# 3.8 Vermicomposting: Worms in Your Classroom

## How to Vermicompost

### Overview

Students will create a worm-composting bin, and monitor the decomposition of their lunch scraps over time. This activity teaches that nature truly recycles, turning food matter into rich organic soil. Additionally, there are many experimental design and mathematic extensions with this activity.

### Lesson Planner

Use the table below for lesson planning purposes.

| | |
|---|---|
| Grade Level(s) | 1st – 8th |
| Time Required | Set Up: 1 class period<br>On-going Monitoring: 6 months |
| Key Concepts/Terms | Biodegradation; Decomposition; The 4 R's – Rethink, Reduce, Reuse, Recycle; Nutrient Cycle; Energy Cycle; "Trash;" Composting; Vermiculture |
| Prerequisites | None |
| Setting | Indoors; Whole class/small group |

### Learning Objectives

After completing this activity, students will be able to…

- Explain how worms and other soil microorganisms break down organic matter to create rich organic soil; and
- Explain what components are necessary for a successful vermiculture bin, as well how to maintain it over time.

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## Background Information

**Decomposition**

Imagine what the world would look like without the decomposition process, where microbes, insects, and fungi break down dead organic matter. Through decomposition and the interactions in food chains and food webs, nutrients and energy are constantly recycled.

**What is Vermicomposting?**

Vermicomposting is using worms to assist in breaking down food scraps into organic compost you can use to enrich the soil.

**Why Vermicomposting is the IDEAL Science/Environmental Project**

A fully functioning, properly equipped vermicomposting bin makes an excellent classroom project. You can teach your students about animal needs, nutrient cycles, trash reduction and you will produce SUPER SOIL and concentrated liquid plant food at the same time.

## Procedure

Follow the steps in the table below to conduct the activity. **Sentences in bold are suggestions for what teachers might say to students.** *Items in italics are possible student answers to questions.*

***Note: This activity has an optional Student Worksheet, pg 64. Directions have been written to include it, but the activity can be conducted with oral directions/discussion instead, if preferred.***

| Phase | Step | Action |
|---|---|---|
| Engage | 1 | Start this activity in a mysterious way by saying, **"I have some animals that I'd like you to meet today. These animals can live in my house, but I don't have to walk them, or clean up after them, and I can go away for weeks at a time and they are still fine. These animals also take my food scraps and turn them into great soil for plants. Any guesses what they are?"** |
| | 2 | **"WORMS are the animals I'd like you to meet today. Did you know that worms benefit us? Do any of you have worms in your house?"** |

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Procedure (continued)

| Phase | Step | Action |
|---|---|---|
| Engage | 3 | *** You can skip this step if your class has already completed the ***Compost in a Bag,*** pg.27. ****<br><br>**"Worms help things decompose or rot. When I say the word ROT what do you think of?"**<br><br>Write down all words that students list.<br><br>After the list is complete, discuss the words, and circle any that are beneficial.<br><br>***Note**:* It is important for students to move beyond disgust with rotting and see the value of decomposition, which is that old organic matter is broken down to be made into something new. |
| Explore | 4 | Hand out a paper plate/napkin to each student/pair of students. Then, give each student about ½ cup of soil from your worm bin. While you are doing this, have students distribute the Student Worksheets and magnifying glasses. |
| | 5 | **"Find your biggest worm, and separate it from the pile of dirt so you can study it."** |
| | 6 | Pass out magnifying glasses while students are locating their worm. |
| | 7 | Show a diagram of worm anatomy (You can make a transparency or poster of Worm Anatomy (see the ***Illustrated Glossary***).) |
| | 8 | **"There should be a section of your worm that is slightly fatter than the rest of it. This section is closer to one end of the worm than the other."**<br><br>Walk around and make sure students have correctly located this section. Give out more soil so students can locate another worm if they don't have a large enough worm, or the clitellum is not easily seen. |

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Procedure (continued)

| Phase | Step | Action |
|---|---|---|
| Explore | 9 | **"This section of the worm is called the CLITELLUM, and it is used for reproduction. Worms are both male and female, and when they mate, both become pregnant and reproduce. What would be the advantage of this for worm species?"**<br><br>*Worms reproduce at a very fast rate and this is a great adaptation for the species, as both worms reproduce, rather than just one.* |
| | 10 | **"The end of the worm that is closest to the clitellum is the head of the worm, called the ANTERIOR end. This is where the mouth of the worm is located."** |
| | 11 | **"The opposite end of the worm is the rear and is called the POSTERIOR. This is where the waste is removed. The waste is the good stuff that we want for improving our soil."** |
| | 12 | **"Using the magnifying glass, examine the body of your worm carefully. It is made of many different SEGMENTS. Each of these segments has small hairs on it. These are called SETAE, and they are to help the worm move."** |
| | 13 | **"You should be able to almost see through your worm, along the whole digestive tract. Use the magnifying glass to see if you can find this."** |
| | 14 | **"On your Student Worksheet, draw your worm and label the parts we have talked about."** |
| | 15 | **"So, what would worms need to live successfully in a bin? If we were to design our own new bin, what would they need?**<br><br>*Worms need:*<br>• *water (enough to keep the pile damp),*<br>• *air (they get enough from the space between the lid and the bin),*<br>• *warmth (they can't last through freezing),*<br>• *dark (they don't like light), and*<br>• *food.* |

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Procedure (continued)

| Phase | Step | Action |
|---|---|---|
| Explore | 16 | Pass out the bags of trash items for students to sort in to 2 piles: one of items that CAN go into the bin, and the other pile of items that CAN'T go in. Give student groups a few minutes to sort their trash into piles. After they have finished, have them list what they thought could go into the vermicomposting bin and why. Correct any misconceptions, and explain why some of the items can't go into the bin.<br><br>**"On Part B of your worksheet, circle all of the items on that list that CAN go in a vermicomposting bin."** |
| Explain | 17 | Have students complete the analysis questions on the ***Student Sheet -- Vermicomposting***, or use those questions to guide your class discussion if you are not using the Student Worksheet. |
| Elaborate | 18 | • Complete a more in-depth anatomy study by dissecting larger worms and compare various worm species' adaptations with their habitats.<br>• Have students design experiments using the vermiculture bin. These could focus on the types of food fed to the worms, the reproductive rate, etc.<br>• Have students plan/create their own vermicomposting bin. |
| Evaluate | 19 | Use the ***Student Sheets*** for evaluation. |

## Vocabulary

Understanding of the following terms is useful in this activity.

| Term | Definition |
|---|---|
| **Biodegrade/ Decompose** | To break down physically, chemically and biologically |
| **Organic Matter** | Matter that came from living things |
| **Recycle** | The salvage and reprocessing of used materials, such as paper, metals, glass, cloth or organic matter. |

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## Objectives

After completing this activity, you should be able to…

- Explain how worms and other soil microorganisms break down organic matter to create rich organic soil; and
- Explain what components are necessary for a successful vermiculture bin, as well how to maintain it over time.

## Part A. Worm Diagram

In the box below, draw a picture of your worm and label the CLITELLUM, ANTERIOR END, POSTERIOR END, SEGMENTS, and SETAE.

In the circle to the right, draw a picture of what the worm looks like through the magnifying glass.

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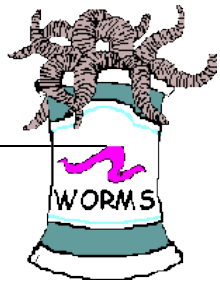
# Student Sheet – Vermicomposting: Worms in Your Lunchroom




## Part B. What Can Go in a Worm Bin?

On the list below, circle the items that **CAN** go in the worm bin:

| | | |
|---|---|---|
| Apple Core | Tea Bag | Plastic Bag |
| Steak | Pepperoni Pizza | Coffee Grounds |
| Eggshells | Leaves | Orange Peels |
| Sandwich Crust | Rotten Banana | Paper Napkins |
| Newspaper | Paper Bags | Rice |

## Part C. Questions for Analysis

1. Explain why worms are important to the health of an ecosystem.

2. Imagine that worms didn't reproduce as quickly as they do. What if it took 10 years before worms were old enough to reproduce? How would the world be different?


3. Imagine the world without worms. What would change? How would it affect the ecosystem?

# Creating a Vermiculture Bin

## Overview

The key ingredients for a vermicomposting bin are:

- suitable container (plastic/wooden box),
- moist bedding material,
- a handful of garden soil,
- redworms, and
- food scraps.

## Container Size

The size of your bin depends on the amount of food scraps you want to compost. Worms can only eat so much garbage. The relationship between the weight of worms required to process a given amount of garbage is called the worm to garbage ratio. Have your students collect their food scraps for one week, weigh them, and use the ratio below to calculate the number of worms and bin size needed.

**A correct worm to garbage ratio is about 2:1**,

(This means that it takes 2 pounds of redworms to process 1 pound of garbage per day.)

## Bedding

**What is Bedding?**

Bedding can be hand-shredded newspaper (colored pages are fine, as well as black & white) or corrugated cardboard torn into thin strips. Bedding provides redworms with the cool, moist environment they need to survive. The worms tunnel through and digest the bedding, along with food scraps to produce vermicompost (worm castings – manure). Adding a handful of natural soil (preferably without any chemicals added) provides other small microbes and insects that help in the decomposition process.

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Bedding (continued)

**How Much Bedding Will I Need?**

To figure out how much bedding is needed for your bin, complete the following steps:

1. Measure the **length, width, and height** of your worm bin in inches.
2. Multiply these dimensions to get the number of **cubic inches** (a measure of volume).
3. Divide the number of cubic inches by 1,728 (the number of inches in one cubic foot) to get the number of **cubic feet** in your worm bin.
4. You will need 2.5 pounds of shredded newspaper for every cubic foot in your worm bin.

Water Amount

To figure out how much water you must add to the shredded newspaper to make the worm bin 75% moist, multiply the pounds of newspaper needed by 3. This number is how many **pints** of water you will need (one pint of water = one pound).

Redworms

**What Kind of Worms Do I Use?**

The two most commonly used redworm species are *Eisenia foetida* and *Lumbricus rubellus*. You can purchase them for about $12-$20/pound (see *Sources*). Your worms will reproduce, so your initial investment will pay for itself, as you are able to share worms with your students and colleagues so that they can create home composting bins.

There is a difference between redworms and common garden worms and night crawlers. Common garden worms/nightcrawlers quickly die off in a worm bin, while redworms do poorly in average garden soil and cannot survive cold winters.

**Redworm Biology**

Redworms can consume their own weight each day in organic matter. They live for about 1 year, and reproduce quickly. Light colored cocoons (what we call worm egg cases) are produced continuously. Each one yields 2-3 young worms in about 3 weeks time. Redworms breathe through their skin and must be kept moist at all times.

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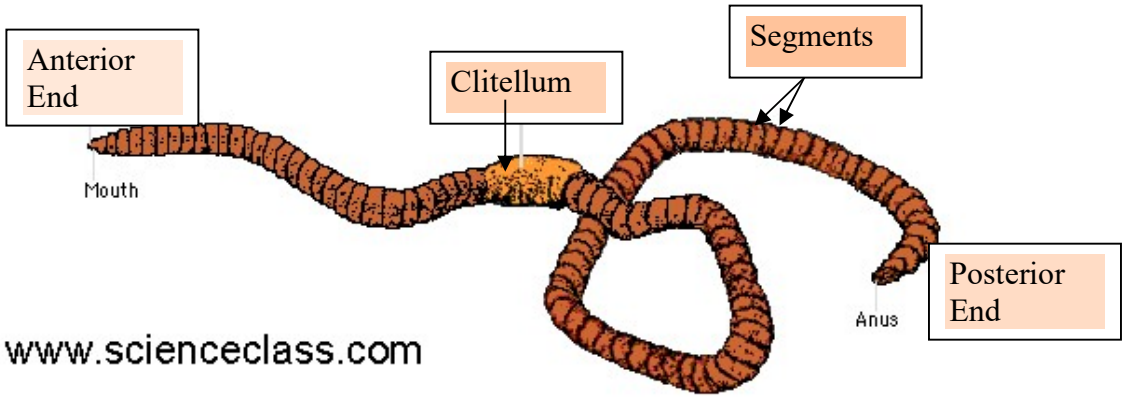
## Redworms (continued)

**Redworm Anatomy**

Refer to the diagram and table below for the anatomy of a redworm.




| Part | What It Is |
|---|---|
| Anterior End | Front end of the worm; the mouth is located here |
| Posterior End | Back end of the worm; the anus is located here |
| Clitellum | The enlarged area about 1/3 of the way from the anterior end; used for sexual reproduction. |
| Setae | Small bristly hairs on the exterior of the worm; help in moving the worm; 4 pair per segment (use a magnifying glass) |
| Segments | Individual sections of the worm's body; the first is the anterior end, the last is the posterior end |

## Providing Air for Your Vermicomposting Bin

Contrary to many bin instructions, you DO NOT need to drill holes in your bin – enough air will pass through the tiny gap in the lid and bin for your worms to get air. Holes will cause your bin to leak (reducing the amount of moisture) and worms and any other critters (from your handful of soil) will escape and cause a nuisance. Your worms will not crawl out of the bin unless the bin becomes too dry/wet.

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## Ideal Temperature & Location of Your Bin

Redworms must be kept moist and well ventilated in a temperature range of 55º-75ºF for maximum consumption of organic matter and reproduction. The bin should also be kept covered and out of direct sunlight, as redworms are light sensitive. Basements, cool garages and closets are all good locations. Again, redworms will die at freezing temperatures.

## Feeding & Maintenance

**Moisture**
Maintain a moist environment for your worms. Periodically, spray or mist the bedding to maintain even moisture. Add shredded newspaper as needed (see *Harvesting Vermicompost,* below).

**Feeding**
Redworms require a steady supply of food scraps to grow and multiply. However, feeding once a week is fine if you've accurately calculated the amount of food needed to maintain your worms. The smaller the food scraps, the quicker they will be digested. You will want to bury your food scraps into the bedding in different locations (or you can experiment, observe worm migration, collect data, etc.).

Refer to the table below for what to put in/what not to put in your bin.

| YES – Good for your bin | NO – Bad for your bin |
|---|---|
| Fruits/Vegetables | Meat/Fat/Bones |
| Eggshells (crushed) | Grease/Oils |
| Cereal/Bread | Pet waste/Litter |
| Tea bags/Leaves | Plastic wrap/Foil |
| Coffee filters/Grounds | Chemicals, Glass, Metal |
| Citrus Peels (these take a long time) | Dairy Products |
| Onion, Banana, and Potato Peels (etc.) | |

## Harvesting Vermicompost

It will take about 6-8 weeks to produce a noticeable amount of vermicompost. The castings appear as small, dark clumps that easily break apart. There are several methods for removing the finished compost, as describe below:

- Every 3-4 months, stop feeding for a few weeks, and rake the compost to one side of the bin. Add fresh bedding to the other side; add food scraps to the new bedding only. Within a few days, your worms will move into the new bedding, and you can harvest the finished compost. Refill the empty end of the bin with fresh bedding and food scraps after harvesting.

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## Harvesting Vermicompost (continued)

- Every 3-4 months, dump the entire bin contents into several piles on a sheet of plastic in a brightly lit room. The worms will dive to the bottom of the pile, and you can remove the finished compost from the tops and sides of the pile.
- Every 3-4 months, remove 2/3 of the bin contents for use in the garden. Add new bedding and slowly allow the worm population to rebuild.
- Stop feeding after 4-6 months and allow the worms to completely digest all of the bedding and food scraps. The result is a fine, homogeneous compost (pure worm castings), with very few redworms.

## Using Vermicompost

You can add vermicompost to seedbeds/planting boxes/holes or use it as a top dressing during the growing season. You can also try adding vermicompost to your potting mix for houseplants (1/4 by volume). Vermicompost will not burn your tender seedlings. However, pure worm castings may have a high soluble salt content; use them sparingly and avoid direct contact with plant roots.

## FAQ's

**How do I create and care for my vermicomposting bin?**

Bury your organic kitchen waste in the worm bin. Bacteria and other organisms break it down and worms eat the food waste, bedding, and bacteria. They turn it all into humus—nutrient-rich food for growing healthy plants

**Doesn't it smell?**

Odor is minimal if you don't overload the system. Worms in a 16"x19"x12" bin can process 2-3 pounds of garbage per week. Capacity of a 20" x 24" x 12" bin is up to 5 pounds of garbage per week.

**How long before I have worm castings to feed my plants?**

Plan on about six months from the time you set up your bin. You will bury garbage every week. As the worms process the garbage and bedding, the contents of the bin will turn dark brown. You can then harvest the vermicompost (compost produced through the action of worms) in a variety of ways to use on your plants and in your garden.

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## FAQ's (continued)

**Do I have to keep buying new worms?**

If you treat them right, they will reproduce. You will find cocoons in your bin from which baby worms will hatch. After several months, you may have twice as many worms. You can use them to go fishing, or help a neighbor set up a bin, or just leave them in your bin. Overpopulation will not be a problem.

**Do people really DO this?**

Worm composting is becoming more and more popular. It is the only way to recycle on-site, in your own home. You place food waste in your worm bin. The worms turn it into plant food. You use the plant food to grow vegetables in your garden, or attractive flowers to delight your senses. If you compost your garbage with worms, you help the environment.

## Redworm Sources

**Flowerfield Enterprises: 10332 Shaver Rd Portage, MI; (269) 327-0108 (also sell worm bin kits).**

**Gardeners Supply Co.: 128 Intervale Rd., Burlington, VT 05401; (802) 863-4535 http://www.gardeners.com/Red-Wiggler-Worms/Composting_WormBins,02-232,default,cp.html**

**Uncle Jim's Worm Farm, including FAQ's**: www.unclejimswormfarm.com/