P.O. Box 219 • Batavia, IL 60510
(800) 452-1261 • Fax (866) 452-1436
www.flinnsci.com • E-mail: flinn@flinnsci.com

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Vermicomposting

Composting With Worms

Introduction

Set up a composting bin in the classroom to demonstrate how redworms decompose food waste to produce nutrient-rich fertilizer. The activity provides a "rich" source of information to discuss decay of living organisms, composting, and the importance of recycling, as well as worm life cycles and the carbon cycle.

Concepts

- Vermicomposting
- Recycling
- Worm life cycles
- Carbon cycle

Background

"All the fertile areas of this planet have at least once passed through the bodies of earthworms." —Charles Darwin.

Worm castings are among the most nutrient-rich soils available, containing about ten times as many nutrients and microorganisms as regular soil. The castings have a dark, rich soil or mud appearance and are excellent for use with houseplants, outdoor plants, or as seed starter soil. Composting bins are relatively simple to maintain after initial setup, and should have little to no odor when properly maintained.

Redworms *(Eisenia foetida)* will survive temperatures between 5 and 30 °C, although optimal activity and reproduction occur at temperatures of 18–21 °C. Foods that have not been heavily processed, such as fruit and vegetable remnants and peels, bread products, crushed eggshells, grass clippings, coffee grounds, tea bags, etc., work well for composting. Nutrient-rich castings may be harvested for the first time approximately four months after the compost habitat is established, and every one to two months thereafter.

A mature redworm may produce two or three egg capsules in a week, and each capsule will hatch two or three hatchlings after three weeks time. Hatchlings look like short pieces of white thread. Once mature, the redworms will look like small, brick-red earthworms. After four to six weeks, sexual maturity is reached and the worms will begin to produce their own capsules. The average life cycle of a redworm is typically 3–4 months, and dead worms will decay in the system like any organic matter. A bin approximately 19 × 16 × 12 inches in size will support well over 1,500 worms. Nightcrawlers (*Lumbricus terrestris*) may also be used for composting in a similar manner. Fishermen often use this method to maintain a consistent source of live bait.

Materials

Aged tap water, 4–5 L
Soil, 5 cups
Blocks, 2–4 (bricks, cinder blocks, or wood) for elevation
Garden fork (optional)
Gloves
Eisenia foetida (redworms), at least 250
Newspapers, 5–6 lbs
Pan, large
Plastic bin with lid, recycled, 19 × 16 × 12 inch
Screen, insect, 1–1.5 sq. ft. (optional)
Spray bottle
Scissors or electric drill

Safety Precautions

Compost bins contain many types of bacteria, mold, and often mites. Wear gloves whenever working with the contents of the compost bin. Wash hands thoroughly with soap and water after touching the compost.

Preparation

1. Prepare aged water by allowing tap water to sit out (outgas) for 24–48 hours. This will allow chlorine and other volatile chemicals to evaporate. Alternatively, bottled spring water may also be used.
2. Holes need to be cut or drilled into the plastic bins to provide a supply of oxygen for the worm population. If using a drill, place 6–8 holes each in the lid and in the bottom of the bin (towards the center where they will not be covered by the elevating blocks), and four holes on each side of the bin. If using scissors (they must be sharp), puncture a "starter" hole with the point of the scissors, and work one of the blades into the hole. Cut in a circular motion and remove a 1- to 1.5-inch vent from the bin (see Figure 1). Since these holes are larger, only four will be needed on the top and bottom of the bin, and two on each side. Hot glue may be used to attach the optional insect screening over the holes in the bottom of the bin to keep the bedding from seeping out, although this is not necessary.

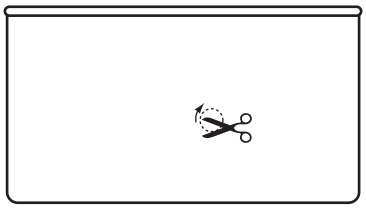

Figure 1. Venting the Bin.

3. To prepare the worm bedding, tear 5–6 lbs of newspaper into 1–2 inch strips and add the strips to the bin. Add approximately 5 cups of soil and 4–5 liters of aged water to the bin and mix to distribute evenly. *Note:* The bedding mixture should contain approximately 75–80% moisture. To test the moisture level, remove a piece of newspaper and squeeze it like a sponge—only a drop or two of water should come out of the paper strip if the dampness is optimal. Add more water if needed.
4. Choose a location for the bin where it will remain undisturbed. Constant vibration may cause worms to crawl out of the bin.
5. Elevate the bin on wooden blocks, bricks or cinder blocks. Place a large pan or tray under the section of the bin with the holes to catch drainage.
6. The redworms may be added to the bedding at this point.

Procedure

1. Bury 1–2 lb of food waste 1–2 inches deep within the bedding every 2–3 days when the compost bin is starting out. Typically worms will eat their weight in food each day, and 1,000 worms weigh about one pound. Monitor how quickly food is "vanishing" and add more waste appropriately. After six weeks the worm population will have grown, and the system will be able to decompose a larger volume of waste. Worms tend to dwell in the top 3–4 inches of the bin, so it is not necessary to bury food waste deeper than 1–2 inches in the bin.
2. To oxygenate the compost, mix the bin contents every time waste is added, using either a gardening fork or gloved hands.
3. If the bedding appears to be drying out, add aged water using a spray bottle. Take into consideration that food waste will add a generous amount of moisture to the system.
4. When the worm castings are ready to be harvested, most of the castings will be found on the top of the compost. Open the bin and allow bright light to shine in the bin for several hours to force the worms deeper into the bedding (the worms are light sensitive). The top layer is then ready to be harvested. The castings look like dark, rich soil or mud.

Disposal

The contents of the compost bin may be added to an outdoor compost pile when the bin is no longer being used in the classroom.

Tips

- It is important to use a recycled plastic bin, such as recycled HDPE, since this activity promotes recycling. A bin size of approximately 19 × 16 × 12 inches works well. Smaller bins do not have as high of a success rate and larger bins may be too heavy to move easily. Plastic bins may be purchased at superstores, department stores, hardware stores, and are included with the Flinn Scientific Worm Composting Kit (Catalog No. FB0534).
- Soil obtained outdoors works best.

- If eggshells or coffee grounds will not be added to the compost, add a cup of sand instead. The sand provides grit for digestion in the worms' gizzards.
- Use only the black and white sections of newspapers. Glossy, colored pages may contain inks and additives that are toxic to the worms.
- If the compost attracts unwanted insects, such as ants and fruit flies, place a thin layer of vinegar in the pan under the bin. This will help trap any unwanted insects.
- Do not add large amounts of meat, which may attract rodents, to the compost bin. Also limit the amount of citrus fruits, which will tend to make the soil too acidic.
- The liquid drainage from the bottom of the bin contains beneficial nutrients, and may be used to water plants.
- Reduce the quantity of bread products added to the compost if the bin begins to develop visible mold.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard C: Life Science, reproduction and heredity, regulation and behavior, population and ecosystems, diversity and adaptations of organisms
Content Standard F: Science in Personal and Social Perspectives; populations, resources, and environments
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard C: Life Science, interdependence of organisms; matter, energy, and organization in living systems; behavior of organisms
Content Standard F: Science in Personal and Social Perspectives; natural resources and environmental quality

References

Appelhof, Mary. *Worms Eat My Garbage.* Flower Press, Kalamazoo, Michigan.

Vermicomposting Survival Guide. http://ctvalley.com/compostguide.html (Accessed October 2006).

Materials for *Vermicomposting* are available from Flinn Scientific, Inc.

Catalog No.	Description
FB0534	Worm Composting Kit
LM1178	*Eisenia Foetida,* class size of 100

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

