

Vermicompost

Waste Not - With Worms

Overview

Vermicomposting takes place at ambient temperatures and thus worms and many other organisms that are visible to the naked eye (e.g., insects, slugs, mites, molds, mushrooms – and even seedlings sometimes) are usually abundant in vermicomposting systems. This is quite different from aerobic composting systems in which high levels of microbial metabolic activity and organic matter decomposition typically result in temperatures which are too hot for such organisms to survive. Therefore, vermicomposting systems are ideal for students to literally see some of the diversity of organisms that can help decompose organic matter and play other ecological roles in the system.

This activity is intended to introduce students to some of the diverse organisms present in vermicomposting systems, including the appearances, roles and environmental preferences of these organisms. It can also be used to explore how the types of biological and ecological information the students generate can be used in managing vermicompost systems. By extension, vermicomposting can also be used as a model for thinking about how ecological information can be used to manage other systems on farms and elsewhere.

Resource References

Do the Rot Thing: A Teacher's Guide to Compost Activities. Central Vermont Solid Waste Management and Alameda County Waste Management & Source Reduction and Recycling Board. 2007

http://www.cvsword.org/uploads/6/1/2/6/6126179/do_the_rot_thing_cvsword1.pdf

Master Composter Manual. Cornell Waste Management Institute. 1998

<http://cwmi.css.cornell.edu/mastercompostermanual.pdf>

The Worm Book. Nancarrow, L. and J.H. Taylor. 1998. Ten Speed Press. Berkeley, CA

The Worm Guide: A Composting Guide for Teachers. California Integrated Waste Management Board. 2004

<http://www.calrecycle.ca.gov/Publications/Documents/Schools/56001007.pdf>

Worm Bin Bingo. Life Lab. 2010

<http://www.lifelab.org/2010/05/worm-bingo/>

(20 individually unique Worm Bin Bingo downloadable cards available at:

<http://www.lifelab.org/wp-content/uploads/2010/12/wormbinbingo.pdf>)

Worms Eat My Garbage, Appelhof, M. 2003. Flower Press, Kalamazoo, MI

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Introduction

Vermicomposting, or using worms to make compost, and using the finished product to amend the soil, has many potential benefits for agriculture and the rest of society. Like aerobic (hot) composting, vermicomposting can biologically transform organic wastes such as food scraps, manure, straw and other old plant matter into a valuable resource that can enhance soil fertility by improving the biological, physical, and chemical properties of the soil.

Composting is a viable way to turn potentially problematic organic byproducts into productive resources. Organic wastes can be expensive to manage and cause potential health and environmental problems. If not managed properly, organic materials can produce pollutants such as nitrates that end up in drinking water or methane and other gases that end up in the atmosphere. However, if properly transformed through vermicomposting or aerobic composting, compost enhances plant health and productivity, because compost contains essential plant nutrients and also can increase the soil's ability to retain and store nutrients and water.

There are some important differences between vermicomposting and typical aerobic (hot) composting systems. In aerobic composting, we create the right mixture of organic matter, moisture and oxygen and a wide diversity of already present aerobic microorganisms or microbes, (i.e., organisms which are not visible to the naked eye, such as bacteria) quickly start decomposing the organic matter and generating heat. We aren't usually concerned with exactly which decomposing microbes are involved and the heat is good because it indicates that the decomposition is going rapidly. With vermicomposting, on the other hand, we do care about which organisms are involved; we specifically want to have an active population of compost worms. (Note that the worms we find in a compost pile are different than the (closely related) worms we find in the soil in a garden or farm field.) Compost worms like environments that are moist and dark, do best with food that is rich in nutrients, and do not tolerate extremes in temperature.

While a healthy vermicompost system has lots of different organisms in addition to the worms, and some of these may contribute to the organic matter decomposition or in some other way be beneficial, some of the other organisms may be detrimental to our goals.

In this activity students will become familiar with vermicomposting through various observations of a vermicomposting system, learn about the environmental conditions that worms and other organisms in the system prefer and be asked to draw conclusions about the best way to manage worm composting.

To Lead This Activity You Need to Know

Facilitators of this activity need to have basic understanding of the following in order to effectively lead students through this activity:

- the biology and life cycle of compost worms, including their environmental and food requirements and preferences
- the identity and some biology of some of the other common organisms in a vermicomposting system
- environmental and management factors that are important in vermicomposting
- specific information about the management of the vermicomposting system at your location

Key Concepts

- Biological decomposition and the different types of organisms involved
- Understanding the biology and environmental requirements of the organisms involved helps us develop better vermicomposting management systems
- The relationships between waste management, nutrient cycling and soil fertility

Objectives

- Understand how worms and other organisms in vermicomposting systems convert ‘waste’ organic materials into valuable resources
- Learn the identity and some of the biology of compost worms and some of the other common organisms in a vermicomposting system
- Conduct simple experiments and observations to determine the environmental requirements and preferences of compost worms and possibly other organisms in the vermicompost system

Materials

- an active, well-managed, sufficiently large vermicomposting system
- trowels or similar small hand tools to help with handling compost, worms, etc.
- relatively shallow (e.g., 4-6” deep), waterproof, opaque boxes or other containers that are at least 12” diameter or 12” x 12” (ideally larger)
- pieces of heavy paper, cardboard or plywood; some should be large enough to block light over ½ of a container, others to block light over all of a container.
- a few liters of vermicompost that was recently removed from the system and then dried to air-dry status (“Dry” vermicompost in the *Moisture* trial, below)
- a few liters of recently removed vermicompost to which additional water was added. Do not add so much water that the water from this material will run into the other materials in the “Moisture” trial (“Wet” vermicompost in that trial)
- recommended: magnifying glasses or hand lenses
- recommended: laminated copies Worm Bin Bingo cards (see Worm Bin Bingo under Resource References, above). You can download several different cards such that all the organisms included in the cards are represented.

Activity (45-50 minutes)

Initial observation of worm composting system (10 minutes – or more, time permitting)

1. Gather students around the vermicomposting system and let them observe the system as a whole, including a few of the worms. Ask them what they see, what they think is happening and why someone would go to the effort of creating and managing such a system (i.e., what's the purpose and what are the advantages of the system)?
2. Give the students trowels or similar hand tools and show them how they can carefully dig around in the pile a bit. Have them look a little closer and ask them to describe some of what they see, including any organisms.
 - a. Optional supplemental activity (time permitting):

Instruct the students to choose one or two different organisms each. For each organism, have each student answer the following questions:

- i. What does the organism look like? (Describe its shape, size, details about body parts, coloration, etc. Make a quick sketch of it.)
- ii. Does it move? If so, describe its movement (e.g., speed, manner of movement, to or away from anything noticeable)
- iii. What do you think its role might be (e.g., decomposer, herbivore, predator, parasite, plant). What do you base this on?
- iv. Do you have an idea what this organism is called? If so, what do you think it is?

(Note the 20 downloadable Worm Bin Bingo cards included in the Resource References section provide excellent photos of many of the organisms that are common in vermicompost systems. It is useful to have these on hand for reference toward the end of this exercise.)

3. Ask the students what sort of environmental conditions they think the worms prefer, based upon what they are observing. If needed, prompt students to think about levels of moisture and light.

Experiment: What environmental conditions do worms prefer?

1. Ask students how they might test their ideas about the environmental conditions worms prefer.
2. After a bit of discussion, if necessary introduce the idea of giving the worms a choice between different levels of moisture and different levels of light.
3. Have the students set up at the following trials. (These can be replicated if you have sufficient containers, vermicompost and other supplies.)
 - a. Moisture Trial: In this trial, students will compare the worms' relative preferences for vermicompost at three moisture levels (called the "moisture treatments"). These are:
Moist (material at the moisture level present in vermicompost system);
Dry (material that was previously removed from the system and air dried);
Wet (material removed from the system to which extra water has been added).

As depicted in Figure 1, each of the treatments is added to a defined section that is about 1/3 of the area of the container, to a depth of ~ 2". Select 6 – 10 active worms from the vermicompost system and place them where the three different treatments come together in about the middle of the container.

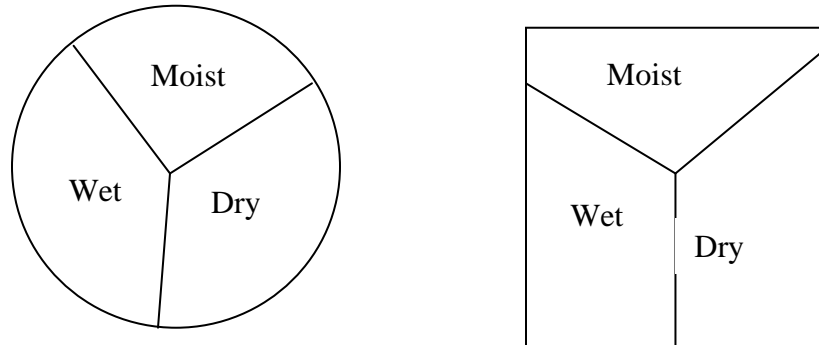


Figure 1. Possible layout for Moisture Trial

Once the 6 – 10 worms are in place, place the box or container in an area where it won't get too hot (e.g., out of direct sunlight) or too cold and cover it completely to block the light.

After 10 -15 minutes, check to see if the worms have moved and if so, to where. If necessary, wait a bit longer and re-check. Once the worms have moved, answer the following questions:

- i. Did the worms show a preference?
- ii. Did all or most the worms tend to move toward the same treatment?
- iii. How do you explain this?
- iv. What might this mean for how we manage our system?

- b. Light trial: In this trial, students will compare the worms' relative preferences for being exposed to light or not (called the "light treatments"). These are: *Dark* (vermicompost exposed to minimal light); *Light* (vermicompost exposed to significant light – but not intense direct sunlight).

Vermicompost from the system (same moisture content as "Moist" in the "Moisture Trial") is added to the entire of the container, to a depth of ~ 2". Place a cover that will block light from 1/2 of the container to create the *Dark* and *Light* treatments. Select 6 – 10 active worms from the vermicompost system and place them very close to the boundary between the two treatments, placing half of them in the *Light* area, right next to the boundary and the other half in the *Dark* area, right next to the boundary.

Once the 6 – 10 worms are in place, place the box or container in an area where it won't get too hot (e.g., out of direct sunlight) or too cold.

After 10 -15 minutes, check to see if the worms have moved and if so, to where. If necessary, wait a bit longer and re-check. Once the worms have moved, answer the following questions:

- i. Did the worms show a preference?
- ii. Did all or most the worms tend to move toward the same treatment?
- iii. How do you explain this?
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- c. *Trials with other organisms (optional, recommended):* You can also perform these same trials with other organisms (e.g., sow bugs, centipedes, ants) that might present in the vermicompost system. Do any such trial with only one type of organism at a time; you may need to adjust the numbers of individuals for the different types of organisms.

Discussion and Reflection (10-15 minutes)

Bring the students together and discuss some of the following questions:

- What sorts of roles do different organisms play in a vermicomposting system?
- Which of these might be beneficial from a vermicomposting perspective?
- What are some of the environmental factors that can impact these organisms?
- How might we use some of this information to manage the system well?
- Do you see similarities between a vermicompost system, including the different organisms involved and their diverse functions, and gardens, farms or ranches? Discuss these.

Note: Both *Worms Eat My Garbage* and *The Worm Book* have very good sections on other organisms in vermicompost systems and dealing with problems in these systems. *The Worm Guide: A Composting Guide for Teachers* also includes sections on these topics that can be useful in this discussion.