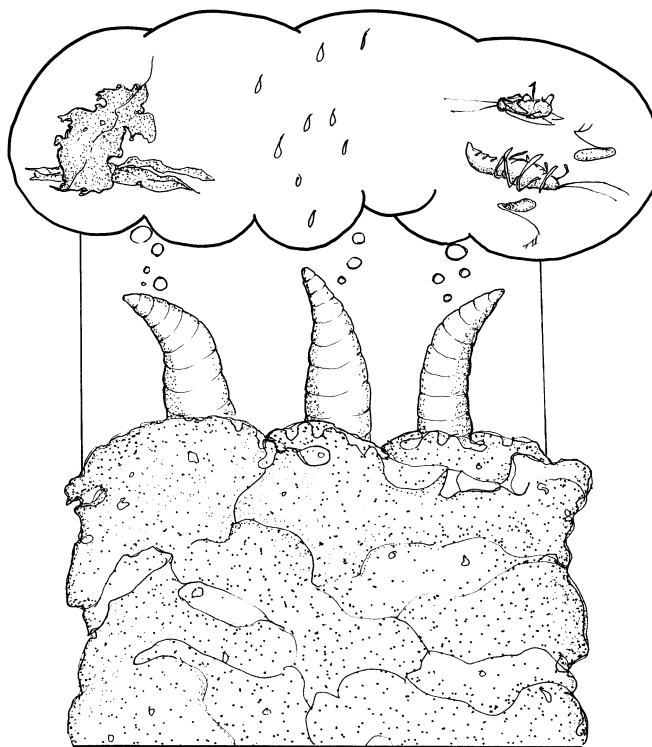




## A Worm's-Eye View of Composting



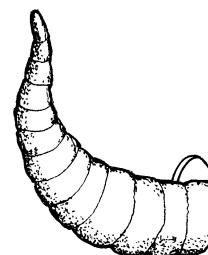
*While visions of dead leaves, moisture, and dead insects danced through their heads. . . .*

Show students some ways they can “be part of the solution,” from diverting food waste from the incinerator or landfill and putting it back to work as compost, to finding ways to donate excess, edible food to people needing food in our communities.

Most kids at some point in life are fascinated with worms. Bringing them into the classroom is capitalizing on this enthusiasm. Decomposition is one of those things that appears as magic to children. Watching worms and micro-organisms decompose classroom snack waste (right under their noses) pulls them into the world of science. Every day in school, children consume food and dispose of what they don't eat. Using a composting bin allows them to be part of the solution—recyclers rather than disposers. And because kids like to feed classroom “pets” they sometimes change what they bring to school to eat so their scraps can be used to feed the worms. Creating vermicompost in the classroom

allows you and your students to continue the important cycle of nutrients described in this book by using that compost to enhance soils used to plant our food.

Composting with earthworms, or “vermicomposting,” is great for settings like apartments and schools where an outdoor compost pile may not be practical. The great advantage of worm composting is that it can be done indoors and out, thus allowing year-round composting—year-round recycling of food waste and year-round production of “vermicompost.” Learning to compost at home and in the classroom provides lessons in decomposition as well as conservation. Vermicomposting is a naturally appealing and fun activity for most children (and adults), even those who may be hesitant at first.

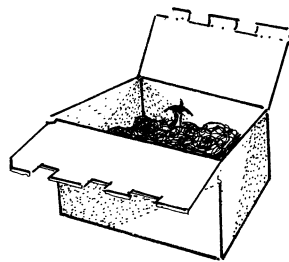




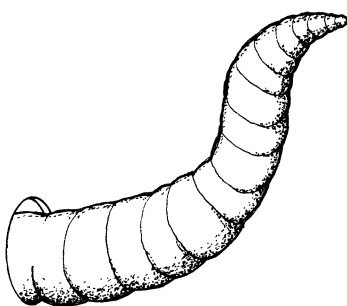
## Vermicomposting Basics<sup>1</sup>

### Container

Composting worms can live in a plastic bin or wooden box, with air holes punched in the sides and top. Holes in the bottom are generally needed for drainage, so you'll want a tray under the bin. Line the inside of the worm bin with fabric screening if the holes in the bottom are large. The size (surface area) of the box will depend on how much space you have and on the amount of food waste you generate. (In *Worms Eat My Garbage*, Mary Appelhof suggests weighing your food waste for one week, and providing one square foot of surface area per pound.) The container depth should be between 8 and 15 inches. You can use one large box or a number of smaller containers for easier lifting and more choice of location.



The bin needs a cover to conserve moisture and provide darkness for the worms. Worms move about in the darkness so a lid also helps to keep them in their composting home. For outdoor bins, a solid lid is preferable, to keep out unwanted scavengers and rain. Worms need air to live, so be sure to have your bin sufficiently ventilated. Worm bins can be used



**Worms like moist environments. We breathe through our wet skins so we are very unhappy if the worm bin is too dry or too wet.**

indoors year-round, and outdoors during milder months (as long as temperatures are between 40–80° F (5–30° C). Indoors, kitchens, closets, classrooms, and basements are excellent locations (warm,

**Please don't let me freeze!**



dark, and dry), but any spare space can be utilized. Outdoors, bins can be kept in sheds or garages, on balconies or patios, or in the yard. They should be kept out of hot sun and heavy rain, however.

You can build, buy, or recycle something like an old dresser drawer, trunk, or discarded barrel. Plastic bins hold moisture—an advantage in an arid school-room. Some composters prefer wood because it is more absorbent and a better insulator for the worms.

### Bedding

The worms need damp bedding. Suitable bedding materials include shredded newspaper, cardboard, and peat. (We've had success with "peat-free" products—those using coconut husks for example.) Add a couple of handfuls of sand or soil to provide necessary grit for the worm's digestion. The bedding's overall moisture level should be like a wrung-out sponge. The bin should be about three-quarters full of moistened bedding. Lift the bedding gently to create air spaces that help to control odors, and give freer movement to the worms.

### Worms

The two types of earthworm best suited to worm composting are the redworms: *Eisenia foetida* (commonly known as red wiggler or manure worm) and

<sup>1</sup> Adapted/edited with permission from *Composting with Red Wiggler Worms* by Gillian Elcock and Josie Martens, Canada's Office of Urban Agriculture, (City Farmer) 1995; [www.cityfarmer.org](http://www.cityfarmer.org)



*Lumbricus rubellus*—often found in aged manure and compost heaps. Do not use dew-worms (large-size worms found in soil and outdoor compost piles), as they are not likely to survive. Several mail-order vendors can provide worms: shop around for the best price (see Bibliography). Mary Appelhof suggests acquiring two pounds of worms (roughly 2,000 wigglers) to digest one pound per day of food waste. If you start with fewer worms, simply reduce the amount of food waste accordingly while the population steadily increases.

### Food Scraps

You can compost food waste such as vegetable scraps, pulverized eggshells, tea bags, coffee grounds, and small amounts of fruit. Eggshells are essential to keep the bedding from becoming too acidic for the worms. For maximum benefit, dry them well, crush them, and sprinkle the tiny pieces over the top of the bedding. It is NOT advisable to compost meats, dairy products, oily foods, or refined grain products because of problems with smells, flies, and mold. Too much fruit in a worm bin can attract fruit flies.



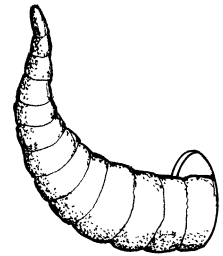
### Harvesting the Compost

The finished compost can be mixed with potting soil and used for houseplants and patio containers. It is an excellent mulch (spread in a layer on top of the soil) for potted or garden plants, or it can be dug into the soil.

It is important to separate the worms from the finished compost—otherwise the worms will begin to die. The quickest way to do this is to simply move the finished compost over to one side of the bin; place new bedding in the space created, and put food waste in the new bedding. The worms will gradually move over and the finished compost can be skimmed off as needed.

If you have the time or want to use all the compost, you can dump the entire contents of the bin onto a large plastic sheet and separate the worms manually. Most children love to help with this process and you can turn it into a fun lesson about

**Worms like a variety of foods—just like people! A class that ate mostly oranges for snacks gave the worm bins mostly orange peels for food. We don't know exactly what happened, but after just two weeks, the kids couldn't find one worm in the bin! Too much fruit produces acidic conditions in the worm bin. So give us some cucumber peelings, lettuce, even coffee grounds (which we love), and a regular diet of ground-up egg shells to help buffer the acidity. Otherwise you may find the worms trying to leave the bin or the fruit flies taking over.**

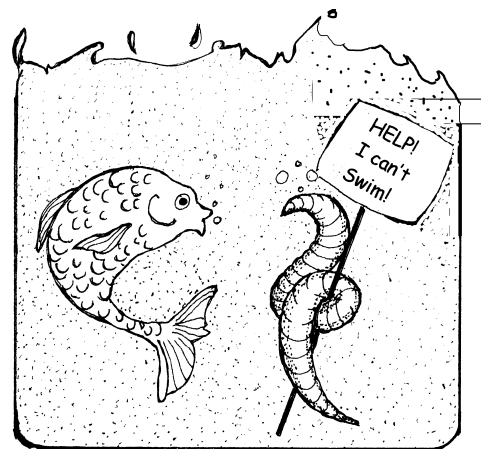


worms for them. Watch out for the tiny, lemon-shaped worm cocoons which contain between two and ten baby worms! By separating the worms from the compost, you save more worms for your next bin. Mix some of the vermicompost in with the new bedding of the next bin, and store the rest in breathable bags for use as required.

### Common Problems and Solutions

The most common problem is an unpleasant, strong odor caused by lack of oxygen in the compost due to overloading with food waste. If the food sits around too long, the bin contents become too wet. The solution is to stop adding food waste until the worms and micro-organisms have broken down what food is in there, to add dry bedding materials, and to gently stir up the entire contents to allow more air in. Check the drainage holes to make sure they are not blocked. Drill more holes if necessary. Worms will drown if their surroundings become too wet.

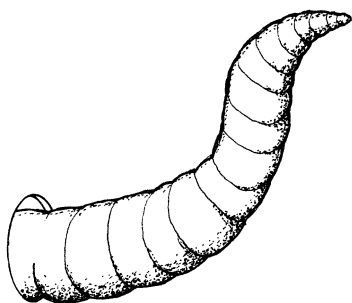
Worms have been known to crawl out of the bedding and onto the sides and lid if conditions are wrong for them. Even if the moisture level seems all





right, the bedding may be too acidic, which can happen if you add a lot of citrus peels or other acidic fruit. Adjust the pH by adding a little garden lime and/or crushed eggshell.

Fruit flies can be an occasional nuisance. Discourage them by always burying the food waste and not overloading with fruit. Keep a plastic sheet on the surface of the compost in the bin. If flies are still persistent, move the bin to an outdoor location, leaving the top off for a period of time to kill off the fruit fly larvae—or transfer it to a location where flies will not be bothersome. Flypaper in or near the bin can also help. Mary Appelhof has several additional remedies in *Worms Eat My Garbage*.



Worm bins need TLC!

- During school vacation in one class, an army of worms escaped from their parched bin and marched "en masse" several feet to find water in the classroom sink! The teacher found a path of dried worms from the worm bin to the sink on Monday.
- Food is made mostly of water. That water ends up in the worm bin. A class that was very enthusiastic put way too much food in the worm bin over a short period of time. Every day the class found worms escaping out the drainage holes in the bin—until things dried up a bit.

## The Final Word

Taking worms out of their natural environment and placing them in containers creates a human responsibility. They are living creatures with their own unique needs, so it is important to create and maintain a healthy habitat for them to do their work. If you supply the right ingredients and care, your worms will thrive and make compost for you.

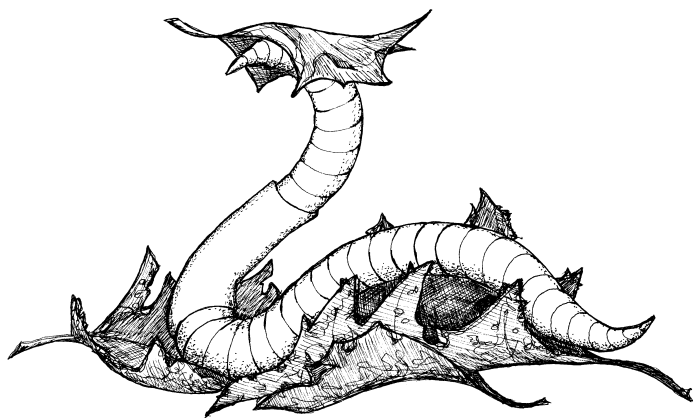
- It's a good idea to make a list of things to check each week. Be sure to put "feeding" on the top of the list! It's fun to check for worm cocoons and

baby worms as well as other compost critters! See *Compost Creatures and Friends* on page 164.

- To get the most out of your experience with the worm bin, consider setting up a learning station with some or all of the following materials available to your students: plastic bucket or jar with tight-fitting lid (restaurants, health food stores, or your cafeteria may have extras), trowel or fork, sprayer/mister for adding small amounts of moisture to the bin, plastic (surgical) gloves for squeamish students, petri dishes/Styrofoam trays for worm or compost observations, measuring cups if you choose to measure food waste by volume, scale if you choose to measure by weight, paper towels for easy cleanup, magnifying glass, cutting board/knives, thermometer, clipboard and pencils, flashlight and colored cellophane, pH testers, humidity reader (hygrometer), untreated limestone, vinegar, reference books and materials, clever title for the worm center, and an observation chart.

## Resources

For more information on worms and vermicompost-



ing, see the Resources in the lessons that follow.

## Earthworms . . .

- Improve the topsoil and enrich plants. That's why farmers and gardeners love them so much.
- Are not native to North America, believe it or not! They probably hitched a ride on plant material or soil brought over by European settlers in the seventeenth and eighteenth centuries.
- Make tunnels in the soil that benefit plants. These tunnels allow air and water to enter the soil. In

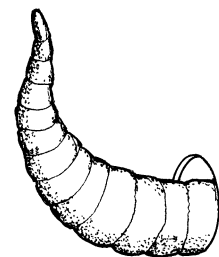
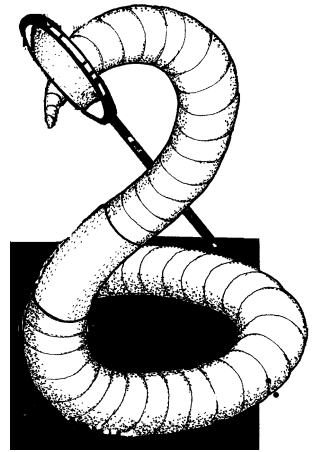


the process of digging their tunnels, earthworms mix soil layers.

- Eat soil—they actually are after the organic matter (dead plant and animal parts) of the soil and microscopic organisms living there. If you have earthworms, your soil has organic matter. When you add organic matter to soil, you invite more worms to your spot and they go to work to improve the soil that much more. It's a win-win situation.
- Excrete castings—a polite term for worm manure. Soil and organic matter that pass through a worm's digestive system is extremely rich in minerals.
- Can produce their own weight in castings every 24 hours at optimal conditions.
- Are segmented worms. There are many different kinds of earthworms on this planet. Garden earthworms are not the same worms as composting redworms. Night crawlers are another variety of earthworm. Some worms in Australia can grow to be several feet in length!!! It has been reported that these Giant Gippsland worms can be heard "munching and gurgling" during the night.
- In large numbers can do great things! The *USDA Yearbook of Agriculture* says that the worms in one acre of land can bring 20 tons of soil to the surface in one year.
- Have no eyes but can sense light, no teeth but they can grind food up in their gizzard, no feet or hands but they can move efficiently through soil, no antennae or nose but they can sense the presence of water nearby, no ears but they can sense the tiny vibrations of an approaching predator, no lungs but they can breathe air through their moist skin, and have a brain about the size of a pinhead but are able to regenerate small sections of their tail.
- When cut in half do *not*—I repeat, do *not*—become two worms. It becomes two pieces of a worm wriggling in pain. Worms can regenerate only small sections of their tail.
- Are sensitive to chemicals and may not appear in great numbers where soil has been treated with pesticides.

## More Wormy Ideas

- Check out different soil samples for signs of worms.
- Find evidence of worms by looking for their castings around their worm tunnels.
- Write stories, songs, or poems about worms underground or in the worm bin.
- List all the adjectives you can think of to describe a worm.
- Look at the classification of animals and see where worms are listed (Annelids, segmented worms).
- Observe changes in the worm bin over time. Keep charts, records, and journals. Measure food waste going in.
- Classify or group food wastes that can be fed to worms. Use the food pyramid for categories or make up your own.
- Make a list of things you know about worms and another list of things you would like to know about worms.
- Build a large worm bin with wheels that you can wheel from classroom to classroom (collect leftovers, of course), sharing the fun and learning opportunities with other teachers who are interested but not committed to a full-time worm bin.
- Ask students to write about what it would be like if they were Annelida—how she lives, what she eats, how she moves, how she survives, good days and bad days, what she thinks about her predators, what kind of a burrow world she wants for her squirmy brood of baby worms, etc. Encourage "worm's-eye view" illustrations.





## Starting Out Right with Worms

Grade Level: K-2

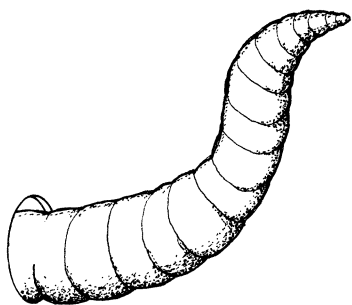
Teach students how to handle living things gently and to make some first observations with their worms.

- Begin by showing the class the bag of worms. (They are often shipped in paper bags or cloth bags inside a cardboard box.)
- Ask: Why cloth and not plastic? Explain how worms breathe. (Through their wet skin.)
- Next, give these directions: "Everyone close your mouth and hold your nose. Now breathe through your skin." Give them a chance to try. (We can't. We need to breathe through our mouths into our lungs. Worms don't have lungs, but like our lungs, the worms' skin needs to stay moist in order for them to get air through their skin.)

- Then hand out materials: one tray, a wet paper towel, and a small pile of wet, shredded newspaper per student or pair.
- Tell students: Now we are going to observe live worms. We have three rules:
  1. Be kind to the worms;
  2. Keep the worms moist (so they can breath);
  3. At a designated signal, put down what is in your hands, freeze, and listen.

Ready? Hand out a few worms per student or pair. Allow observation and ask questions intermittently—for instance: How can you tell where the head and tail are? Show them how to find the clitellum; only adult worms have them. Clean up.

Sing "The Worms Go Marching Song" while putting things away



## The Worms Go Marching Song

(Sung to the tune of "The Ants Go Marching," words by Kathy Lyons)

The worms go marching one by one,  
Hurrah! Hurrah!  
The worms go marching one by one,  
Hurrah! Hurrah!  
The worms go marching one by one,  
We better go now, here comes the sun.

*Chorus*

And they all go marching down into the ground,  
Where it's cool and it's wet.

Squirm, squirm, squirm, squirm

Squirm, squirm, squirm.

The worms go marching two by two. . . .  
We are part of the garden, too.

*Chorus*

The worms go marching three by three. . . .  
We eat your kitchen scraps for free.

*Chorus*

The worms go marching four by four. . . .  
We'll happily eat your apple core.

*Chorus*

The worms go marching five by five. . . .  
We help the soil, and that's no jive.

*Chorus*

The worms go marching six by six. . . . (make up your own words)