place in standing water for an hour or two, then return the melon slices to the bin and repeat until the population is reduced.

Sliced cantaloupe used to reduce mite population in worm bin.



Mites (look like sesame seeds) on cantaloupe slice 1.5 hours after introduction to bin.



Worm Death: If your worms are trying to escape the bin (typically this is a mass exodus onto the floor), or if their population is dwindling, check for the following:

Bin is too wet. Worms are drowning. Read above solution.

Bin is too dry. Worms are suffocating. Worms need a moist environment in order to breath. Spritz with water until bedding and substrate are moist or add a cup or two of water to the entire system.

Bin is not getting enough air. Worms are suffocating. Read above solution.

Worms are not getting enough food. Once the worms devour all of the food, they will start eating their own castings, which are poisonous to them. Feed them more, or harvest the compost.

Bin is exposed to extreme temperatures. Worms thrive in temperatures from 60 to 75 degrees F.

NOTE: Dead worms decompose rather quickly. If you do not monitor the above conditions, you can have a bin full of dead worms before you even realize it.

Finally, if the problem cannot be controlled, sometimes the best solution is to rescue the worms and start a new bin from scratch, using what you have learned from your past experience to maintain a better worm home. Please don't hesitate to contact Chittenden Solid Waste District (872-8100 X211 or schools@cswd.net) with any questions.

Worm Bin Enrichment

FACTS

- ∞ Worms have amazing healing powers, but contrary to popular belief, they cannot reproduce by being cut into small pieces. If you cut a worm in half, both sides will continue wiggling. The portion with the head may grow a new tail if the cut is after the segments that contain vital organs. The tail portion will continue wiggling until the nerve cells die. It will not grow a new head.
 - What other animals can regenerate parts of their bodies?
- ∞ Worms can eat half of their weight in food each day (in optimal conditions). Over one million worms may be present in one acre of soil, and these worms can produce 700 pounds of castings each day. Two thousand red worms in a worm bin can produce seven pounds of castings in one month.
- ∞ Worms do not have teeth. Their food is softened by moisture and by microorganisms which break it down. Food is further broken down in the worms' gizzards, which contain hard particles (such as soil and sand) and muscles to grind ingested food.
- ∞ Worms don't have eyes, but they can sense light at their front ends. They move away from light and become paralyzed if they are exposed to light for too long (approximately an hour). If a worm's skin dries out, it will die.

Worms breathe through their skin and need a moist environment to survive. But too much moisture will kill them. Have you ever noticed worms on the sidewalk after a rainstorm? This happens because the worms' homes in the soil got flooded, and the worms came to the surface in search of less soggy conditions. On the pavement, worms often get disoriented and cannot find their way back to the soil; they dry up and die when the sun comes out.

- ∞ Worms are hermaphrodites, so each worm has both male and female organs. Two worms mate by lining up in opposite directions and joining at their clitella (the swollen area near the heads of mature worms which contain their reproductive organs). They remain attached for about 15 minutes to exchange sperm. Several days later, a cocoon develops on their clitella, which each worm will shed into the castings in seven to ten days. Egg capsules are lemon-shaped, dirty yellow/amber in color, and about the size of a match head. As they mature, they grow darker in color. After 14-21 days, two to five baby worms will hatch from the cocoons. However, during inclement conditions, baby worms may stay in their cocoons for many weeks until temperatures warm up again. When the baby worms eventually crawl out, they are the thickness of a piece of thread and approximately one cm long. Usually the worms appear white with a faint red streak under a microscope, this is an ideal time to observe their beating hearts. As they grow, their pigmentation will develop fully, giving them the reddish-brown color common to "red" worms. They will reach sexual maturity in two to three months.
- ∞ Red worms can live as long as four years, but most die after about one year. You will rarely notice a dead worm in your bin because their bodies are 90% water and they decompose very quickly.
 - If you notice dead worms in your bin, what might be the cause?
- ∞ Tiny bristles, called setae, on worms' bodies help them through the soil.



Worm cocoon

- ∞ There are over 3,000 species of earthworms in the world (15 species in VT; none of which are native). Red wigglers (*Eisenia fetida*) are ideally suited to living in worm bins because they are surface feeders, don't burrow very deeply, and thrive in close proximity with other worms. Night-crawlers, on the other hand, are known to burrow several feet into the ground and might feel confined by the small size of most worm bins. In nature, red worms can be found living in leaf mounds, compost heaps, manure piles, and other decaying vegetation with high moisture levels in warm areas of the world like the Mediterranean (*E. fetida* will die over winter if released in Vermont). They are also commonly raised on worm farms for composting and bait.
- ∞ In addition to producing compost, other species of earthworms till layers of soil while tunneling through the earth. These burrows can help air and water reach plant roots.
- ∞ Worms are not the only living organisms in the worm bin. All sorts of microorganisms (in fact, billions of them) live in a worm bin. These microorganisms are introduced to the bin from the skin and gut of the worm and from soil added to the bedding. Food scraps introduce microorganisms, as do fungal and bacterial spores that land in the bin from the air.
- ∞ Many people mistakenly believe that food scraps placed in landfill-bound trash decomposes quickly, like it does in a worm bin or compost pile. However, this is not at all true because landfills lack sufficient quantities air, moisture and right species of FBI agents (fungus, bacteria, and invertebrates), the key ingredients in decomposition. Consequently, worms and other important decomposers cannot survive in landfills.



Red mites

ACTIVITIES

- ∞ Observe which foods decompose the fastest, and try to explain why. What are your worms' favorite foods? Do they like dry or wet leftovers best? Why?
- ∞ Observe worms' reactions to light. Why do they stay inside your covered worm bin?
- ∞ After a heavy rainstorm, go out on a worm hunt. What should you do when you see worms on the pavement? Be a worm wrangler; put them back in the soil where they belong and can survive. Why do we want worms to survive?
- ∞ Try to find mature worms, young worms, and worm cocoons in your worm bin. Are there other critters living in the worm bin? What do they look like? Look for similar critters in outside compost piles or under fallen leaves. Where else in nature can you find these decomposers (compost critters)?
- ∞ Look for worms in gardens, vacant lots, and other locations. How many kinds of worms can you find? Where do you think you will find the most worms? Research worms from around the world. Where do some of the most unusual worms live?
- ∞ Put some worm food in an air tight bag. Compare what happens to this food to what happens to food in a worm bin.



Frequently Asked Questions (FAQ)

Are the red worms used in a worm bin the same as earthworms?

When most people think of earthworms, they usually mean "night crawlers" (*Lumbricus terrestris*), which can be 8-10" long and 1/2" in diameter. These night crawlers are different from red wigglers (*Eisenia fetida*), although both are called earthworms since they are found in the earth.

Night crawlers are soil-dwellers and like to burrow several feet into the ground. By burrowing, the night crawlers mix different layers of the soil; their tunnels aerate the soil. On the other hand, red wigglers are surface-dwellers and prefer to live within the top six inches of the soil, which is why red wigglers prefer shallow boxes as homes. Red wigglers also prefer to live in mediums with a high concentration of organic matter and are often found among the fallen leaves of the forest floor as well as in manure piles.

Should I add red worms to my garden or compost pile?

No, *Eisenia fetida* are not native to Vermont therefore should not be placed outside (actually no earthworms in Vermont are native but we don't want to add to the invasive critter issue VT already faces). They are a Mediterranean species bred here specifically for indoor composting. Most will NOT survive Vermont's winters so please don't release them into the wild.

Why is it important to sprinkle soil into the worm bin?

Soil provides the worm bin with an inoculation (kick-start) of beneficial microorganisms. The gritty soil particles also aid the worms' digestive process since they have no teeth.

I have been told that turning my outdoor pile is essential to producing compost. Should I turn the contents of my worm bin?

In both processes, the decomposing organisms (fungus, bacteria, and invertebrates) depend on oxygen.

Outdoor compost piles: Turning them serves to aerate them and speed up the rate of decomposition.

However, many people would rather let their piles sit and let nature do the work. It may take a little longer, but as the cliché goes, "compost happens". If you turn your pile frequently, you may produce compost in 4-8 months; if you turn your pile once in a while, you may produce compost in a year or two.

Worm bins: Except in certain circumstances, it is not recommended to turn the contents of your worm bin.

Worms are natural aerators and need little assistance with this task. Furthermore, it disturbs them to have the bedding and food scraps turned and mixed. See the troubleshooting section for exceptions.

Can worms bite?

Worms do not have teeth and cannot bite you. Do not be afraid to hold a worm. Most people find them to be soft and ticklish.

What is the yellow liquid the worms sometimes release when we are holding them?

The yellow liquid is not urine, which many people first guess. The yellow liquid, called coelomic fluid, is released when a worm is stressed, which often happens when people touch them. When a worm is placed on a person's dry hand, the worm's body will begin to dry out. The worm will start wiggling, trying to find its way back to the soil or bin, and in the process, it will release this yellow liquid in order to make its body moist again or as a defense mechanism. Exposure to light also triggers the release of the coelomic fluid. This yellow liquid may smell unpleasant, hence the scientific name *Eisenia fetida*: *fetida* means smelly (the word fetid comes from this Latin word).

What happens if you cut a worm in half?

Almost everyone wants to know the answer to this question. If you cut a worm in half, you will most likely end up with 2 halves of a dead worm. If the worm is lucky, the piece with the head may grow a new tail (the cut would have to happen very close to the tail-end of the body), but the piece with the tail will not grow a new head. I hypothesize this myth began when scientists discovered that worms were hermaphroditic and folks thought if each worm contained male and female parts, cutting them in half would make one female worm and one male worm. But that is just a hypothesis.

Why is worm compost so good for plants?

As worms process (digest) the food scraps, the nutrients in the food are changed into forms which can be reused by plants quicker than conventional compost. Worm compost makes nutrients immediately available to plants. When compost is mixed with water, it has the ability to hold many positively-charged mineral ions (cations) and nutrients, which can then be taken up by plants. Some research has shown that worm compost has more available nutrients than traditional compost (backyard or industrial).

Nutrient Element	Vermicompost (%)	Garden Compost (%)
Organic carbon	9.8-13.4	12.2
Nitrogen	0.51-1.61	0.8
Phosphorus	0.19-1.02	0.35
Potassium	0.15-0.73	0.48
Calcium	1.18-7.61	2.27
Magnesium	0.093-0.568	0.57
Sodium	0.058-0.158	<0.01
Zinc	0.0042-0.110	0.0012
Copper	0.0026-0.0048	0.0017
Iron	0.2050-1.3313	1.169
Manganese	0.0105-0.2038	0.0414

(Source: Nagavallemma, 2004)

Where can I get some Red Wigglers to start my own worm bin?

You can order worms (and get great information) from the following websites (partial list only):

1. Uncle Jim's Worm Farm (Spring Grove, PA): <http://unclejimswormfarm.com/>
2. The Worm Farm (Durham, CA): <https://www.thewormfarm.net/products/c31-Worms/>
3. Planet Natural (Bozeman, MT): <http://www.planetnatural.com/product/red-wiggler-worms/>
4. Red Worm Composting: <http://www.redwormcomposting.com/buy-composting-worms/>

Educational Resources

1. [Worms Eat Our Garbage](#): Classroom Activities by Mary Appelhof
2. [Vermicomposting](#) (NC State Extension)
3. [Worm Watch](#)-a citizen science project getting the dirt on earthworms
4. [Worm Farming Secrets](#)
5. Facebook Groups: [Red Worm Composting](#) and [Vermicomposting-Worm Farming](#)
6. [A series of searchable texts](#) on earthworm biodiversity, ecology and systematics from various regions of the world.
7. [Eisenia fetida](#) (University of Wisconsin - La Crosse student research site)
8. [Urban Worm Company](#)—Steve has an informative newsletter and website