TEACHER'S GUIDE

It's Gotten Rotten

to be used in conjunction with
It's Gotten Rotten
a 20–minute video about composting
as a topic for scientific inquiry
by high school students

Nancy M. Trautmann and Marianne E. Krasny
Cornell University

funded by
NYS Energy Research and
Development Authority

CONTENTS

Designer and Illustrator Jane MacDonald

PURPOSES OF THE VIDEO AND GUIDE

School composting is carried out for two distinct purposes: for disposal of leaves, grass clippings, or food scraps, and as a focus for scientific exploration by students. The latter goal is the focus for *It's Gotten Rotten*. The video is designed to introduce high school students to the science of composting, focusing primarily on the biology of the invertebrates and microorganisms that decompose organic matter. Students are shown designing and using both indoor and outdoor composting systems, observing living organisms, and using finished compost to grow plants.

The goals of the video are:

- *to expose students to the concept of composting—i.e., recycling organic matter into a useful product rather than throwing it away.*
- *to give students a close-up view of some of the invertebrates and microorganisms that take part in the composting process.*
- *to introduce some of the techniques involved in carrying out scientific investigations, including making observations, recording data, and interpreting results.*
- *to motivate students to carry out their own scientific investigations making and using compost.*

It's Gotten Rotten sets the scene for classroom composting. It is designed to be used in conjunction with *Composting in the Classroom* (Trautmann and Krasny, 1997), a detailed manual for teachers who are interested in using composting as a topic for scientific exploration at the high school level.

WHY COMPOSTING?

Composting is a topic of growing interest in schools throughout the country. Why composting? There are a number of reasons.

Composting provides a partial solution to an issue of great concern in many communities. All around the country, landfills are filling up, garbage incineration is becoming increasingly unpopular, and other waste disposal options are becoming ever harder to find. Composting provides a way not only of reducing the amount of waste that needs to be disposed of, but also of converting it into a product that is useful for gardening, landscaping, or growing house plants. By addressing the solid waste issue, composting provides a means for students to attain a sense of environmental stewardship.

Many educational programs focus on reducing, reusing, and recycling solid wastes. Composting fits in with this idea but takes it a step beyond. With composting, children can do more than just send off cans or newspapers for recycling—they can see the entire cycle, from rotting food scraps or other organic wastes...to something that is pleasant to handle and is good for the soil. Contrary to the "out of sight, out of mind" philosophy, students who compost become aware of organic wastes as potential resources rather than just something "gross" to be thrown away and forgotten. They learn through direct experience that they personally can make a difference and have a positive effect on the environment.

Another reason for composting in schools is that it provides a rich topic for scientific investigation and discovery. Although composting is simple (you just put organic matter in a pile and wait for it to decompose), it also involves some fascinating and as yet incompletely understood interactions between biological, chemical, and physical processes.

In outdoor compost systems, there is a complex food web at work. Some of the more familiar soil invertebrates, such as millipedes, sowbugs, snails, and slugs, help to shred the organic matter into smaller-sized pieces, creating greater surface area for action by microorganisms. These microbes are in turn eaten by invertebrates such as mites and springtails. Students can observe compost organisms at work and study their life cycles or carry out food preference experiments.

The vast bulk of the decomposition work in compost is carried out by microorganisms including fungi, bacteria, and actinomycetes (a group of bacteria that grow filaments). Under optimal conditions, a compost pile will heat up to temperatures in the range of 50–65°C (120–150°F), caused by the metabolic heat of these microorganisms. You can see evidence of this when a steamy mist rises from your compost pile as you turn it or dig into it. Students conducting composting experiments can use daily temperature readings to compare how quickly the system heats up, how hot it gets, and how long it retains its heat. Some classes have made this into a competition, for example to see whose compost reaches the hottest temperature or stays hot the longest.

A common assumption is that composting makes sense only out in the country or in suburban areas where people have large yards. Some of the most avid composters, however, live in the heart of cities, where the compost they make helps to restore or replace worn-out or contaminated soils for school or community gardens. These gardens and accompanying compost systems appear in former vacant lots, and even on roof tops and balconies of schools and community buildings. Composting can take place indoors, using systems such as the garbage can and soda bottle bioreactors described in this publication.

In short, composting is a topic that addresses a real-world issue and helps to instill a sense of environmental stewardship in youth. It can be carried out at a wide range of scales, indoors or out, in any geographic location. Because it is a process that relies on biology, chemistry, and physics, it can be used for many different scientific projects or experiments and can help students to see the interconnections between various scientific disciplines. Once made, compost is useful for gardening projects and plant growth experiments.

CLASSROOM ACTIVITIES RELATED TO COMPOSTING

Conduct an audit of organic wastes thrown away in your school. For one day, have students record the volume of food that is thrown away in the school cafeteria. Include food preparation wastes such as salad trimmings as well as the students' plate scrapings. Have students investigate what is done with leaves, grass clippings, and brush from the school grounds. Compile all of these numbers into an estimate of the amount of organic material thrown away annually. Ask the students if they can think of any waste disposal alternatives.

Discuss the concept of composting. How can rotten apple cores and pizza crusts turn into something that resembles soil? Does anything like this happen in nature?

Visit a composting site in your community. For example, there may be a demonstration site run by cooperative extension or community gardeners, or a municipal facility for composting yard wastes.

Design and build a composting system, using either an outdoor bin or one of the indoor bioreactors described below. Try making compost. Based on the initial results, ask the students to decide on the requirements for successful composting, then design simple experiments to test these ideas.

Conduct composting experiments. How does the frequency of mixing affect the maximum temperature of a compost pile? Does the rate of worm reproduction depend on the type of organic matter available? How can you tell if compost is finished and ready to use in the garden or on houseplants? Whether your interests are in biology, chemistry, or physics, composting provides a wealth of possibilities for scientific experimentation.

Observe compost organisms. Compost provides a readily available source of a wide variety of microorganisms and invertebrates. If you don't make your own compost at school, try looking through a pile of decomposing leaves, or gather compost samples from home gardeners or municipal yard waste composting operations. Unless they dry out, such samples will yield a wealth of organisms even after several months in storage.

TECHNIQUES FOR SCHOOL COMPOSTING

When you think of composting, chances are you envision one of a variety of bins that are used for composting outdoors.[1] But composting can also be carried out right in the classroom, in containers or bioreactors ranging from soda bottles to garbage cans. Although they are generally too small to recycle large quantities of organic wastes, they are ideal for conducting composting research and designing small-scale models of larger composting systems.

Because these units are small, they need to be carefully designed and monitored to provide conditions favorable for aerobic, heat-producing composting. Two types of bioreactors are described in this guide:

- **Two-can bioreactors** are made from nested garbage cans. Each two-can system will process enough organic matter to fill a 20–gallon can. Temperature increases indicating microbial activity can be observed within the first week of composting, and the compost should be finished and ready for curing within two to three months.

- **Soda bottle bioreactors** are used as tools for research rather than waste management. They are small and inexpensive, enabling students to design and carry out individualized research projects comparing the effect of variables such as reactor design, moisture content, and insulation on compost temperature.

Another option for indoor composting is to use worm bins, which rely on red worms (commonly *Eisenia fetida*) and microorganisms to decompose food scraps and bedding materials, producing finished compost in three to five months. For information on how to set up and maintain worm bins, see *Composting in the Classroom* (Trautmann and Krasny, 1997) or *Worms Eat My Garbage* (Appelhof, 1982).

---

[1] For examples of outdoor systems, see *Composting: Wastes to Resources* (Bonhotal and Krasny, 1990) or Chapter 2 in *Composting in the Classroom* (Trautmann and Krasny, 1997).

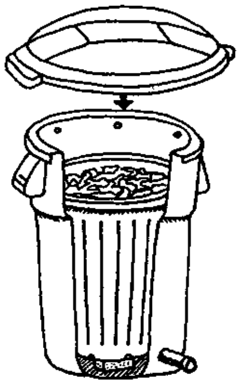
TWO-CAN BIOREACTOR

Purpose

Two-can composters consist of a 20-gallon garbage can containing organic wastes placed inside a 32-gallon garbage can. Although many classrooms have successfully composted with a single container, placing the can that holds wastes inside another container helps alleviate any odor and fly problems that may arise. The outside container can also be used to collect leachate.

Two-can units are designed to be used as small-scale indoor composting units for home composting, and as an educational tool in the classroom. A 20-gallon can holds about 10% of the volume of a cubic meter outdoor pile. Hence the need to pay careful attention to C:N ratios, moisture content, and temperature, if you want the compost to heat up.

A system using a 10-gallon plastic garbage can inside a 20-gallon can may be substituted if space is a problem. The smaller system may operate at lower temperatures, thereby lengthening the time for decomposition. Students may want to experiment with various aeration and insulation systems and mixtures of wastes to see if they can come up with a 10-gallon system that achieves temperatures as high as those in a larger system.



Materials

- 32-gallon plastic garbage can
- 20-gallon plastic garbage can
- drill
- brick
- spigot (optional)
- duct tape (optional)
- insulation (optional)
- 6 pieces of nylon window screen (each about 5-cm by 5-cm)
- dial thermometer with stem at least 60 cm long
- compost ingredients (see Step 8 below)

Construction

1. Using a drill, make 15 to 20 holes (1-2.5 cm diameter) through the bottom of the 20-gallon can.
2. Drill five 1-2.5 cm holes just below the rim of the larger garbage can, and cover them on the inside with pieces of nylon window screen.
3. Design and build a spigot at the bottom of the larger can for draining leachate. One way to do this is to fit a piece of pipe into a hole at the bottom edge of the outer can, sealing around the edges with waterproof tape or sealant. Close the outer end of the pipe with a tight-fitting cork or stopper that can be removed to drain the accumulated leachate, and cover the inner end with a piece of nylon screening to block flow of solid particles.
4. Place a brick or some other object in the bottom of the 32-gallon can. This is to separate the two cans, leaving space for leachate to collect. (Students may want to measure the leachate and add it back into the compost.)
5. If you will be composting in a cold area, you may want to add insulation to the outer barrel and lid with duct tape, making sure not to block aeration holes.
6. To reduce potential odors, line the bottom of the outer can with several centimeters of absorbent material such as peat moss or finished compost. Periodically drain the leachate to avoid anaerobic conditions that may cause odors. The leachate can be poured back in the top if the compost appears to be drying out. Otherwise, dispose of it outside or down the drain, but do not use it for watering plants. (This leachate is not the "compost tea" prized by gardeners and could harm vegetation unless diluted. Compost tea is made by soaking mature compost, after decomposition is completed.)
7. Fill the reactor, starting with a 5-10 cm layer of "brown" material such as wood chips, finished compost, or twigs and branches. Loading can take place all at once (called "batch composting") or in periodic increments. With batch composting, you are more likely to achieve high temperatures quickly, but you will need to have all organic material ready to add at one time. If you will be adding layers of materials over time rather than all at once, the material probably won't begin to get hot until the can is at least 1/3 full.

   Whether you fill the reactor all at once or in batches, remember to keep the ingredients loose and fluffy. Although they will become more compact during composting, never pack them down yourself because the air spaces are needed for maintaining aerobic conditions. Another important rule is to keep the mixture in the inner can covered at all times with a layer of high-carbon material such as finished compost, sawdust, straw, or wood shavings. This minimizes the chance of odor or insect problems.
8. To get your compost to heat up, you will need to provide ingredients within the target ranges for moisture, carbon, and nitrogen. For moisture, the ideal mixture is 40-50% water by weight. You can calculate this,[2] or use the rule of thumb that the ingredient mix should feel about as damp as a wrung-out sponge. For carbon and nitrogen, the mixture should contain approximately 30 times as much available carbon as nitrogen (or a C:N ratio of 30:1). Organic materials that are high in carbon include wood chips or shavings, shredded newspaper, paper egg

---

[2] For the moisture calculation procedure, visit our web site at: http://www.cfe.cornell.edu/compost/calc/moisture_content.html, or see Chapter 3 in *Composting in the Classroom* (Trautmann and Krasny, 1997).

cartons, and brown leaves. Those high in nitrogen include food scraps, green grass or yard trimmings, coffee grounds, and manure. (Do not use feces from cats or meat-eating animals because of the potential for spread of disease organisms.)

Table 1. C:N ratios of common compost ingredients*

Materials High in Carbon	**C:N**
autumn leaves	40–80:1
sawdust	200–750:1
wood chips or shavings - hardwood	450–800:1
wood chips or shavings - softwood	200–1,300:1
bark - hardwood	100–400:1
bark - softwood	100–1,200:1
straw	50–150:1
mixed paper	100–200:1
newspaper	400–900:1
corrugated cardboard	600:1

Materials High in Nitrogen	**C:N**
vegetable scraps	10–20:1
fruit wastes	20–50:1
coffee grounds	20:1
grass clippings	10–25:1
cottonseed meal	10:1
dried blood	3:1
horse manure	20–50:1

* Source: Rynk, R., ed. 1992. *On-Farm Composting Handbook.* Northeast Regional Agricultural Engineering Service. 152 Riley-Robb Hall, Cornell University, Ithaca NY 14853. These data should be viewed as representative ranges compiled from many different studies, not as universal values or averages.

The compost process should take three to five weeks after the can is filled. You can then transfer the compost into other containers or an outdoor pile for several weeks or months of curing while starting up a new batch of compost in the two-can system.

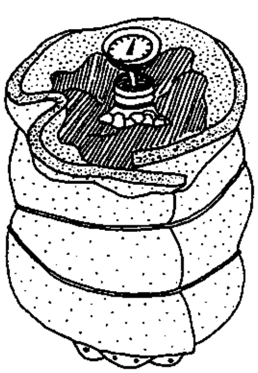
SODA BOTTLE BIOREACTOR

Purpose

Soda bottle bioreactors are designed to be used as tools for composting research rather than as a means to dispose of organic waste. They are small and inexpensive, enabling students to design and carry out individualized research projects. For example, students might choose to study the effect of moisture content or nutrient ratios on the peak temperature achieved by each compost mixture.

Use the instructions below as a starting point. Challenge your students to design their own soda bottle reactors, and to monitor the temperatures their reactors achieve.

Materials



- two 2–liter or 3–liter soda bottles
- Styrofoam plate or tray
- one smaller plastic container such as a margarine tub that fits inside the bottom of the soda bottle (optional—see Step 3, below)
- drill or nail for making holes
- duct tape or clear packaging tape
- utility knife or sharp-pointed scissors
- insulation materials such as sheets of foam rubber or fiberglass
- fine-meshed screen or fabric (such as a piece of nylon stocking) large enough to cover holes at top and bottom of soda bottle, to keep flies out
- thermometer that will fit into the top of the soda bottle and be long enough to reach down into the center of the compost (the type with a dial on the top is easiest to read)
- chopped vegetable scraps such as lettuce leaves, carrot or potato peelings, and apple cores, or garden wastes such as weeds or grass clippings
- bulking agent such as wood shavings or 1–cm pieces of paper egg cartons, cardboard, or wood
- hollow flexible tubing to provide ventilation out the top (optional—see Step 10, below)

Construction

1. Using a utility knife or sharp-pointed scissors, cut the top off one soda bottle just below the shoulder and the other just above the shoulder. Using the larger pieces of the two bottles, you will now have a top from one that fits snugly over the bottom from the other.

2. The next step is to make a Styrofoam circle. Trace a circle the diameter of the soda bottle on a Styrofoam plate and cut it out, forming a piece that fits snugly inside the soda bottle. Use a nail to punch holes through the Styrofoam for aeration. The circle will form a tray to hold up the compost in the bioreactor. Beneath this tray, there will be air space for ventilation and leachate collection.
3. If your soda bottle is indented at the bottom, the indentations may provide sufficient support for the Styrofoam circle. Otherwise, you will need to fashion a support. One technique is to place a smaller plastic container upside down into the bottom of the soda bottle. Other possibilities include wiring or taping the tray into place.
4. Fit the Styrofoam circle into place in the soda bottle, roughly 4–5 cm from the bottom. Below this tray, make air holes in the sides of the soda bottle. This can be done with a drill or by carefully heating a nail and using it to melt holes through the plastic. If you are using a plastic container to hold up the Styrofoam tray, you may need to drill holes through the container as well. The object is to make sure that air will be able to enter the bioreactor, diffuse through the compost, and exit through the hole or tubing at the top.

   Avoid making holes in the very bottom of the bottle unless you plan to use a pan underneath to collect whatever leachate may be generated during composting.
5. Following the guidelines in Step 8 of the two-can bioreactor construction, assemble your compost ingredients. Mixtures containing a variety of ingredients are more likely than homogeneous ones to achieve hot temperatures when composted. Because soda bottle bioreactors are so small, composting proceeds best if the ingredients are cut or chopped into roughly 1-cm pieces. Remember that you want air to be able to diffuse through the pores in the compost, so keep your mix light and fluffy and do not pack it down.
6. Loosely fill the bioreactor. Put the top piece of the soda bottle on and seal it in place with tape.
7. Cover the top hole with a piece of screen or nylon stocking and secure in place with a rubberband. Alternatively, if you are worried about potential odors, you can ventilate your bioreactor using rubber tubing out the top. Simply use the screw-on soda bottle cover with a hole drilled through it for a piece of rubber tubing, which leads out the window or into a ventilation hood.
8. If you think flies may become a problem, cover all air holes with a piece of nylon stocking or other fine-meshed fabric.
9. Insulate the bioreactor, making sure not to block the ventilation holes. (Because these soda bottle bioreactors are much smaller than the typical compost pile, they will work best if insulated to retain the heat that is generated during decomposition.) You can experiment with various types and amounts of insulation.

Now you are ready to watch the compost process at work! You can chart the progress of your compost by taking temperature readings. Insert a thermometer down into the compost through the top of the soda bottle. For the first few days, the temperature readings should be taken at least daily, preferably more often. In these small systems, it is possible that temperatures will reach their peak in less than 24 hours. To avoid missing a possible early peak, use a max/min thermometer or a continuously recording temperature sensor, or have students measure temperatures several hours after they add their wastes, and early the next morning.

Soda bottle reactors generally reach temperatures of 40–45°C, lower than temperatures achieved with larger composting systems. If the conditions are not right, no noticeable temperature increase will occur. Challenge your students to design systems that show temperature increases, and use their results as a starting point for a discussion of the various factors (C:N ratios, size, and moisture levels of organic materials, air flow, and insulation) that affect microbial growth and decomposition.

Because the bottles are so small, you may not end up with a product that looks as finished as the compost from larger piles or bioreactors. However, you should find that the volume shrinks by 1/2 to 2/3 and that the original materials are no longer recognizable. You can let the compost age in the soda bottles for several months, or transfer it to other containers for curing while starting up a new batch of compost in the reactors.

INVERTEBRATES COMMONLY FOUND IN COMPOST

Below are descriptions of the most common invertebrates found in compost, organized in order of roughly increasing size within the broad phylogenic classifications.

ANNELIDS

Potworms *(Phylum Annelida, Class Oligochaeta, Family Enchytraeidae)*: Enchytraeids are small (10–25 mm long), segmented worms also known as white worms or pot worms. Because they lack hemoglobin, they are white and can thus be distinguished from newly hatched, pink earthworms. Pot worms often are found in worm bins and damp compost piles. They feed on mycelia, the threadlike strands produced by fungi. They also eat decomposing vegetation along with its accompanying bacterial populations.

Earthworms *(Phylum Annelida, Class Oligochaeta)*: Of the invertebrates who play a role in the initial stage of organic matter decomposition, earthworms are probably the most important. But there are many different types of earthworms; worldwide, the class Oligochaeta includes about 3000 species. Most worms active in compost piles normally live in the upper organic or litter layer of soil. They are detritivores, feeding primarily on relatively-undecomposed plant material. Both *Lumbricus terrestris*, a worm common in soils in North America, and *Eisenia fetida*, the species most commonly used in worm composting, belong to this group. Other species of worms that are less useful for composting burrow deeper beneath the surface and ingest large quantities of soil containing more highly decomposed plant material.

ARTHROPODS

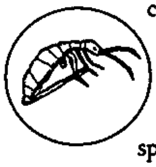
Arachnids

Mites *(Phylum Arthropoda, Class Arachnida, Order Acarina)*: There are over 30,000 species of mites worldwide, living in every conceivable habitat. Some are so specialized that they live only on one other species of organism. They range in size from microscopic to the size of a pin head. Like spiders, they have eight legs. Mites are extremely numerous in compost and are found at all levels of the compost food web. Some are primary consumers that eat organic debris such as leaves and rotten wood. Others are at the secondary level, eating fungi or bacteria that break down organic matter. Still others are predators, preying on nematodes, eggs, insect larvae, springtails, and other mites. Sometimes mites can be seen holding onto larger invertebrates such as sowbugs, millipedes, or beetles. One very common compost mite is globular shaped, red-orange in color, and has bristling hairs on its back.

Pseudoscorpions *(Phylum Arthropoda, Class Arachnida, Order Pseudoscorpionida)*: Pseudoscorpions look like tiny scorpions with large claws relative to their body size, but lacking tails and stingers. They range from one to several millimeters in size. Their prey includes nematodes, mites, springtails, and small larvae and worms. Lacking eyes and ears, pseudoscorpions locate their prey by sensing odors or vibrations. They seize victims with their front claws, then inject poison from glands located at the tips of the claws.

Spiders *(Phylum Arthropoda, Class Arachnida, Order Araneae)*: Spiders feed on insects and other small invertebrates in compost piles.

Insects



Springtails *(Phylum Arthropoda, Class Insecta, Order Collembola)*: Springtails are small wingless insects that are numerous in compost. A small springlike lever at the base of the abdomen catapults them into the air when they are disturbed. If you pull apart layers of decaying leaves, you are likely to see springtails hopping or scurrying for cover. They feed primarily on fungi, although some species eat nematodes or detritus.

Flies *(Phylum Arthropoda, Class Insecta, Order Diptera)*: During the early stages of the composting process, flies provide ideal airborne transportation for bacteria on their way to the pile. Flies spend their larval phase in compost as maggots, which do not survive thermophilic temperatures. Adults are attracted to fresh or rotting food and can become a nuisance around worm bins or compost piles if the food scraps are not well covered.

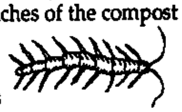
Ants *(Phylum Arthropoda, Class Insecta, Order Hymenoptera)*: Ants eat a wide range of foods, including fungi, food scraps, other insects, and seeds. Ant colonies often can be found in compost piles during the curing stage.

Beetles *(Phylum Arthropoda, Class Insecta, Order Coleoptera)*: The most common beetles in compost are the rove beetle, ground beetle, and feather-winged beetle. Tiny feather-winged beetles feed on fungal spores, while the larger rove and ground beetles prey on other insects, snails, slugs, and other small animals.

Earwigs *(Phylum Arthropoda, Class Insecta, Order Dermaptera)*: Earwigs are distinguished by jawlike pincers on the tail end. Some species are predators and others are detritivores. They are usually 2–3 cm long.

Other Arthropods

Millipedes *(Phylum Arthropoda, Class Diplopoda)*: Millipedes are slower and more cylindrical than centipedes and have two pairs of legs on each body segment. They feed mainly on decaying plant tissue but will eat insect carcasses and excrement.



Centipedes *(Phylum Arthropoda, Class Chilopoda)*: Centipedes are fast-moving predators found mostly in the top few inches of the compost heap. They have formidable claws behind their head that possess poison glands that paralyze small worms, insect larvae, and adult arthropods such as insects and spiders. They can be distinguished from millipedes by their flattened bodies and single pair of legs per body segment.

CRUSTACEANS

Sowbugs and Pillbugs *(Phylum Arthropoda, Class Crustacea, Order Isopoda)*: Sowbugs, also called isopods, potato bugs, or wood lice, are the only terrestrial crustacean. Because they lack the waxy cuticle common to most insects, they must remain in damp habitats. They move slowly, grazing on decaying wood and resistant tissues such as the veins of leaves. Pillbugs, or rollypolies, are similar to sowbugs, except they roll into a ball when disturbed, whereas sowbugs remain flat.

NEMATODES

Nematodes *(Phylum Nematoda)*: Under a magnifying lens nematodes, or roundworms, resemble fine human hair. They are cylindrical and often transparent. Nematodes are the most abundant of the invertebrate decomposers—a handful of decaying compost probably contains several million. They live in water-filled pores and in the thin films of water surrounding compost particles. Some species scavenge decaying vegetation, some eat bacteria or fungi, and others prey on protozoa and other nematodes.

MOLLUSKS

Slugs and Snails *(Phylum Mollusca, Class Gastropoda)*: Some species of slugs and snails eat living plant material, whereas others feed on decaying vegetation. Unlike many other invertebrates, some snails and slugs secrete cellulose-digesting enzymes rather than depending on bacteria to carry out this digestion for them.

GLOSSARY

Aeration. The process through which atmospheric air enters a compost system.

Aerobic. (1) Characterized by presence of oxygen, (2) Living or becoming active in the presence of oxygen, (3) Occurring only in the presence of oxygen.

Anaerobic. (1) Characterized by absence of oxygen, (2) Living or functioning in the absence of air or free oxygen, (3) Occurring only in the absence of oxygen.

Bacteria. Single-celled microscopic organisms lacking an enclosed nucleus. Commonly have a spherical, rod, or spiral shape.

Biodegradable. Capable of being broken down through biochemical processes.

Bioreactor. An enclosed container used for making compost and conducting scientific experiments on the composting process.

Bulking agent. A material used in composting to provide structural support and maintain air spaces between particles.

Cilia. Microscopic hairs extending from a cell and often capable of motion.

C:N ratio. The ratio of the weight of organic carbon to the weight of total nitrogen in soil, compost, or other organic material.

Compost. (1) The process of decomposition of organic materials under controlled conditions, (2) The humus-like material produced by decomposing organic materials under controlled conditions.

Compost system. The method used to convert organic wastes into a stable end product.

Curing. The final stage of composting, after the period of rapid decomposition has been completed, in which slow chemical changes occur that make the compost more suitable for use with plants.

Decomposer. An organism that feeds on dead organic matter and aids in its degradation.

Food chain. A sequence of organisms that eat each other, starting with either green plants or organic detritus as the primary energy source.

Food web. The network of interconnected food chains found in an ecological community.

Fungi. Plural of fungus. Organisms that lack chlorophyll, feed on dead organic matter, reproduce by spores, and grow cellular filaments called hyphae. Include molds, mildews, yeasts, and mushrooms.

Humus. The well decomposed, stable organic complex that remains after plant and animal residues have decomposed in soil or compost.

Invertebrate. An animal without a backbone, such as an insect or worm.

Leachate. The liquid that drains out of a compost system as organic matter decomposes.

Macroorganism. An organism large enough to be observed with the naked eye.

Microbe. A microorganism.

Microorganism. An organism so small that magnification is required for observation.

Organic matter. Material that has come from something that is or was once alive.

Protozoa. Single-celled animal-like microorganisms including amoebas, flagellates, ciliates, and sporozoans.