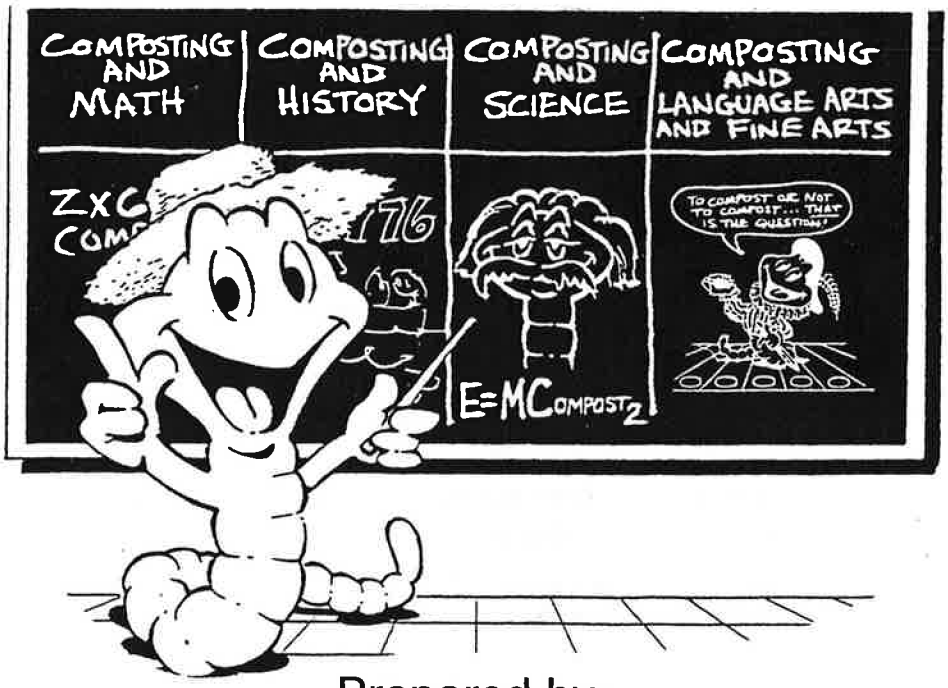
Santa Clara County Master Composter Training Manual



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Placer County

Adapted for Santa Clara County
for use by

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UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION PLACER COUNTY

Master Composter Training Manual

This manual was developed and compiled through a joint project of the Placer County University of California Cooperative Extension Office and the Placer County Department of Public Works.

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This manual relies heavily on the work of the following individuals and agencies:

Hopkins, Sherl W. ***Master Composter Training Manual.*** University of California Cooperative Extension, Los Angeles County, California.

Timmons, Lorraine. ***Master Composter Training Manual.*** Ventura County Solid Waste Management and City of Ojai, California.

Williams, J. David, T. Glover, J. O. Donald, W. O. Goff. ***Composting Manual.*** Alabama Cooperative Extension, Auburn University, Alabama.

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Introduction to Composting

Garbage has become big news. In many parts of the country there is simply no place to take the trash. Community landfills are filling up rapidly, and no one seems to want a landfill in their backyard. With strict new state regulations governing the operation of landfills, it's getting harder and more expensive to dispose of our society's discards. When we stop and think about our throwaway attitude, we must realize that there is no such place as "away"; our discards need to be managed somehow in a safe and cost-effective manner.

The History of Composting

Composting is the breakdown of organic matter by bacteria and other organisms. The value of organic matter to plant health was first established by early man. Outside ancient tribal settlements, rings of fish bones, food scraps and feces accumulated over time. Materials brought in from great distances were concentrated in one small area. Some speculate that our ancestors began cultivating the plants that emerged from these dump heaps because the accidentally rich soils produced a bountiful harvest.

This human role in composting is not new and as garden writer Stuart Campbell, explains in his book, ***Let It Rot***, *"Ancient man was the real father of organic gardening, he was an artist, not a scientist. Only by trial and error was he able to learn what worked when it came to making synthetic manure."*

As agricultural practices were established, the importance of using manures to replenish the nutrients of cultivated soils became known. The following is a passage by the Roman Varro (116 - 270 BC). *"Hard by the steadying there should be two manure pits, or one pit divided into two parts; into one part should be cast the fresh manure, and from the other the rotted manure should be hauled to the field; for the manure is not so good as when it is well rotted."* This advice is as good today as it was 2000 years ago.

After centuries of sustainable soil practices by small farmers, the Roman emperor began giving land to officials

who gained his favor. To reap larger incomes from these holdings, slaves were used to plant and harvest, but not to build the soil.

These exploitative farming methods so reduced the soil's fertility that soon only grazing animals could be raised on this land. The powerful Empire moved its capital from depleted Rome to Constantinople so that food crops could be imported from the rich soils of the Nile delta. The rest of the Roman decline is history.

Other cultures have treated their soils with varying degrees of wisdom. Sustainability, treating land as if you expected your descendants to find it fertile far into the future, has been a value taken more seriously by some cultures and less by others. Sir Albert Howard, in his landmark book, An Agricultural Testament (1943), observed the rise and fall of many important and powerful civilizations. He saw the implications of once fertile land depleted by poor agricultural practices and dedicated his life to understanding how to increase the natural fertility of the soil.

In India, Sir Albert saw manures gathered from the roads and used as fuel rather than a fertilizer for next year's crops. This practice led to soil depletion. While working in India for the British Government, Sir Albert developed a composting technique called the Indore Method, which uses a small amount of animal manure to help compost crop waste. Sir Albert also gained many of his ideas from China where crop wastes were thrown onto the roads, pulverized by passing cart, and then collected with human and animal waste to be returned immediately to the fields. The Chinese people integrated waste recycling into crop, livestock and fish systems to maximize production, and were thus very creative in dealing with organic waste management.

"Often," wrote Sir Albert, *"the Asians situate their fish ponds at the bottom of a hill or sloping farmland, allowing natural drainage to carry the manures and agricultural runoff into the pond. The Asians also use pond water to irrigate (and fertilize) their crops. At regular intervals the ponds are drained and the accumulated bottom sludge is dug out and added to the vegetable beds as compost."* This method of intensive recycling of nutrients has given China the ability to sustain food production levels to meet the needs of three persons per acre for thousands of years.

Americans also have a heritage of composting. In the early 18th century, colonial farmers discovered that by properly composting two loads of muck (moist, sticky dirt or mud taken from drained ponds or drainage ditches) with one load of barnyard manure, they obtained a product equivalent to three loads of manure.

As these pioneering farmers moved west and found six to nine feet of humus-rich topsoil on the Midwestern plains, composting no longer seemed necessary. Their assumptions about the endless native fertility of these soils proved wrong. After poor agricultural practices left the ground vulnerable to wind erosion, the Dust Bowl conditions of the 1930s took away much of the fertile soil.

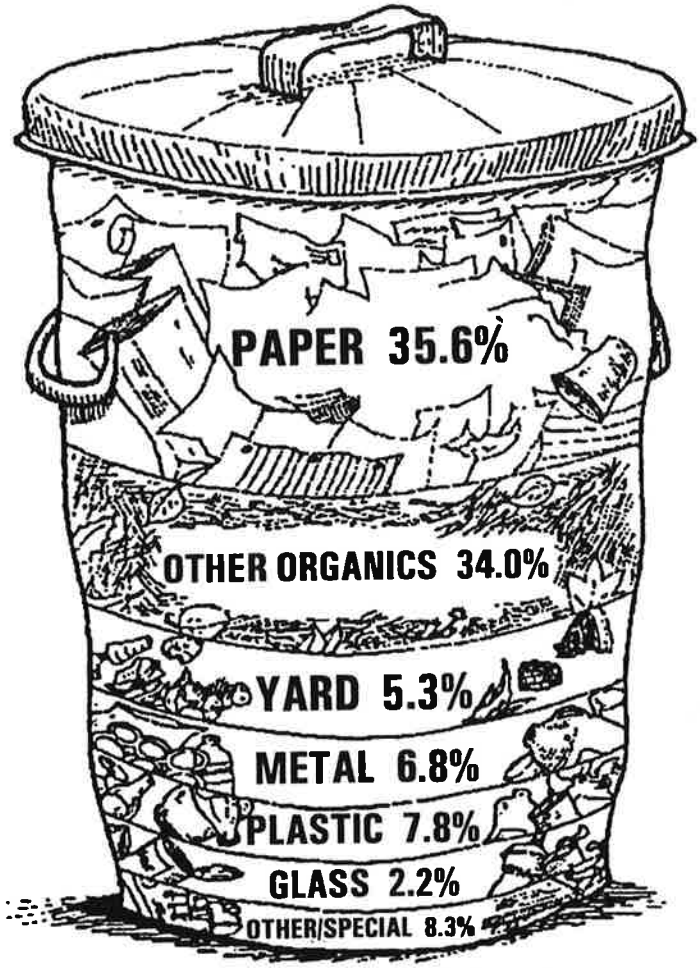
What is Solid Waste?

The material in our garbage cans is "waste" only when it is mixed together. When many of these items are separated into individual categories, they are treasures of "resources" that can be reused or recycled into new products.

The decision whether to waste our resources or to reuse and recycle them is up to us. We each make these choices every time we purchase a product or decide we no longer need something. Recycling and buying recycled materials instead of virgin or primary resources to meet our daily needs saves large amounts of energy and dramatically reduces air and water pollution. These daily choices, multiplied by millions of people, have major effects on our environment.

These resource savings and reductions in pollution can increase the wealth of our community and also strengthen our economy. Residents can help our community turn waste into resources by first understanding:

- *What is in our trash cans*
- *How it gets there*
- *What happens after we "throw it away"*



Discarded Resources

Modern discards include yard trimmings, glass, metals, plastics, construction materials, tires, and many kinds of paper. Approximately two percent of our discards are products such as paints, cleaning agents and pesticides - many of them classified as household hazardous waste, requiring special treatment and protective measure when disposed. Other discards, such as old refrigerators or air conditioners, contain Freon refrigerants and require special handling. The figure to the left shows the composition of Placer County's waste stream.

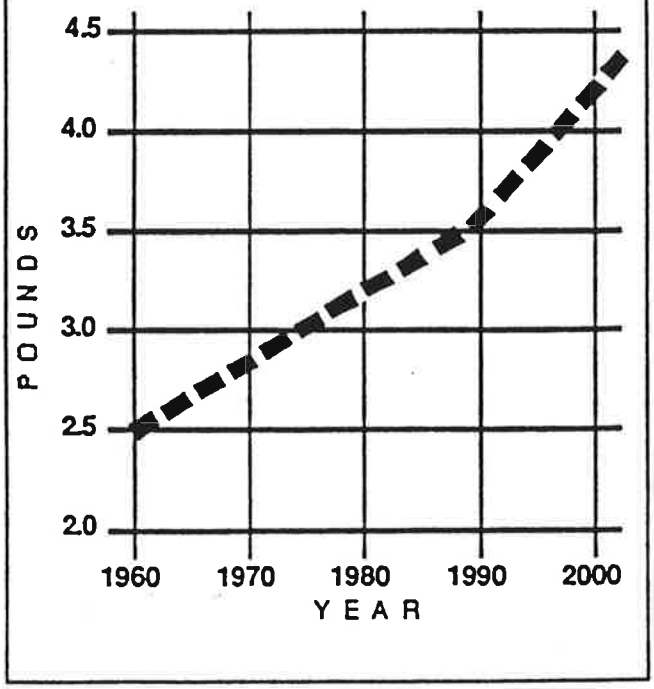
Unfortunately, much of the increase in our discards is not directly tied to improvements in the quality of our lives. This is demonstrated by the fact that affluent nations including Germany, Denmark, the Netherlands, and Japan are able to maintain a standard of living comparable to that in the United States while generating only half as much discarded resources per person as we do. This can be attributed to the use of fewer disposable products and less packaging, more reliance on refillable containers and higher recycling rates.

Statewide Efforts

California Integrated Waste Management Act of 1989, this legislation more commonly known as Assembly Bill 939, became law as of January 1, 1990. The Act establishes priorities for the management of solid waste by requiring each county and city in the State to divert at least 25 percent of the waste going to landfills by 1995, and 50 percent by the year 2000. In meeting these goals, each jurisdiction is required to prepare detailed "planning" elements that set forth a definite strategy to reach stated goals. City or counties that fail to

DISCARDS PER PERSON

Pounds of discards generated per person per day in the U.S., 1960-2000. (Source: Garbage Magazine, Sept./Oct. 1989)



comply with the Act face a penalty of up to $10,000 per day. The law also requires that each city and county develop a program for safe disposal of household hazardous waste.

AB 939 *(see graph below)* established a hierarchy for discard management in California:

- *Source Reduction*
- *Recycling and Composting*
- *Transformation*
- *Land Disposal*

In this hierarchy, source reduction is the highest and best method of reducing waste, and land disposal is the last resort.

Source reduction refers to all of the things we can do to reduce the amount of discards generated in the first place. Examples of source reduction include redesigning production processes and packaging for waste minimization. Source reduction also includes reuse and repair of durable goods and selective shopping. Backyard composting is considered source reduction since materials are kept from the discard disposal infrastructure.

Recycling refers to systems that collect, process and market individual discarded materials, such as paper, glass, metals or plastics, so they can be made into new products or packaging.

MAJOR ELEMENTS IN AB 939

25% Waste Reduction & Recycling Goal by 1995. 50% Waste Reduction & Recycling Goal by 2000
Priorities: 1st Source reduction. 2nd Recycling and composting. 3rd Transformation. 4th Land disposal.
Requires counties and cities to develop waste management plans (SRREs) to achieve WR/R goals.
Imposes fines of up to $10,000 per day on jurisdictions for non-compliance.
California Integrated Waste Management Board to provide assistance to local governments for research, planning, market development and education. All state activities funded by tipping fee surcharge of up to $1.00 per ton

Composting refers to diversion of organic materials from the "waste" stream, usually at a centralized processing site.

Transformation is another term for "waste to energy" systems, such as those that burn mixed discard to reduce their volume and extract energy. The heat energy is often converted to electricity. The resulting ash is then landfilled.

Landfilling is the process of disposing of discard using soils and fabricated liners designed to permanently seal materials from air and water circulation.

It is important to note that any discard management system at this time must include a landfill component because not all discarded materials can be recycled, composted or incinerated.

In the past, discard management systems relied on landfills. Now, most communities are diversifying their approach by developing source reduction, recycling, composting, and/or transformation systems to reduce the volume of materials heading for landfill disposal.

Waste Reduction through Backyard Composting

As long as plants have been around, composting has been going on. The process of composting is simply the breakdown of organic materials by microorganisms. The microorganisms which decompose plant waste have managed without our help for a long time. The forest floor is a natural composting system in which a leaf mulch decomposes, recycling nutrients and conditioning the soil.

Benefits to Backyard Composting

Backyard composting is an important strategy for managing discarded resources. Yard trimmings and food scraps, taken together, make up one of the largest components of residential discarded resources. Backyard composting is one of the most economical and effective methods of recycling these organic materials.

✔ Saves energy and prevents air pollution

By avoiding the collection and burying of yard trimmings in landfills energy can be saved. Less materials put out at the

curb means fewer trips to the landfill by collection trucks, and less activity by the large earth moving tractors at the landfill.

✔ Saves consumers money

Compost created in your backyard is replacing soil amendment you may have purchased.

✔ Creates good soil

Rather than burying the ingredients of soil in a landfill forever, in the compost pile, organic matter is broken down by soil organisms into plant nutrients and humus. Humus is the most essential ingredient for building a fertile soil. With soil erosion a worldwide problem, every effort to return organic material to topsoil is valuable.

Modern Landfills

In many countries, such as Japan, recycling is necessary due to limited natural resources, the lack of space to landfill materials and the depletion of forests and other resources. In America, where we have more resources and more space for landfills, we have other reasons to recycle. We are conserving resources for future generations and we have other concerns about landfills:

1 ***Landfills are difficult to site.*** *No one wants one in their community.*

2 ***Landfills are expensive to site.*** *The cost of making landfills environmentally safe, and limiting their impacts on groundwater and other resources, has increased dramatically as we have realized the scope of short- and long-term dangers.*

3 ***Transporting materials to landfills is becoming increasingly expensive as urban areas expand and landfills are sited further away from population center.***

As our urban areas have expanded and the amount of discards we generate has increased, undeveloped land for dumping materials has become scarce. The spread of suburban development leaves few large parcels of land available that are far from residential development, yet close to urban discard generating centers. Across the country, proposed new landfills sites have been greeted by potential neighbors with a cry of "Not in My Back Yard!" — often shortened to "NIMBY."

Community concerns over having a landfill for a neighbor are heightened by recent events. Years of uncontrolled dumping have sometimes resulted in a mixture of toxic materials in our landfills, often made up of unknown materials.

Many landfills have been nominated as toxic waste "Superfund" sites by the federal Environmental Protection Agency (EPA). Rainwater dripping through a landfill picks up dissolved chemicals, creating a toxic leachate which, if not contained, can contaminate streams and groundwater. Also, organic materials decompose in the absence of oxygen in landfills and create methane gas, which is explosive in high concentrations. This gas can migrate into neighboring homes if not vented or captured.

Landfills in Placer County are strictly regulated by the County Planning Department, the County Environmental Health Department, the County Air Pollution Control District, the California Regional Quality Control Board, and the California Integrated Waste management Board. In addition, the United States EPA recently adopted federal regulations, called Subtitle D of the Resource Conservation and Recovery Act which cover landfill location, operation, design, groundwater monitoring and corrective action, closure and post-closure care, and financial assurance.

New landfills must meet stringent siting standards related to soil geology, proximity to wells and aquifers, and impacts on neighboring land uses. These standards require that new and existing landfills install impermeable liners below new burial areas to collect leachate for treatment; that methane gas be collected and vented or utilized; and systems to monitor potential surface and groundwater contamination be established. In addition, these monitoring and control activities must continue long after the landfill is closed.

Carrying out the requirements of federal state laws is a giant step toward minimizing many of the environmental problems associated with landfills. However these improvements come at great cost. A large part of the garbage rates around the nation in recent years include costs for upgrading our landfills to environmentally safe standards and cash reserves for the closure and postclosure of these facilities.

When the cost of upgrading landfills to comply with state and federal standards is added to the current cost of developing new sites and operating landfill disposal facilities, we can begin to see the true costs of burying our discards in landfills. The increased costs of landfilling materials has contributed to making waste reduction, recycling and composting a cost-effective alternative to disposal.

The landfill rates, or tipping fees in Santa Clara County are considered low ($30-50 *per ton) when compared to the fees in many other areas, such as cities on the east coast *(some exceed $200 per ton)*, and in Oregon and Washington *(around $80 per ton)*. *for compacted waste. $100/ton for yard waste by volume. San Jose's cost to process yard waste for curbside is $22/ton delivered, $100/ton curbside pickup.

The bottom line is that landfills are no longer an easy, inexpensive solution to our discard management needs. We will never be able to completely eliminate the need for landfills, but we must start to decrease the wasteful use of them as repositories for our discarded resources.

Master Composters and the Future of Santa Clara County's "Waste"

The environmental and economic consequences of our disposal habits are catching up with us. We are being forced to reassess our attitudes about garbage and how we use resources. If we want to save money and resources, we must change our ways.

Santa Clara County has chosen to pursue a forward-thinking and balanced approach to its solid waste disposal problems. It emphasizes waste reduction, recycling and use of environmentally sound landfills to handle the remaining non-recyclable discards.

This approach requires not only technical changes, but human behavioral ones as well.

The success of this program will rely on the cooperation of all Santa Clara County citizens. Cooperation will be achieved through citizens understanding the county's discarded resource situation and becoming aware of the options available for waste reduction and recycling. Through knowledge, citizens can make informed decisions about disposal practices.

Selecting A Compost System For Home Use

Considerations

As long as plants have been around, composting has been going on. With a little management, however, the decomposition of yard and garden waste can be greatly accelerated. Depending on the materials used, the attention given to compost management, and the kind of composting system you select, the process may be completed within a matter of weeks rather than years. When you compost, instead of adding yard and garden waste to the waste stream, you recycle a valuable soil conditioner for your yard and garden.

An active composting effort with a systematic approach can yield finished compost in just a matter of weeks or months. The kind of system you select to manage your compost depends on a number of considerations:

- *Labor*
- *Rate of Composting Desired*
- *Organic Material Availability*
- *Location of Compost Site*
- *Cost*

Labor

How much time and effort are you willing to commit to maintaining optimum composting conditions? With composting, like gardening, the more attention and effort you put into the task, the more effective your results.

Rate of Composting Desired

Several composting systems have a range of care that will allow flexibility in how fast you want the waste to become compost. Closer supervision generally results in a quicker

compost. If your yard or garden is large and generates a lot of waste, you need to consider a system that will promote rapid composting to accommodate the large volume of the waste.

Organic Materials

The kind of materials that you put into the compost system makes a big difference in the rate of breakdown. Green, leafy materials decompose much faster than wood chips, and smaller particles decompose more quickly than large chunks. Keep in mind that faster breakdown means more frequent mixing, and the composting set-up you choose determines how well you should manage the process.

Location of Compost Site

If your compost system is going to be highly visible to you or your neighbors it should be somewhat attractive. Some folks don't mind seeing a pile of leaves in the back yard, but a well-built, three-bin composting unit or a manufactured plactic composting bin may be desirable where aesthetics is an important consideration.

Cost

The cost of the compost system may be the most important factor for some people. A compost drum or tumbler may cost several hundred dollars, while a pile of leaves doesn't cost anything. However, a homemade or manufactured compost system, with some management, can produce a useful finished compost far more quickly than the undisturbed pile of leaves.

Composting and Yard Recycling Composting Methods

Composting and yard recycling methods range from "no work" techniques that require maintenance once to twice a year, to active turning methods that are maintained weekly. The five methods which will be discussed in this manual are:

- *Open-air composting*
- *Closed-air composting*

- *Composting using worms*
- *Soil incorporation*
- *Mulching & yard waste recycling*

Open-Air Composting

This is done in piles or containers open to the air. It is primarily for composting landscape trimmings, and it can be done very quickly *(hot composting)*, or over a long period of time *(slow composting)*.

Closed-Air Composting

This is done in closed containers, making use of anaerobic bacteria, as well as aerobic organisms. It is a low-maintenance technique, suited for composting kitchen scraps — because the container is closed from pests — as well as landscape trimmings.

Composting With Worms

This method also called vermicomposting involves raising redworms in a dark container and feeding them kitchen scraps. This method is particularly suited for apartment dwellers or others with limited space.

Soil Incorporation

This is merely burying materials directly into the earth. Several methods can be selected to meet the individual needs of homeowners.

Mulching and Yard Recycling

Mulching is also a method — albeit slow — of adding nutrients to the soil. Mulch is different from compost in that the material used often has not been decomposed, whereas decomposition is in the definition of compost. Compost can, however, be used on the soil surface as a mulch. In addition to compost, other common mulch materials include grass clippings, leaves, wood chips, ground bark, sawdust, horse manure, cardboard, and straw.

Open-Air and Closed-Air Composting

Open Air Composting

Open-air composting can be done successfully without any type of container. If no container will be used, locating the pile against a block wall or other structure will help with moisture retention and in building up the ideal pile volume.

Composting bins can be made at home, or there are many commercial models to choose from. Whichever type is used, it is helpful to have two bins, so while one batch is "curing" another can be started. Following are some features to keep in mind when building or purchasing a bin:

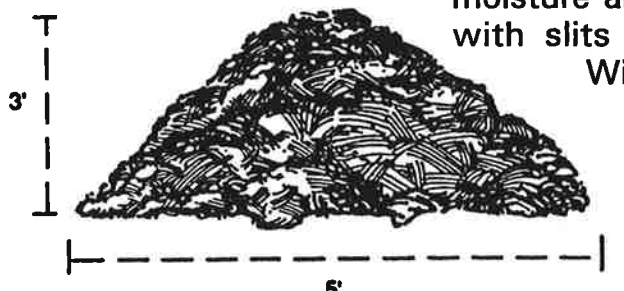
- *Volume*
- *Ventilation*
- *Access for Pile Turning*
- *Rodent Resistance*
- *Construction*

Volume

The ideal volume of a compost pile is between 3' squared (3x3x3) to 5' squared (5x5x5). The volume of many commercial compost bins is smaller than is optimum.

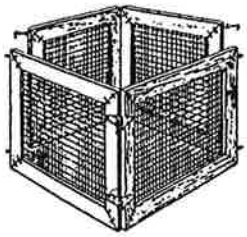
Ventilation

In dry climates bins that have features which help retain moisture are preferred. Plastic or wooden sides with slits or holes for ventilation work well. Wire mesh allows more moisture loss. Plastic or wooden lids are also important in reducing moisture loss. A tarp can also be thrown over a pile to help retain moisture.



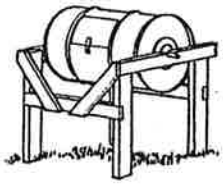
The Pile

Access for Pile Turning



If finished compost is desire in a relatively short amount of time, it will be important to be able to turn the compost pile regularly. Therefore, a bin which allows easy access is best. The ideal system includes a series of bins, such as the three-bin turning unit, for processing compost at different stages of decomposition. Barrels or drums are also used, mounted either vertically or horizontally for easy turning. Bins that have one side open, a hinged panel, or can be taken apart, moved, and put back together, also allow easy turning. If compost can be produced over a longer period of time, then access for turning is not as critical. "holding units" is the name given to bins used to keep decomposing materials in an organized way until they break down, with little or no maintenance. Turning the compost in holding units is often difficult, unless a special aerating tool is used. These tools are poked down into the center and pulled up.

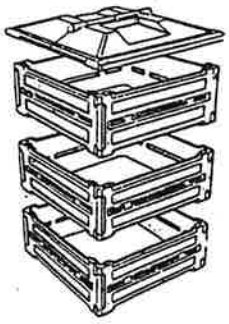
Rodent-Resistance

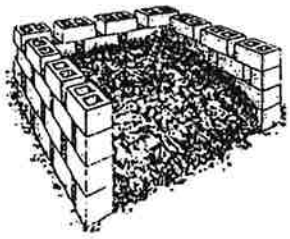


If a rodent-resistant bin is desired, be sure it has a tight-fitting lid, a floor, and no holes or gaps larger than 1/4 inch. A wood or wire mesh floor can be attached to the bin or the bin can rest on paving stones, cement, brick or wood. Existing compost bins can be modified by totally enclosing them in 1/4 inch wire mesh.

Construction

Composting bins made from reused or recycles materials are preferred. Fortunately, many composting bins on the market are made from recycled plastic. Be sure to ask. If building your own bin, seek out sources of used lumber. Wooden pallets can be used whole as sides of a bin, or can be dismantled, and the wood used in the construction of a new bin. Used cinder blocks also make good compost bins.



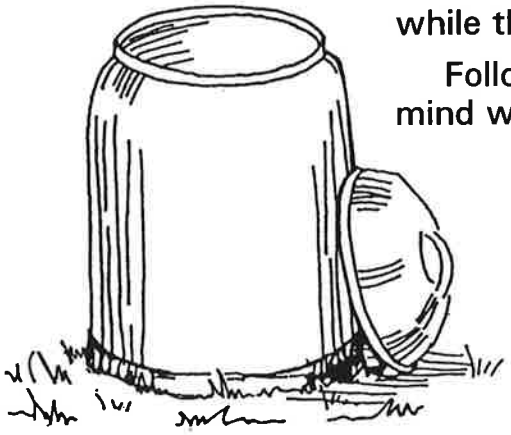


Rodent Resistant

Closed Air Composting

Closed-air composting is usually done in solid plastic containers, with tight-fitting lids, and open bottoms. It can also be accomplished by covering a compost pile with heavy black plastic and sealing it around the perimeter with bricks or stones.

There are several models of closed-air bins on the market, and homemade systems can be constructed from old barrels. In addition to completely closed systems, there are also semi-closed systems available, which have snug fitting plastic lids, yet allow some air circulation. As with open-air composting, it is helpful to have two bins, so one can be curing while the other is in use.



Following are some of the features to keep in mind with closed-air systems:

- *Volume*
- *Ventilation*
- *Rodent Resistance*
- *Construction*

Volume

Although not as critical as with open-air systems, a large volume is functional. If used barrels are employed, look for those with 55 gallon capacity or greater.

Ventilation

Only semi-closed systems will have any air filters for ventilation.

Rodent-Resistance

A solid plastic bin, with a tight-fitting lid will go a long way towards discouraging rodents. However, a hungry rodent could easily burrow under and into the bin. To help prevent this, line the bottom of the bin with 1/4 inch wire mesh, or with paving stones, cement pieces, or bricks. Keep in mind

however, that these precautions only make the bin rodent-resistant, not rodent-proof. Persistent rodents have even been known to chew through metal compost bins.

Construction

Homemade bins can be made from plastic trash cans, or old shipping barrels. Keep in mind that the best place to locate a closed-air system is in the sun, so the bin will be subject to regular sun exposure. The thin plastic of most trash cans will weather quickly in the sun. Used shipping barrels, which are made of thicker plastic, are often available from hardware stores. If a plastic tarp is used, look for one which is thick and black. Commercial closed-air bins are usually made from thick plastic which has a special photo-inhibitor in the plastic. If purchasing a bin, be sure to look for one made from recycled plastic.

Composting with Worms

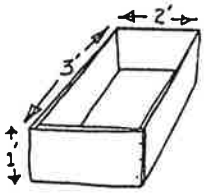
Worm composting systems are neat, easy and odorless, and work well for people living in apartments or condominiums or for those with small yards and not much yard debris. This method of composting is also more practical for people whose physical activity is limited or impaired. Busy redworms turn food scraps and plant trimmings into some of the best organic fertilizer on earth — called worm castings. Composting with worms, also called vermicomposting is relatively effortless. Setting up the bin the first time, and periodically harvesting the castings, is all that is required.

This chapter explains how to set up a worm bin, what foods the worms like to eat, and how to harvest the finished castings.

Selecting A Worm Bin

Composting with worms can be done in homemade wooden boxes, in converted plastic containers, in buckets, or in commercially available bins. All bins should be dark inside, as worms don't like light. They should also have lids to keep out flies and rodents and drainage holes in the bottom (¼" or smaller) for ventilation and drainage. The best container to use depends on the space and location available, the amount of material to be composted weekly, and personal preferences. Following is a discussion of other important worm bin features.

Wood Box



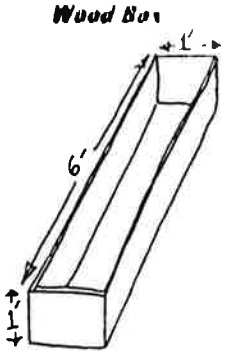
Bin Features

Plastic Bucket

Dimensions: Since redworms are surface feeders, the worm bin should be relatively shallow (8 - 12" deep). If a bin is too deep, the moist materials can pack down, compressing air out, and creating anaerobic conditions. Aerobic conditions should be maintained for the worms, and so no offensive odors are generated. In addition, shallow bins have greater surface area and thus provide more locations to bury materials on a rotating basis.

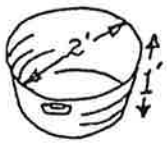
The overall size of the container will depend upon the amount of material that needs to be processed. ***A common***

rule of thumb for bin size is two square feet of surface area

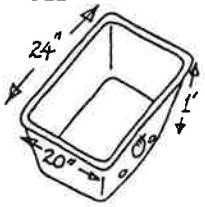


rule of thumb for bin size is two square feet of surface area per person, or one square foot of surface area per pound of food scraps per week. Households that eat lots of vegetable and fruits however, will likely exceed this limit. For these households, adding a closed-air composting bin to complement the worm bin may be the best solution.

One of the benefits of building from wood is that it can be built to any size desired, and attractive design features can be added. Some people have even built worm bins as a piece of furniture. Exterior grade plywood should be used, since the box will be damp most of the time. Highly aromatic woods, such as redwood or cedar, and chemically treated woods should not be used as they may be harmful to the worms.



Wooden boxes should be placed on blocks or a platform to avoid contact with the ground, which may result in rapid rotting. Untreated wooden boxes, used continuously, should last two to three years. Its a good idea to add latches and weather stripping to the lids of wooden bins to counteract warping and to help keep out flies.



Bins built from plastic containers, such as plastic storage boxes, are relatively easy to construct, and can last for many years. However, because plastic doesn't breathe like wood does, the contents of these bins tends to get soggy.

Where To Place The Worm Bin

Just like us, worms take in oxygen and discard carbon dioxide. (Although they don't have lungs, they respire through their skin). Therefore it is important that the bin is located where there is plenty of air circulation. Redworms tolerate a wide range of temperatures, but the most rapid feeding and conversion of organic material will occur at temperatures between 55 - 77°F. Bins should be placed in the shade, or in locations that receive limited direct sunlight. Good locations include the patio, garage, kitchen, or laundry room.

Types Of Worms

Redworms, also called manure worms, or red wigglers, are the type of worm used in worm composting systems. These worms process large amount of organic material, and reproduce quickly and confinement. ***Lumbricus rubellus*** is the

scientific name for the most popular type of redworm used for composting.

Redworms are not the type of worm that will thrive in the garden. They are not normally a soil dwelling worm, and require large amounts of organic material to live. Nightcrawlers, although great for the garden, are not suitable for home composting systems. They require large amounts of soil, and they dig burrows and don't like to have their burrows disturbed.

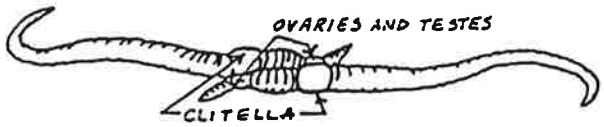
Redworms have no eyes, however they are sensitive to light. When worms are suddenly exposed to bright light they will quickly try to move away from the light. Worms also have no teeth; instead they have a muscular gizzard, which functions similarly to that of birds. Small grains of sand and mineral particles lodge in this gizzard. Muscular contractions compress these hard materials against each other and the food, mix it with some fluid, and grind it into smaller particles. Worms also have no lungs; respiration occurs directly through their skin. A worm's skin must be kept moist, therefore, to allow it to respire or it will die.

Worms are ***hermaphrodites***, equipped with both male and female organs. When temperatures, moisture, and food are favorable, a mature redworm can mate and produce two to three cocoons per week. Two to five baby worms can hatch from each cocoon produced by a two-month old redworm. Worm cocoons are lemon-shaped and about the size of a matchhead.

Earthworm Mating and Cocoon Formation

Each worm has BOTH ovaries and testes.

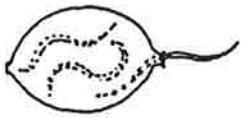
Two worms join by mucus from their clitella. Sperm then pass from each worm to the sperm storage sacs in the other worm.



Later, a cocoon forms on the clitellum of each worm. The worm backs out of the hardening cocoon.

Eggs and sperm are deposited in the cocoon as it passes over openings from ovaries and sperm storage sacs.

After being released from the worm, the cocoon closes at both ends. Egg fertilization takes place in the cocoon.



Two or more baby worms hatch from one end of the cocoon.

1. Open newspaper to centerfold.

2. Tear it lengthwise down the centerfold.

3. Gather the two halves.

4. Tear lengthwise again.

5. Repeat process four or more times until long shreds are 3-6" wide.

HINT: Tear with the grain of paper. If you can't tear long strips, then you are probably tearing against the grain, turn the paper 90° before tearing it.

Most worms probably live and die within the same year, although they can live longer. Although worms are very prolific, they will automatically keep their numbers in check in a worm box. However, if worms are removed, such as for starting another worm bin, the population in the first bin will quickly return to its former level. Contrary to folklore, if a worm is cut in half, both halves don't regenerate: a worm can replace a limited number of front or hind segments, but only if it's still got a middle.

It is surprising to many just how much work these little creatures can do for us. ***They eat between one-half and up to their full weight in organic material each day.*** The castings they produce are 5 to 11 times richer in available N-P-K than the material they consumed. Various secretions of their intestinal tracts act chemically to release major plant nutrients. They also will release most of the needed micronutrients. Best of all they will consume all of the organic material offered to them.

It takes about two pounds of redworms to process an average of one pound of material per day. A good rule of thumb is to set up a worm bin with about 1/4 pound of worms for every cubic foot, with a minimum of one pound of worms. Redworms can be purchased or taken from another worm bin. Worm kits, which include a worm box, bedding, and worms, are also available commercially. Look in the phone book under "Worms," or "Fishing Supplies," or in the classified section of gardening magazines.

Worm Bedding

The first step in setting up a worm bin is to prepare the worm's bedding. Worm bedding holds moisture and provides a medium in which the worms can work, as well as a place to bury materials. In nature, ***redworms are litter dwellers***; that is, they are found among masses of decaying vegetation such as fallen leaves, manure piles, or under rotten logs.

Worm bedding is usually a material high in cellulose similar to this natural litter, such as newspaper, cardboard, leaves, and manure. Shredded corrugated boxes make one of the best beddings for worm bins. It is light, fluffy, and is easy to dampen to the proper moisture content.

The least expensive and most readily available bedding is hand-shredded newsprint. A commonly asked question about

newsprint is, "Isn't the ink harmful to the worms?" The answer is no. Most newspapers stopped using lead in their inks years ago, and the other ingredients in inks are not toxic to worms. The slick, glossy sections and ad supplements are a different story — they may possibly contain inks with heavy-metal based pigments.)

Shredded office paper is another good source of bedding, although the thin strips can dry quickly. Manure is an excellent material for bedding, but worms shouldn't be added to hot manure. ***Soil is not a good bedding choice***; it is not where redworms dwell naturally (unless it's soil thick with organic matter), and it makes the compost very heavy. One handful of soil is helpful, however, when preparing the bed, as it provides some grit to aid in breaking down materials within the worm's gizzard. A handful of ground limestone is also good for providing grit.

Shredded bedding materials (strips should be no greater than 2 inches wide) should be immersed in water for several minutes, or until thoroughly wet, and then the excess water wrung out. By preparing bedding with approximately the same moisture content (75%) as the worm's body, the worm doesn't have to combat an environment that is either too dry, or too moist. With manure beddings, add water at least two days before adding the worms. Then, if the manure heats up as it begins to compost, the worms won't die from the heat.

Worm Food

Worms eat all types of vegetable and fruit scraps, pasta, bread, cooked beans, and other kitchen leftovers. Since seeds, such as from tomatoes and melons, may not be broken down in the worm bin, they should probably not be added.

Worms love coffee grounds, and the grounds even enhance the texture of the final compost. Tea leaves, tea bags, coffee filters, paper towels, and napkins, are also acceptable worm food.

Egg shells are loved by worms, and they provide hard particles to help with grinding in their gizzards. ***No animal products should be added to the worm bin, including cheese, oils, bones and meat.***

Yard trimmings can also be fed to worms. The same rules apply as with open- and closed-air composting, such as

avoiding disease plants or plants recently treated with herbicides, etc. Chopping food and yard trimmings into smaller pieces will speed up digestion by the worms.

Setting Up A Worm Bin

1. Fill the bin with well-moistened bedding, such as shredded newspaper or cardboard or manure, and a handful of soil, limestone, or eggshells.

2. Add at least one pound of redworms (Eisenia Foetida). If you purchase your worms, get them into the bedding immediately, and don't be surprised if you find them in clumps. Just gently separate them and spread the worms over the surface of the bedding. Expose the worms to the light for awhile so they migrate down into the bedding.

3. Once the worms are down in the bedding, food can be added. Push aside some of the bedding, add the food and cover the food with an inch or so of bedding. Rotate the placement of food in the box each time materials are added. Use a garden spade for moving materials around in the bin to avoid killing worms. Worms may take a few weeks to adjust to their new environment, so don't add a lot of food right at first.

4. Worm bins can be overloaded. When this happens, it is more likely that anaerobic conditions will develop, resulting in unpleasant odors. This problem can usually be corrected by not adding materials for awhile. With a supply of food, worms can go for weeks without being fed. How often the worms are fed depends entirely on the rate of food generated by the household as well as how finely their food is chopped. The finer the food, the more that can be processed.

5. As the proportion of worm castings increase, the quality of the environment for the worms decreases. There will come a time when so much of the bedding in the box becomes casting that the worm population will suffer. ***To maintain a healthy worm population, the castings should be harvested from the bedding shortly before the bedding is completely converted to castings.***

Feeding the Worms

You can feed the worms every day, twice a week, or only once a week. Let your schedule, not the worms, be your

guide. If you're going to be away from your home for more than a month, you may wish to have someone feed the worms for you. To feed your worm bed, push back the bedding, place the food, and cover it so that it's an inch or so beneath the surface. There's no need to chip or grind the food; let the microorganisms and worms do that for you.

If you place the garbage in sequence at different locations in the bin over the course of several days, you won't come back to the same place twice and thus will avoid a disagreeable encounter with freshly decomposing garbage.

Other Creatures in the Worm Bin

Of course, redworms won't be the only decomposing organism found in worm bins. Following is a discussion of other creatures that can be found in the worm bin:

Enchytraeids (En kee tray' id): More commonly known as white worms, these are small (¼ to 1 inch long), white, very thin, segmented worms which look as if they might be newly hatched redworms. However, redworms have red blood; even newly hatched redworms are reddish. Echytraeids eat well-decomposed material, and are not a problem in the worm bin.

Centipedes: These are fierce hunters, and do prey on redworms. Fortunately, redworms are such copious reproducers that having a few centipedes in the bin is usually no problem.

Springtails: In your worm bin, you may see a sprinkling of hundreds of tiny (1/16 inch) white creatures against the dark background of the decomposing bedding. When you reach your hand toward them, some spring away in all directions. These are springtails. Springtails feed on molds and decaying matter and are important producers of humus, and are considered to be one of the most important soil organisms.

Mites: These are also a common critter in worm boxes. Mites are so small it is difficult to see them, except as minute, round dots moving across the surface of the bedding. One kind of mite, known as the earthworm mite, can be a problem in worm bins. This mite is brown to reddish, and can achieve such high numbers that the worms may refuse to feed. They are more likely to be present in very wet beds, and may concentrate on one or another kind of food, completely covering the surface. If this happens, remover the mite

infested food and put it out in the sun to kill the mites. Bait others in the same way, or by placing a piece of bread on the bedding and remove it when the mites concentrate on its underside. To prevent a problem with earthworm mites, don't allow the bin to become too soggy. Keep the lid off a soggy bin for a few days to allow it to dry out.

Fruit flies: One of the most annoying problems with using a worm box can be fruit flies. Fruit flies come in on fruit peels and rinds, or are attracted by them in late summer or early fall. There are no easy (environmentally safe) ways to get rid of them. Covering the food scraps with the bedding will help minimize a fruit fly problem. It also helps to cover the bedding with plastic, and to put weather stripping around the lip of the lid. Sticky fly traps, or tacky paper can also be attached to the inside of the lid. Another remedy is to place a cup of vinegar inside the bin (the cup and the vinegar, don't pour the vinegar out!) the flies are attracted to the vinegar, which kills them.

Ants: Ants are important decomposers and can be common in worm boxes. If ants become a problem, permanently sticky barriers, such as Tanglefoot, Stickem, and Sticky Stuff, which are often used to keep bugs from crawling up fruit trees, can be spread along the base of the box. Another strategy is to set the legs of the worm bin in containers filled with mineral oil or water. The ants get trapped in the oil and won't be able to enter the bin.

Other Creatures: Be sure to keep the worm bin well-covered so that it doesn't get used as a kitty litter box. The ammonia in the urine could kill the worms, and dangerous disease organisms can be carried in the feces of cats.

Millipedes, sow bugs, slugs, snails, pill bugs, beetles, and ***spiders*** are other common beneficial decomposers found in worm boxes.

Worm Compost Trouble Shooting Guide		
SYMPTOM	**PROBLEM**	**SOLUTION**
Compost pile smells bad	Not enough air circulation	Add fresh bedding
	Improper food scraps added	Remove meat, bones or other animal products
	Too much food	Feed the worms less
Worms are dying	Not enough food	Add food into bedding
	Bin too dry	Moisten contents until slightly damp
	Bin too wet	Add bedding
	Bedding is eaten, too much castings	Harvest castings and add fresh bedding
Fly infestation	Food exposed	Secure lid and line with latches and weather stripping, cover food scraps with bedding, cover worms and bedding with sheet of plastic or newspaper
Ant infestation	Food accessible	Coat legs of bin with *Tangle Foot* or similar product, or set legs in cans of water or mineral oil

Harvesting the Worm Compost

When most of the contents of the bin have become dark castings, and the finished compost has been greatly reduced from the original volume, it is time to harvest the worm compost. Following are several methods of harvesting castings.

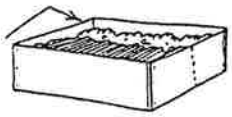
Vertical Harvest: Since worms will migrate to the surface to feed on newly added food, most of the worms will be concentrated in the top layer of material. Remove the top few inches and set it aside in a bucket or wheel barrel, and harvest the compost below. This method works best for tall bin systems.

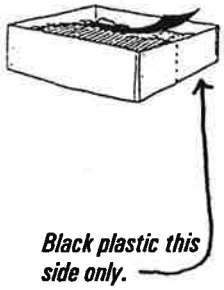
Horizontal Harvest

Horizontal Harvest: In this method, the contents of the bin are moved to one side, fresh bedding is added in the empty space, and all food is then added to the new bedding. The worms will slowly migrate over to the new bedding. Every two to three months, the vermicompost can be removed and replaced with fresh bedding, and the process continued from side to side.

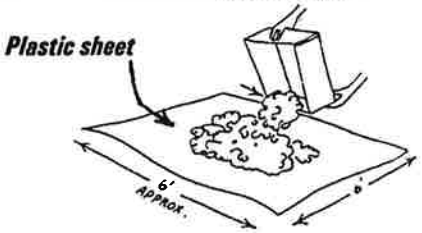
Dump and Sort: This method is more labor intensive. Spread a sheet of plastic out under a bright light or in the sun. Dump the contents of the worm box into a number of piles on the sheet. The worms will crawl away from the light into the center of each pile and you can brush away the worm compost on the outside by hand. Each time the outer compost is scrapped, give the worms about a half hour to migrate toward the center again, before scraping again. Soon you will have wriggling piles of worms surrounded by donut-shaped piles of worm compost.

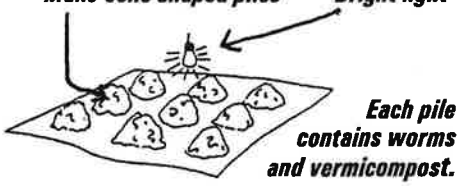
Sift the harvested compost to remove the uncomposted materials, and return these to the bin.

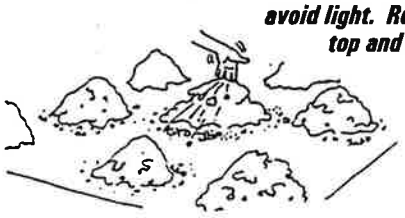


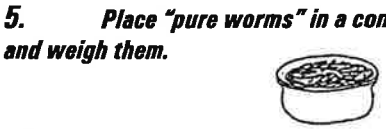


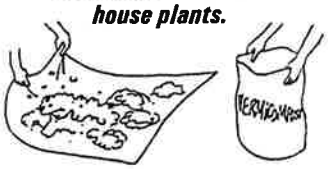
Dump & Hand Sort

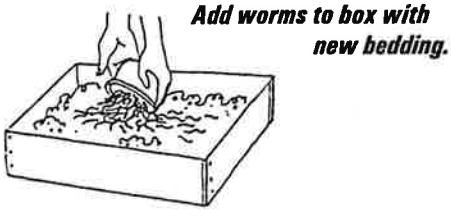












Using Worm Compost

Worm compost, or worm castings, are generally too fine grained and dense to use as a growing medium. It is best to make a planting mix using the worm compost as the basic ingredient.

A successful mix is equal parts of worm compost, peat moss and course sand. Vermiculite may be used in place of the sand. This is a very good mix for seed starter trays and cups.

The pure worm compost can be used as a general soil conditioner for house plant containers. Because of the concentration of nutrients in this material, it can be used as a slow release fertilizer.

Worm compost can be sifted onto lawns, spread around the bottom of vegetable plants or worked into the soil around shrubs and trees.

Like traditional compost, worm compost has a dark brown color and a fresh, earthy smell. The pH is correct for good plant growth. The C:N ratio is very low, much lower than compost made by the more traditional methods.

Compostable Materials and their Preparation

Anything organic — leaves on the ground, a fallen tree, or a wood-framed house — will decompose. The more resistant the material is to decay, however, the longer the process will take. Except in some special situations, decomposition is inevitable!

A diversity of materials is the key to really first rate compost. In addition to the major plant nutrients such as nitrogen, phosphorus, and potassium, plants take up a host of other minor elements and trace elements. The more diverse the materials used in the compost pile, the more likely that these elements will be returned to the plants in the garden. That does not mean the materials will compost better, only that they will feed the plants better.

Summary of Common Organic Waste Resources

- *Grass clippings*
- *Yard waste*
- *Leaves*
- *Vegetable trimmings*
- *Food scraps*
- *Wood chips (tree trimmings that have been shredded to size)*
- *Newsprint*
- *Sawdust*

Summary of Non-Compostable Organic Materials

Everything of an organic nature will compost, but not everything belongs in your compost pile. Some materials can create problems and should be kept out of home compost systems. These materials include the following:

- *Plants infected with a disease*
- *Plants which take too long to break down*
- *Plants with severe insect attack*
- *Ivy and succulents*
- *Pernicious weeds*
- *Cat and dog manures*
- *Meat and fish leftovers or trimmings*

Description of Materials and their Usefulness in Composting

Following are descriptions of common organic materials and their usefulness in the compost pile.

Barbecue Ashes

Ashes from the barbecue (except for wood charcoal, such as mesquite) contain sulfur oxides and other chemicals which are bad for the garden, therefore these ashes should not be used.

Bermudagrass

Bermudagrass is very invasive, reproducing readily from the tiniest bit of surviving vegetation. Dry the grass very thoroughly in the sun, so it is completely dead, before adding it to the compost pile.

Bones

Bones take too long to break down and are attractive to scavenging animals, so they should not be included in the compost pile.

Branches

Branches must be shredded before adding them to the compost pile.

Cardboard

Cardboard is made from thick paper. If it is well shredded, it can be added to the compost pile. Because it is almost pure cellulose, cardboard should be mixed thoroughly with green materials. Waxed cardboard however, will not compost well.

Cheese

Animal grease and oils, such as in cheese, not only attract pests, but also inhibit the biochemical processes necessary to successful composting.

Coffee Grounds

Earth worms love coffee grounds, so use them in the compost pile, in your worm box, or as a mulch. The grounds are acidic and can be used by themselves around evergreens, roses and other acid loving plants. Coffee filters and tea bags can also be included in the worm box or compost pile.

Corn Stalks

Cornstalks and husks are very slow to break down. It is best to run them through a shredder before adding them to the compost pile; and they should be mixed with materials that break down easily. They are good for providing aeration to the pile.

Cotton Rags

Natural fibers such as cotton, fleece, hemp and burlap may all be composted. These materials tend to break down slowly so it is best to shred or chop them first.

Diseased Plants

It is best not to compost diseased plant materials because insect eggs, disease spores, or the actual insects themselves could survive in the compost pile and reinfect your garden.

Eucalyptus Leaves

Eucalyptus leaves have a reputation for being toxic to plants, however, recent studies dispute this idea. However, eucalyptus leaves are slow to breakdown due to their high oil content.

Food Scraps

All kitchen scraps, excluding animal products *(egg shells are okay)* can be composted in closed-air containers or worm bins. Animal products are slow to break down and attract pests. Store scraps in a container with a tight fitting lid. Kitchen scraps can also be stored in the freezer.

If vegetable and fruit scraps will be added to open-air composting piles, it is important to bury the food several inches in the center of the pile. This will help avoid attracting pests, plus breakdown occurs quicker in the pile's center.

Food Scrap Uses

CAN BE USED

Apples
Apples peels
Cabbage
Carrots
Celery
Coffee filters
Coffee grounds
Egg shells
Grapefruit
Lettuce
Onion peel
Orange peel
Pears
Pineapple
Potatoes
Pumpkin shells
Squash
Tea leaves
Tea bags
Tomatoes
Turnip leaves

CANNOT BE USED

Butter
Bones
Cheese
Chicken
Fish scraps
Lard
Mayonnaise
Meat scraps
Milk
Peanut butter
Sour cream
Vegetable oil
Yogurt

Garden Trimmings and Flower Stems

The remains of flower stems and garden trimmings are often brown and slower to decompose. They can be added to help aerate piles of denser materials such as grass clippings.

Grass Clippings

Grass clippings — our most common organic discard at home- have been called *"green manure."* Fresh grass clippings are rich in nitrogen and will help a pile heat up. Because of their high water content, they can also pack down and become slimy, so add the clippings in layers and alternate with leaves, and other brown materials, or with dried grass clippings. Current research suggests that when grass clippings are dried quickly there is only a small amount of nitrogen loss; however, when subjected to alternating periods of drying and wetting before use in a compost pile, significant amounts of nitrogen will be lost.

Hedge Prunings and Twigs

Hedge prunings and twigs are usually very coarse and difficult to break down unless they are chopped or shredded. The harder or more woody the twigs, the smaller they need to be chopped. Woody trimmings up to 1/8" in diameter can be run over with a power lawn mower: chopping materials with a sharp shovel is also effective. Hedge prunings are beneficial in permitting air penetration to the pile. They are commonly used on the bottom of the pile for this reason.

House Plants

House plants are a good addition to the compost pile. They act as greens if fresh, and browns if dried. Old potting soil can also be added to the pile.

Ivy

Plants which spread by rhizomes (vegetatively) may not be killed even in a well built hot pile. Dry these plants thoroughly in the sun before adding them to the pile.

Manure

There are few materials that are as beneficial to compost as manure. One reason manure is so valuable is because of its large bacterial population (as much as 30% of its mass). Manure is also very high in nitrogen, acting as a nitrogen

activator in the pile. When manure is added directly to the soil, it generally releases highly soluble nitrates that behave similarly to chemical fertilizers, as well as ammonia, which can burn plant roots and interfere with seed gemination.

When composted first, manure's imbalances can be rectified and the manure itself can be digested and used more quickly than if added alone. It is best if fresh manure can be allowed to weather for a week before adding it to the compost pile.

Chicken manure is the "hottest" of all the animal manures, meaning that it is the richest in nitrogen, phosphorus, and potassium. Manure from horses, sheep, and rabbits are also considered hot. Horse manure is often mixed with woody stable bedding or straw, which gives it a good mix of carbon and nitrogen. Horse manure, however, is more likely than others to contain weed seeds.

Cattle manure is moister and less concentrated than that of other large animals. It is considered a cold manure, but it is especially rich in beneficial microorganisms. Feces from meat eating animals, such as dogs and cats, should not be added to the pile. Their manures can contain pathogens harmful to children and pregnant women.

Meat

Meat is slow to break down, attracts pests, and inhibits the biochemical processes necessary to successful composting. It should never be added to the compost pile.

Newspaper

To use newspaper or other types of paper successfully, shred it as finely as possible. Matted layers of paper will slow decomposition. Because it is almost pure cellulose, paper should be mixed thoroughly with green materials. Many newspapers are now using soy-based inks. Shredded newspaper also makes an excellent bedding material for farm animals.

Other types of paper can also be composted, but do not use glossy paper (such as in magazines), photographs, waxed paper, or other paper with a high amount of colored ink.

Nut Shells

Although slow to break down, nut shells are high in carbon and help to aerate the pile.

Oak Leaves

Oak leaves are slightly acidic, but overall are a wonderful addition to the compost pile. They are relatively slow to breakdown.

Oleander Leaves

Oleander leaves are one of the most toxic plants known to humans. However, the leaves must be ingested to be dangerous. Therefore, oleander leaves should not be used in mulch or compost which will be spread in vegetable gardens, or anywhere that animals or children might ingest them. (Horses can die from ingesting just a small amount of oleander.) The molecule which poses the danger in oleander is very large, so there is no concern that it could be taken up by other plants in the landscape.

Pet Feces

There is too great a risk of disease and parasite transmission if the feces of meat eating pets is added to the compost pile. Cat droppings are especially hazardous to pregnant women. Kitty litter should also not be added. Aquarium water, however, contains algae and organic matter that can be beneficial to plants, so can be added to the pile. Dog and cat feces can be buried in the landscape around ornamental plants — NEVER in food growing areas.

Pine Needles

Pine needles are compostable, although they will break down rather slowly because of their thick outer waxy coating. Pine needles are also acidic in nature, and should not be used in large quantities, unless compost for acid-loving plants is desired. Pine needles can be used as a mulch around acid-loving plants such a roses and azaleas.

Plants Treated with Herbicides

Many different types of chemicals are used in herbicides. Some become harmless very quickly, and some break down

after thorough composting; however, some are extremely long-lived and will probably survive most composting processes. Therefore, it is best to avoid adding plants that have been treated with herbicides to the compost pile, especially plants that have been recently treated.

Sawdust

The sawdust of deciduous, hardwood trees is best for making compost. Cedar can have inhibitory substances and the sawdust from pressure-treated, pressed wood, painted wood, or plyweed contains various toxic materials, so these should also be avoided due to its high oil content. In the compost pile, sawdust is valuable as a carbon source, as a bulking agent, and in allowing good air penetration in the pile. Keep in mind when using sawdust it is very high in carbon and very low in nitrogen. Sawdust also makes a great mulch.

Seaweed

Kelp and other types of seaweed can be very beneficial to the compost pile (always rinse first). Avoid long vine-like varieties. Use wet, fresh seaweed quickly because it deteriorates rapidly. Bacteria feast on the leaves, which makes seaweed an excellent compost pile activator. It also adds many types of micronutrients and are a boon to plants and soil health.

Sod

Sod stripped from a lawn requires special, covered compost piles. Pile the fresh cut sod, roots up, grass down, in a square or rectangle up to 3 feet high. Make sure each layer is thoroughly wet, and cover the entire pile (including the sides) with black plastic or a tarp. Sod piles may take one to three years to completely decompose. Decomposition of sod piles can be shortened to as little as six months by sprinkling each layer with a high-nitrogen fertilizer, such as cottonseed meal or ammonium sulfate. Small pieces of sod can be chopped and added to a regular compost pile.

Straw

Although straw will add few nutrients to the compost heap, it is an excellent source of carbon and is unsurpassed in aerating the pile. It can be slow to break down, so be sure to

add plenty of high nitrogen materials and keep the pile moist. Straw can also be used as a mulch, as long as there are no seeds present.

Weeds

It is best to compost weeds before they go to seed. Some seeds survive high temperatures, and even a well made hot compost pile may not reach these temperatures uniformly. If you do add weeds with seeds, put them in the center of your pile-where the temperature is highest-and make sure you have plenty of greens in the pile to ensure sufficient heating.

Plants that reproduce through underground stems of rhizomes, such as Bermuda, morning glory, and ivy roots, should be thoroughly dried in the sun before adding to the compost pile.

Wood Ashes

Wood ash is a strong alkalinizing agent. Soils in Placer County tend to be acid. Use wood ash in moderation on the compost pile. Wood ash does add potash to the pile.

Storage of Organic Material

Successful composting requires four major ingredients: carbon, nitrogen, oxygen and water. If these four elements are never brought together, the compost process cannot start. If any one of these elements is removed, the composting process will stop. This is the basis of being able to store any organic material until it is needed for the compost pile.

Individuals using the standard or fast method may find it necessary to store organic material while another batch is working in the composter. Brown and green material must be stored in separated piles of containers. Kitchen scraps may even be stored for long periods in well ventilated and drained containers, or in the freezer.

The easier element to remove from the compost formula is water. Dry materials will decay very slowly. If kept dry and supplied with a good flow of air, it will be odor free. With a good air supply, wet kitchen waste will lose most of its moisture content and remain in an undecayed state.

It may be necessary to fork over the stored piles from time to time to insure a good air supply. If stored material is allowed to become wet and is deprived of oxygen, unpleasant odors will result. A good flow of air will dry the material very quickly. Check often to see that no moisture had developed.

Some less expensive compost containers: the round wire and plastic bins, make excellent storage bins. Smaller storage containers for kitchen waste can be made from buckets in which several holes have been drilled. This container can be kept in the kitchen for a couple of days and then emptied into the larger outdoor container. Each time a new compost pile is started all stored material should be combined as previously described.

Shredding of Organic Material

Particle size is very important to successful composting. All tough, woody material should be reduced to the smallest possible size. Dry leaves tend to mat together if left whole. Large pieces of branches and stems will not fully decay unless reduced in size. The composting microbes can find more surface area on which to act after the material has been chopped or bruised.

Here are some suggestions for creating optimum composting materials. Chop leaves by running over them with

Caution:

Never try to force material into the chipper. Always keep your hands out of the way of the moving blades. If you must reach into the cutting zone of the machine, stop the engine, make sure the cutting blades have stopped and remove the spark-plug wire. Only then is it safe to reach in and remove the jammed material. Electric powered shredders will handle dry leaves and small twigs but not branches or wet material.

the lawn mower of be placed in a large trash can and shredding with a fishing string weed trimmer.

Woody stems can be cut into small sizes with hand tools but this is usually too much work. A home chipper/shredder is needed if a large amount of stems and branches is to be handled. Most gasoline-powered chippers will chop branches up to 3 inches in diameter. These machines will handle dry leaves very well. Few power chippers can make a good job of wet or green material.

The Life Cycle of Compost — The Scientific Process

The compost world is an ecosystem all its own whose main function is the biological decomposition of organic matter. A pile of leaves, an old cotton rag, or a freshly cut 2 x 4 board left outdoors will decompose.

The composting process depends on:

- *Organic Matter*
- *Microorganisms*
- *Macroorganisms*
- *Carbon*
- *Nitrogen*
- *Water*
- *Oxygen*
- *Temperature*

With the proper management of these factors, home composting of yard waste will produce a quality product in a short time.

How long the composting process takes depends on many factors: the density of the material, the amount of surface area exposed (particle size), the carbon and nitrogen content of the material, and factors such as moisture, air, and the presence of insulating materials around the composting material.

Organic Matter

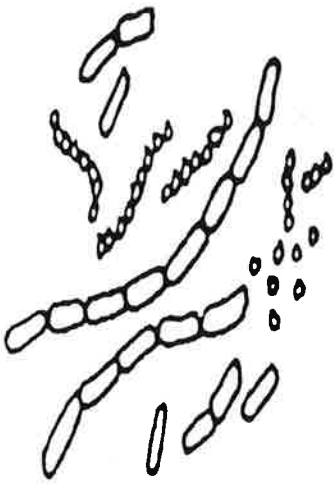
Chapter 5 gives a complete description of the types of organic materials that can be used in home composting. It also gives information on materials that should be avoided.

Microorganisms

The microorganisms *(bacteria, fungus and actinomycetes)* that do the decomposition work in the compost heap have four basic requirements:

- *Air*
- *Water*
- *Right food*
- *Right temperature*

Following is a discussion of the important roles played by each of these microorganisms.



Bacteria

Bacteria begin the breakdown of organic material, making it easier for larger decomposers to continue the job. Many different types of bacteria are at work in the compost pile. Each type thrives on special conditions and different types of organic matter.

Given the right environmental conditions — proper moisture, temperature, air (if aerobic bacteria), a favorable balance of carbon and nitrogen, and lots of surface area to work on — bacteria can reproduce at a remarkable rate.

Bacteria reproduce by division: simply laying down a wall through the middle of their bodies and becoming two. Then they do it again and become four, then eight, sixteen, thirty-two, and so on. This might not be as impressive if it didn't happen so fast.

> One gram of the common bacteria *Escherichia coli*, would become a pound in three hours, and a mass the size of the earth in one and a half days if sufficient food and proper conditions were available. Luckily for us, these conditions have never been met!

Bacteria are single celled creatures that are so small it would take 25,000 of them laid end to end to take up 1 inch on a ruler. Since bacteria are smaller, less mobile, and less complexly organized than most organisms, they are less able to escape an environment that becomes unfavorable. A decrease in the temperature of the compost pile or a sharp change in its pH can render bacteria inactive or kill them.

Many types of bacteria are at work in the compost pile. Each type thrives on special conditions and different types of organic materials. Even at temperatures below freezing some bacteria can be at work on organic matter. These **psychrophilic bacteria** *(a grouping of bacterial species that includes all those working in the lowest temperature range)* do their best work at about 55°F, but they are able to carry on right down to 0°F. As these bacteria eat away at organic materials they give off a small amount of heat. If conditions are right for them to grow and reproduce rapidly this heat will be sufficient to set the stage for the next group of bacteria, the **mesophilic**, or middle-temperature-range, bacteria.

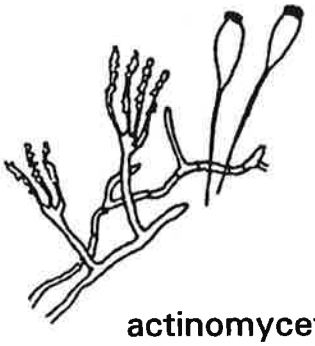
Like us, mesophilic bacteria thrive at temperatures from 70 to 90°F, and just survive from 40 to 70°F, or from 90 to 110° F. In many compost piles, these efficient mid-range bacteria do most of the work. However, given optimal conditions, they may produce enough heat to kick in the real hot shots, the **thermophilic**, or heat-loving, bacteria.

Thermophilic bacteria work fast, in a temperature range of 140 to 200°F. Unless the pile is fed new materials or turned at strategic times, they will work for only 3 to 5 days until their activity peaks and the pile cools down below their optimum range. But what activity in those 3 to 5 days! In that short time, they turn green, gold and tan organic material into a uniform deep brown. If the pile is turned to let more air in, the thermophilic bacteria will feast for another 3 to 5 days.

If the bacteria in the compost pile do not get adequate oxygen, as in the case of a moist pile that is never turned, or in closed-air composting bins, ***anaerobic bacteria*** *— bacteria that live in the absence of oxygen* — will thrive. One of the benefits of anaerobic decomposition is that it yields a compost with a higher amount of usable nitrogen. A drawback is that anaerobic bacteria produce organic acids and amines (ammonia-like substances) which are smelly. Anaerobic bacteria also do not produce the heat characteristics of

anaerobic bacteria in compost piles.

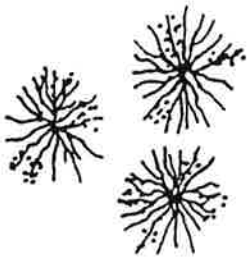
In all of this work, the bacteria are not alone — though at first they are the most active decomposers. Other microbes, fungi and a host of invertebrates take part in the composting process. Some are active in the heating cycle, but most organisms prefer the cooler temperatures of slow compost piles or proliferate only when hot piles start to stabilize at lower temperatures.



Fungi

Fungi are primitive plants that are single celled or are many celled and filamentous (such as mushrooms). Most of them are classified as saprophytes because they live on dead or dying material and obtain energy by breaking down organic matter in dead plants and animals. Like actinomycetes, fungi take over during the final stages of the pile when the compost has been changed to a more easily digested form. The growth of fungi, even more than bacteria, is greatly restricted by cold temperatures.

Actinomycetes



Actinomycetes have been described as a sort of "half-breed" organism-part bacteria, part fungus. They operate at medium temperatures or in the moderate heat zones of the pile. Actinomycetes produce grayish cobwebby growths throughout compost that give the pile a pleasing, earthy smell-similar to a rotting log. They are especially important in the formation of humus. In large clusters, they are easy to spot and become most evident during the later stages of decomposition. While they are decomposing animal and vegetable matter, actinomycetes liberate carbon, nitrogen, and ammonia, making nutrients available for higher plants. They are found on every natural substrate, and the majority are aerobic.

Macroorganisms

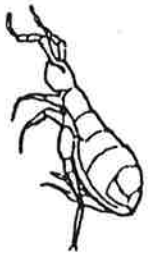
After the temperature decreases, or in the later stages of a slowly decomposing compost pile, the pile becomes a real zoo. Larger organisms, many of them feeding on the piles' earlier inhabitants, add diversity to the cast of characters in

the compost pile. The following is just a sampling of this diverse group.

Nematodes, or roundworms, are the most abundant invertebrates in the soil. Typically less than 1 millimeter in length, they prey on bacteria, protozoa, fungal spores and each other. Though there are pest forms of nematodes, most of those found in soil and compost are beneficial.

As they feed among the mycelial fibers of fungi, nematodes are frequently trapped within the tiny "nooses" that develop on the strands of molds. Many species of mold are able to produce such snares, and it is said that chemicals produced by the nematodes stimulate the production of so-called nematode traps. Once caught within the fungal snare structure, the nematode is digested as an energy source for the fungus.

Fermentation mites, also called mold mites, are transparent-bodied creatures that feed primarily on yeasts in fermenting masses or organic debris. Literally thousands of these individuals can develop into a seething mass over a fermenting surface. Because of this, they often become pest species in fermenting industries such as wineries and cheese factories. They are not pests in the compost pile.



Springtails, along with nematodes and mites, share the numerical dominance among soil invertebrates. Springtails are tiny (1/16 to 1/4 inch) and white. When you reach your finger toward them, some spring away in all directions. Springtails are primitive insects with a pointed prong extending forward underneath their abdomen from the rear. By extending this "spring" they jump all over the place. They feed principally on fungi, although they also eat nematodes and small bits of organic detritus. They are considered to be among the most important soil organisms and are a major controlling factor of fungi populations.

Wolf spiders are truly "wolves" of the soil and forest floor micro-communities. They build no webs, and merely run free hunting their prey. Their prey include all sizes of arthropods, depending on the size of the spider.

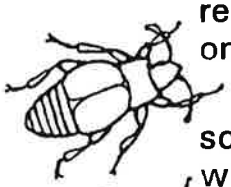
Centipedes are found frequently in soil micro-communities. They prey on almost any type of soil organism that is within their size range or slightly larger. Centipedes have a flattened body, and their legs are much longer than those of a millipede (thousand-legged). They are also much larger and faster moving.

Millipedes are vegetarians that are helpful in breaking down organic matter. Millipedes have a worm-like body, and adults can grow to a length of 1 to 2 inches.

Sow bugs and ***pillbugs*** (Isopods) are small, fat-bodied, flat decomposers that closely resemble each other. The way to tell them apart is by the fact that only pillbugs are able to roll up into a ball. Like other crustaceans, sowbugs breath through gills and require a moist environment. They feed on rotting woody materials and highly durable leaf tissues. If you mulch your garden with organic matter, you are certain to see sowbugs in abundance because the decaying organic matter provides them with a source of food.

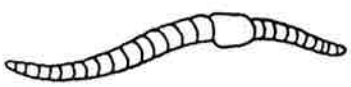
Sowbugs and pillbugs may occasionally feed on seedling, new roots, lower (often partially decaying) leaves, and fruits or vegetables laying directly on the soil or near a damp soil surface. They get blamed for more damage than they actually do, however, because they are frequently found in decaying fruit initially damaged by other pests such as snails or slugs.

If sowbugs become a problem in the garden surrounding a compost pile, try limiting the moist and decaying matter environment in which they thrive. Try to water early in the day so plants and the soil surface dry out by the evening. Choose mulch materials that are coarse enough to let water pass through easily so the surface next to crop plants will not remain damp for long. Elevate maturing melons and squashes on old strawberry baskets or pebbles.



Beetles have may representatives lurking through litter and soil spaces. The rove beetle, ground beetle, and feather-winged beetle are the most common beetles in compost. Beetles are easily visible insects with two pairs of wings. Most adult beetles, like the larval grubs of their species, feed on decaying vegetables, while some, like the rove and ground beetles, prey on snails, insects, and other small animals.

Earthworms pass organic matter through their bodies, grinding it with the help of tiny stones in their gizzard. The material passes out of the worm's body in the form of worm castings, which are the richest and finest quality of all humus material. Fresh castings are markedly higher in bacteria, organic material, and available nitrogen, calcium, magnesium, phosphorus, and potassium than soil itself. As worms process organic materials, they coat the materials with a mucus film that binds small



particles together into stable aggregates and helps to protect nutrients from being leached out by rain. Redworms are the type of earthworm used in worm boxes for composting. They process large amounts of organic material and they reproduce quickly.

Good Bug-Bad Bug?

There is a common assumption that some bugs are "good" and others "bad." Remember that all creature have a niche that they fill, even "bad" bugs. Few bugs are bad for decomposition. However, concerns are valid when these creatures overly encroach on our "personal space." Following is a discussion about some of the insects people commonly label as "pests," including methods of managing their populations should they become a problem.

Enchytraeids, commonly known as white worms, or pot worms are small (1/4 to 1 inch long), white, and segmented. They are so tiny they look like they might be newly hatched redworms. However, redworms have red blood; even newly hatched redworms are reddish. Enchytraeids can be common in home worm boxes.

Flies, including house flies, play an important part in the recycling and breaking down of all types of organic debris. Adults can feed on almost any kind of organic material. To control their numbers, keep attractive food scraps, such as fatty foods, out of the compost pile. Turn the compost pile frequently and thoroughly, making sure the outsides are folded into the center, so that all portions of the mix are subjected to the heat (larvae die at high temperatures). Do not put kitchen scraps in a slow compost pile, as high temperatures may never be reached. Covering the pile with a dry material such as straw, old grass clippings, or carpet pieces of plastic is also helpful. The container used in the kitchen to collect food scraps should close tightly, and should be emptied regularly. Keeping the container in the freezer prevents fly problems and also solves any odor problems.

Snails and ***Slugs***. Generally snails and slugs feed on living plant material, but they do attack fresh garbage and plant debris and do appear in the compost pile. While they are not considered a problem for the composting process, their

proximity to the garden can, of course, be a problem. Both slugs and snails require a damp environment to survive; they avoid the sun and come out primarily at night or on cloudy days.

To control their numbers in the garden, eliminate, to the extent possible, all places where they hide during the day. Boards, stones, debris, weedy areas around tree trunks, and dense ground covers such as ivy are ideal sheltering spots. Handpicking can be very effective if done thoroughly on a regular basis. The best time to hand collect snails is in the early morning. Snails can also be trapped by laying out a shallow pan filled with stale beer, or a yeast and water mixture. It is best if the pan is laid in a depression so the snails and slugs are able to crawl into it more easily. Barriers can also be effective. Easy barriers to maintain are those made with copper flashing and screens. A well-tested barrier for keeping snails out of vegetables is a vertical copper screen surrounding a snail-free garden area. In addition, rove beetles, a common inhabitant of compost piles, are natural predators of snails.

Fruit beetles, in late summer to early fall, lay their eggs in compost piles and other decomposing plant litter. The larvae are fairly large (about 2 inches long) and C-shaped; the body is pale translucent white, and the head is dark brown. Because of their large size, the larvae can be disconcerting to stumble upon in the compost pile. While the larvae does not damage plants, the mature beetles do attack maturing soft fruit such as tomatoes, peaches, plums, figs and apricots. You may want to remove them from your pile and use them for bird or fish food.

Ants feeding on a variety of material, including aphid honeydew, fungi, seed, sweets, scraps, other insects, and sometimes other ants. Compost provides some of these foods, and it also provides shelter for nests and hills. They will remain, however, only while the pile is relatively cool. Ants in an open-air compost pile may also be an indicator that the pile is too dry. Ants may even benefit the composting process by bringing fungi and other organisms into their nests. The work of ants can also make compost richer in phosphorus and potassium by moving minerals from one place to another.

Earwigs are among the most readily recognized and most commonly complained about insect pests in gardens.

Therefore, people are sometimes concerned that earwigs may be attracted to compost piles. Earwigs forage at night, eating the eggs, young and adults of small organisms such as insects, mites and nematodes, as well as algae, fungi and tender plant tips. Earwigs are easy to trap. Containers such as tuna-fish cans that hold ½ inch of vegetable oil or moistened bread crumbs can serve as traps. Because of earwigs' predilection for crawling into small spaces, rolled-up newspapers are also good traps. The traps, should be placed on the soil near plants just before dark. Shaking the trapped insects into a pail of soapy waters drowns them.

Cockroaches are not common in compost piles.

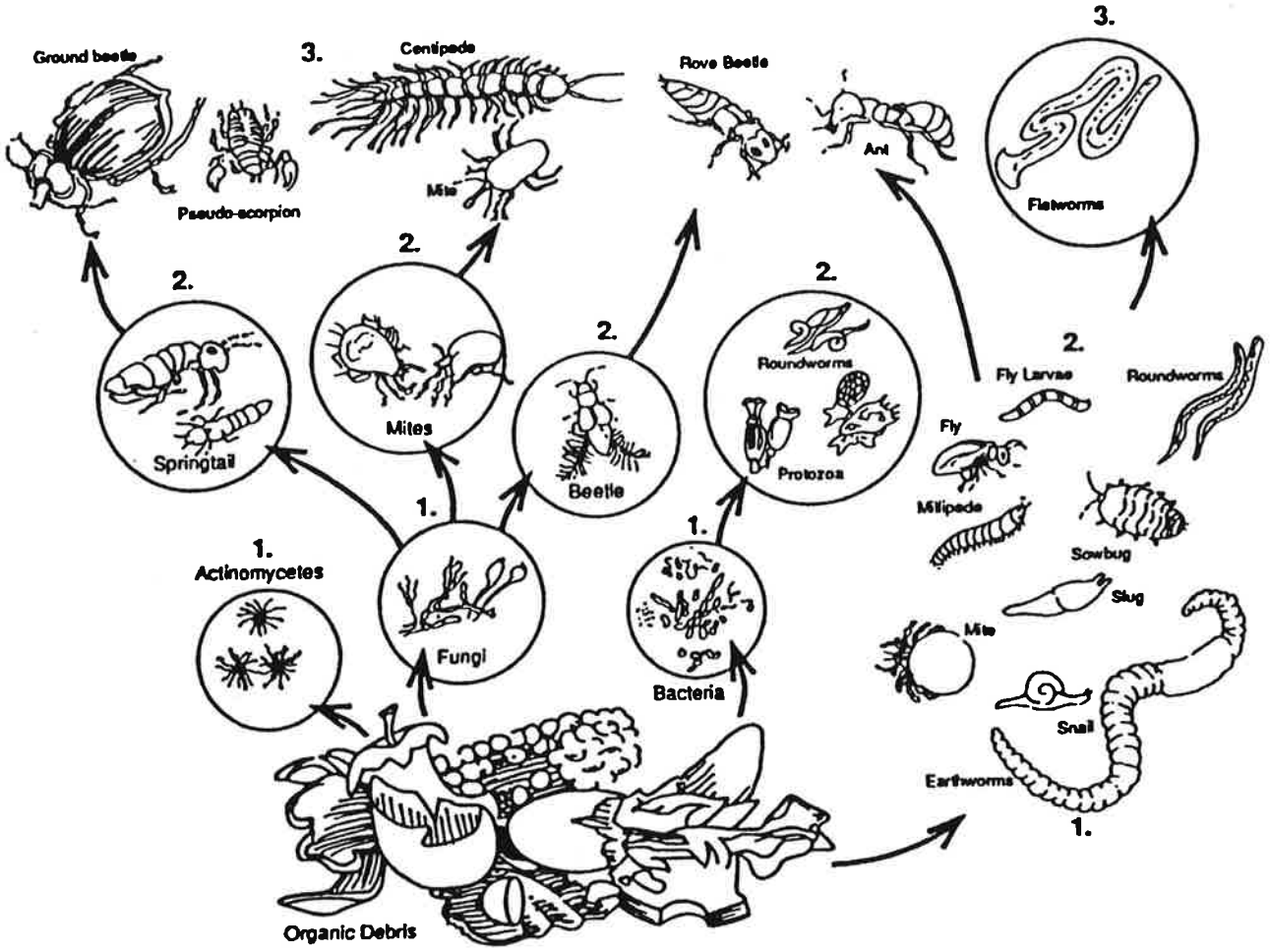
Four Legged "Pests"

Rats are definitely unwanted visitors to the compost pile. With a hospitable environment and plenty of food, their numbers increase quickly and they may become transmitters of disease. It is very important to only compost food scraps in rodent-proof, closed-air composting bins or in worm bins. Always keep animal based foods, such as meat and fish, bones, cheese and fats, out of the compost pile (egg shells are the exception). Keeping the pile well mixed will also discourage rats.

If rats do invade a compost pile, the problem should be corrected swiftly. Hundred of residents could be composting successfully with no rodent problem, but if one person's compost pile creates a rat nuisance, the word can spread quickly, giving composting a bad rap.

Dogs and ***cats*** won't attempt nesting in a compost pile, as rats might, but they are interested in much of the same foods. Thus the same restrictions on food scraps are appropriate if a problem exists.

Food Web of Organisms in Compost Mulch or Soil



Once set in motion, the compost world becomes a micro-community whose population and character will change and self-adjust. Keeping the conditions optimum will enable the members of the compost world to produce a high quality product out of something apparently useless, and you reap the benefits of their labor.

Carbon and Nitrogen

All living organisms need relatively large amounts of the element ***carbon (C)*** and smaller amounts of ***nitrogen (N)***. The balance of these elements in a material is called the ***carbon-nitrogen ratio (C:N)***. This ratio is an important factor determining how easily bacteria are able to decompose an organic material. The microorganisms in compost use carbon for energy and protein to build and repair our bodies. ***The optimal proportion of these two elements used by the bacteria averages about 30 parts carbon to 1 part nitrogen***. Given a steady diet at this 30:1 ratio, they can decompose organic material very quickly.

Carbon-Rich Yard Waste

In general, woody material are high in carbon. Shredding or clipping these materials increases the surface area and makes decomposing easier for the microorganisms. Dry leaves, corn stalks, straw, bark, and sawdust are also good sources of carbon. ***Carbon rich sources are often referred to as "browns."*** Even newspaper can be shredded and added to compost to supply the carbon.

Nitrogen-Rich Yard Waste

Nitrogen sources are often referred to as "greens." Grass clippings (the greener the better) are a good source of nitrogen, especially if the lawn has been fertilized. Other sources are kitchen scraps and animal manures, including cow, horse, and poultry. If using kitchen scraps, avoid fats, meats, and bones - these attract unwanted pests such as rodents and dogs - stay with vegetable waste, coffee grounds, egg shells, and fruit waste. Certainly nitrogen fertilizers can be added to compost if needed, but that is rarely necessary.

As the chart that follows illustrates, most materials available for composting don't have the ideal carbon to nitrogen ratio. One way to speed-up composting is to balance the numbers. It helps to think of materials high in nitrogen as "greens," and woody, carbon-rich materials as "browns." There is often a visual correlation between high nitrogen content in green plant material, and high carbon content in brown materials. For instance, a mixture of one-half brown

materials tree leaves (40:1 ratio) could be used with one-half fresh, green grass clippings (20:1 ratio) to make a pile with the ideal 30:1 ratio. This balancing works best on a weight, rather than volume, basis.

Reference Chart for Carbon:Nitrogen Ratios of Selected Materials

MATERIAL	C:N (AVERAGES)	MATERIAL	C:N (AVERAGES)
Bark	120:1	Paper	170:1
Coffee Grounds	20:1	Pine Needles	70:1
Cow Manure	20:1	Poultry Manure	10:1
Corn Stalks	60:1	Sawdust	500:1
Grass Clippings	20:1	Straw	40-100:1
Horse Manure	25:1	Vegetable Wastes	12-20:1
Leaves	60:1	Wood Chips	100-500:1
Leguminous Plants	15:1		

The C:N ratios above are only guidelines. For instance, brown grass clippings from an unwatered lawn will have far less nitrogen content than green clippings from an abundantly fertilized lawn. Similarly, the leaves from different types of trees vary in the C:N balance. There are also some confusing exceptions to green-nitrogen, brown-carbon correlations. For instance evergreen leaves are low in nitrogen, and brown-colored animal manures are often high in nitrogen. The best way to become familiar with C:N balancing is to try to be specific about it for a while, then relax into an intuitive assessment of what a pile needs. Think like a chef varying the ingredients for a recipe. Be curious, write down the type and quantity of materials used, and take note of the temperature your pile reaches and the quality of the finished compost. After a while, the process becomes intuitive, just like cooking.

Water

All life on earth needs a certain amount of water and oxygen to sustain itself. The life in a compost pile is no different. The amount of oxygen and water in a compost pile is a delicate trade-off that must be balanced for rapid decomposition to take place. At less than 40% moisture the bacteria is slowed by the lack of water. At greater than 60% moisture there is not enough oxygen for aerobic decomposition and anaerobic bacteria can take over the pile.

Taken as a microorganism farm, the compost needs tending to its moisture requirements just as the farmer tends to the irrigation of crops and the ventilation of livestock enclosures. ***Compost should be about as moist as a well wrung-out sponge.*** It should be moist to touch but yield no liquid when squeezed. This provides a thin film of moisture on materials for the decomposer organisms while still allowing air into their surroundings.

If the pile is too wet, it should be turned *(pulled apart and restacked)* to bring air back into the pile and loosen the materials for better drainage and air drying.

If the pile is too dry, it may be soaked from above with a trickling hose. A more effective method is to turn the pile and rewet the material as it is being turned. Certain materials will shed water or become damp only on their surface. Dead leaves, sawdust, straw, some dead weed and vegetables must be gradually wetted until they glisten with moisture. Then, they should be mixed until the water is absorbed into their fibers.

Oxygen

The preferred method of composting is an ***aerobic process***, which means decomposition occurs in the presence of oxygen. The alternative is an ***anaerobic condition*** (no free oxygen available), and this is undesirable in a compost pile. *A common product of anaerobic decomposition is hydrogen sulfide, which smells like rotten eggs.* Anaerobic decomposition is sometimes referred to as fermentation. Sometime anaerobic conditions can generate acids and alcohols that are harmful to plants.

Aerobic composting occurs via aerobic microorganisms which thrive at oxygen levels greater than 5 percent. The air we breathe has approximately 21 percent oxygen in it. Aeration replaces oxygen-deficient air in the center of the compost pile with fresh, oxygen-rich air. This can occur by active or passive (natural) means.

Passive aeration occurs naturally when air warmed by the compost process rises through the pile, pulling in fresh air from the sides. In a smaller way, wind also stimulates aeration. There are essentially two active ways to increase the aeration with a compost pile: (1) turn and mix the compost, and; (2) build the pile correctly and in a suitable container, so surface air can diffuse into the center.

Turning and mixing should be done on a regular basis. In some cases a weekly turning is needed. Turning should definitely be done if the pile reaches 140°F or if odors develop.

Building the pile correctly refers to the pile or container size as well as the mixture and porosity of the organic material. The compost pile or container should be at least 3 feet high and 3 to 5 feet wide. Smaller piles don't heat up well, and larger piles are more likely to become anaerobic. Generally speaking, the composting process will be speeded up when bulky, high carbon materials are shredded and mixed with higher nitrogen materials. Particle size could be so small, however, that aeration would be decreased and anaerobic conditions could result. Organic material would probably have to be ground to the size of sawdust to cause this kind of problem.

Temperature

Temperature is a function of pile size, oxygen, and moisture content. Temperature affects biological activity, and composting is dependent on this activity. Each type of organism has an optimum temperature range. ***Composting will occur from 95 to 160°F***, with the most effective range between 122 and 131°F. The bacteria that are the best decomposers thrive in this temperature range. Temperatures exceeding 140°F will kill pathogens and weed seeds, but decomposition will slow down. Turning must be done to avoid a total crash of the microorganism population, which may occur if the temperature continues to climb.

To reach a desirable composting temperature, a pile must be large enough to provide an insulating effect for the interior of the pile. Compost pile temperature depends on how the heat produced by microorganisms is offset by the heat lost through aeration or surface cooling. During periods of extremely cold weather, piles may need to be larger than usual to minimize surface heat loss. When composting high nitrogen wastes, like grass clippings in the summer, smaller piles and frequent turning are needed both to provide oxygen and to release excess heat.

When the pile temperature drops below 70°F, the composting process is nearly complete. However, it is also possible that imbalances of oxygen or moisture are causing the pile to cool. If the compost is properly moist and turning does not cause temperatures to rise, the compost is probably finished or needs more nitrogen rich material added.

Temperature monitoring is very helpful for managing the compost process. By measuring temperatures regularly, you can tell how fast material is composting and whether there are hot or cold spots in the pile. Turning the compost whenever temperatures get above or below the optimum range will help produce high quality compost in the shortest possible time.

The Rapid Composting Method

The author is Robert D. Raabe, Professor of Plant Pathology, Berkeley.

Composting is a process in which organic substances are reduced from large volumes of rapidly decomposable materials to small volumes of materials which continue to decompose slowly. In this process, the ratio of carbon to other elements is brought into balance, thus avoiding temporary immobilization of nutrients. One of the many benefits of adding compost to the soil is that the nutrients in it are slowly released to the soil and are then available for use by plants. Decomposition will take place in soil if undecomposed organic materials are added to it, but in the breakdown process nutrients will be tied up and unavailable for plants to use. This may result in nutrient deficiencies and poor growth, especially if large amounts of material are added.

The old method of composting was to pile organic materials and let them stand for a year, at which time the materials would be ready for use. The main advantage of this method is that little working time or effort is required from the composter. Disadvantages are that space is utilized for a whole year, some nutrients might be leached due to exposure to rainfall, and disease-producing organisms, some weeds, weed seeds and insects are not controlled.

Recently, a new method has been developed which corrects some of the problems associated with the old type of composting. With this process, compost can be made in 2 to 3 weeks. Extra effort on the part of the composter is required in exchange for this time saving, but for those who want large amounts of compost, or for those who wish to convert materials which are usually wasted into useable compost, the effort is worthwhile.

There are several important factors essential to the rapid composting method. Because all are important, there is no significance to the order in which they are listed here.

1. Material will compost best if it is between ½ to 1½ inches in size. Soft, succulent tissues need not be chopped in very small pieces because they decompose rapidly. The harder or the more woody the tissues, the smaller they need to be divided to decompose rapidly. Woody material should be put through a grinder, but most grinders chop herbaceous materials too finely for good composting. Chopping material with a sharp shovel is effective. When pruning plants, cut material into small pieces with the pruning shears — it takes a little effort but the results (and the exercise!) are good.

2. For the composting process to work most effectively, material to be composted should have a carbon to nitrogen ratio of 30 to 1. This cannot be measured easily, but experience has shown that mixing equal vol-

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umes of green plant material with equal volumes of naturally dry plant material will give approximately a 30/1 carbon to nitrogen (C/N) ratio. Green material can be grass clippings, old flowers, green prunings, weeds, fresh garbage and fruit and vegetable wastes. Dried material can be dead, fallen leaves, dried grass, straw and somewhat woody materials from prunings. Such materials are easy to find in fall and early spring but are more difficult to find in the growing season. During this time, paper bags, cardboard boxes, cereal and milk cartons, and paper can be used for dried materials but they must be finely chopped or shredded. Newspapers can be used if shredded and separated by plant tissues so they do not mat—matting is bad because oxygen is necessary for rapid decomposition and matting excludes oxygen. Any material which is cut green and is allowed to dry is considered green. Some green materials, such as grass clippings also may mat if care is not taken to separate them using dry materials.

3. Composting works best if the moisture content of materials in the pile is about 50 percent. This is not easy to measure, but with experience the correct amount of moisture can be estimated. Too much moisture will make a soggy mass, and decomposition will be slow and will smell. If the organic material is too dry, decomposition will be very slow or will not occur at all.

4. Heat, which is very important in rapid composting, is supplied by the respiration of the microorganisms as they break down the organic materials. To prevent heat loss and to build up the amount of heat necessary, a minimum volume of material is essential: a pile at least 36" × 36" × 36" is recommended. If less than 32", the rapid process will not occur. Heat retention is better in bins than in open piles, so rapid composting is more effective if bins are used. In addition, the use of bins is much neater. High temperatures favor the microorganisms which are the most rapid decomposers; these microorganisms function at about 160° F (71° C) and a good pile will maintain itself at about that temperature. A thermometer to measure temperatures inside the pile is helpful although not necessary.

5. The compost pile needs to be turned to prevent the pile from getting too hot. If it gets much above 160° F, the microorganisms will be killed, the pile will cool, and the whole process will have to start from the beginning. By turning the pile it will not overheat, and it will be aerated also, both of which are necessary to keep the most active decomposers functioning.

   The pile should be turned so that material which is on the outside is moved to the center. In this way, all the material will reach optimum temperatures at various times. Due to heat loss around the margins, only the central portion of the pile is at the optimum temperature. Because of the necessity for turning, it is desirable to have two bins so the material can be turned from one into another. Bins made with removable slats in the front make the turning process easier.

   Bins with covers retain the heat better than do those having no covers. Once the decomposition process starts, the pile becomes smaller and because the bin is no longer full, some heat will be lost at the top. This can be prevented by using a piece of polyethylene plastic slightly larger than the top area of the bins. After the compost is turned, the plastic is placed directly on the top of the compost and is tucked in around the edges.

   If the material in the pile is turned every day, it will take 2 weeks or a little longer to compost. If turned every other day, it will take about 3 weeks. The longer the interval between turning the longer it will take for the composting to finish.

6. Once a pile is started, do not add anything (with perhaps one exception, which will be mentioned in 9). The reason is that it takes a certain length of time for the material to break down and anything added has to start at the beginning, thus lengthening the decomposition time for the whole pile.

   Excess material should be as dry as possible during storage until a new pile is started. Moist stored materials will start to decompose and if this occurs, they will not do a good job in the compost pile.

7. Nothing needs to be added to the organic materials to make them decompose. The microorganisms active in the decomposition process are ubiquitous where plant materials are found and will develop rapidly in any compost piles.

8. If done correctly, a pile will heat to high temperatures within 24 to 48 hours. If it doesn't, the pile is too wet or too dry or there is not enough green material (or nitrogen) present. If too wet, the material should be spread out to dry. If too dry, add moisture. If neither of these, then the nitrogen is low (a high C/N ratio) and this can be corrected by adding materials high in nitrogen (such as ammonium sulfate, grass clippings, fresh chicken manure or urine diluted 1 to 5).

9. If the C/N ratio is less than 30/1, the organic matter will decompose very rapidly but there will be a loss of nitrogen. This will be given off as ammonia and if this odor is present in or around a composting pile, it means that valuable nitrogen is being lost in the air. This can be counteracted by the addition of some sawdust to that part of the pile where there is an ammonia odor — sawdust is very high in carbon and low in nitrogen (a high C/N ratio) and therefore will counteract the excess nitrogen. Other than adding water should the pile become dry, this is the only thing which should be added to a pile once it's started. Because composting can be done anytime, during the rainy season some covering of the pile may be necessary to keep the composting materials from becoming too wet.

10. Materials which should not be added to a composting pile include soil, ashes from a stove or fireplace, and manure from carnivorous (meat-eating) animals. Soil adds nothing but weight to a compost pile and will discourage the turning of the pile which is necessary for the rapid composting process. Wood ashes will not decompose. Most soils in California have a basic pH and as wood ashes are basic, they should not be added to a compost pile or to the soil. Manure from carnivorous animals such as dogs, cats, lions, tigers, etc., could contain disease-producing organisms that might infect humans. It is not known whether or not the rapid composting process will kill these organisms and therefore such manures should not be used — manures from herbivorous animals such as rabbits, goats, cattle, horses, elephants or fowl can be used.

11. The rapid decomposition can be detected by a pleasant odor, by the heat produced (this is even visible in the form of water vapor given off during the turning of the pile), by the growth of white fungi on the decomposing organic material, by a reduction of volume, and by the change in color of the materials to dark brown.

12. As composting nears completion the temperature drops and, finally, little or no heat is produced. The compost is then ready to use. If in the preparation of the compost, the material was not chopped in small pieces, screening the material through 1-inch-mesh chicken wire will hold back such pieces. These can be added to the next pile and eventually they will decompose.

Advantages of the rapid composting system include:

- The production of a valuable soil amendment from many organic materials which normally might be wasted.
- Compost can be made ready for use in as short a time as 14 to 21 days.
- Rapid composting kills all plant disease-producing organisms if done as described. It does not inactivate heat resistant viruses such as tobacco mosaic virus.
- Insects do not survive the composting process. Though some may be attracted to the pile, if they lay their eggs in the compost the heat will destroy them.
- Most weeds and weed seeds are killed. Some weeds such as oxalis bulbs, seeds of burr clover, some amaranthus seeds and seeds of cheeseweed are not killed by the high temperatures in the pile.

In addition to the above, outdoor exercise is an added benefit.

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Starting A Compost System

General Information

How the compost system is built and maintained depends upon how quickly finished compost is desired. Hot composting produces compost quickly, slow composting can take years. In all methods there are several factors which affect the success and speed of the process:

- *Size of material*
- *Moisture and aeration*
- *Volume*

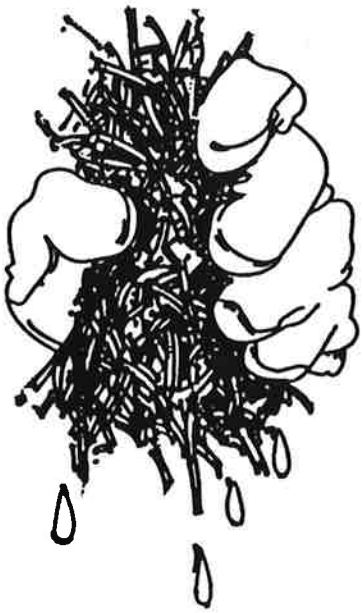
Size of Materials

A melting block of ice provides a good analogy for how the size of the materials, or the surface area, affects the speed of decomposition. A large block of ice melts slowly, but when it is broken into smaller pieces the surface area increases, and the ice melts quicker. Similarly, when large, coarse or woody organic materials are chopped or shredded into smaller pieces, the composting process speeds up. With more surface area exposed, bacteria have greater access to food, so they can reproduce and grow quicker, producing more heat.

Any food material with a thick outer layer, such as an orange or pumpkin, should be cut open and chopped to allow microbes easy access. Several methods of chopping materials are described in the Chapter on Mulching. In addition to those methods which use machines, materials can be chopped into smaller pieces with machetes, meat cleavers, yard clippers, or even the sharp edge of a shovel *(Refer to Chapter 5 for greater detail)*.

Moisture and Aeration

All compost organisms need a certain amount of water and air to survive. The amounts of air and water in a compost pile form a delicate balance that must be maintained for rapid



decomposition to take place. Too much air circulation in the pile can drive moisture out. Anaerobic bacteria, which thrive in the absence of oxygen, can take over the pile. ***Anaerobic decomposition is slow and can produce by-products, including an odor similar to rotten eggs***. Lifting, turning and remixing materials, and adding more carbonaceous material, is the most effective way to add air to piles.

A simple rule of thumb for determining optimal moisture levels: ***compost should be about as moist as a wrung-out sponge***. It should be obviously moist to touch, but yield no liquid when squeezed. This level of moisture provides organisms a thin film of water on materials, while still allowing air into their surroundings.

Volume

home

For fast, efficient composting, a compost pile should be large enough to hold heat and moisture, and small enough to admit air to the center. ***As a rule of thumb, compost piles should be about 3 ft. by 3 ft. by 3 ft. (1 cubic yard)***. A smaller pile will dry out easily, and cannot retain the heat required for quick composting. However, by insulating the sides of smaller piles, higher temperatures and moisture can be maintained.

The upper limits for a compost pile are around 5 ft. by 5 ft. by any length. Larger piles must be turned or aerated more frequently.

Selecting a Method

Three basic methods of home composting will be described here:

- *Standard Method*
- *Fast Method*
- *Slow or Static Method*

Three basic methods of home composting will be described here: the standard hot method, the fast hot method, and the slow or static method. Compost can be produced by any of

the three methods. Your choice will be influenced by economy, neatness, volume or material available, the amount of finished compost needed and the time you want to spend on composting.

Standard Method

The standard method is recommended if there is a variety of organic materials available such as leaves, grass, branches, and kitchen wastes. There will be a need to set aside some time to build the pile and to turn it each week. A specific small area will be required for the compost pile and for the temporary storage of organic material. This method produces finished compost in 4 to 6 weeks in the summer, a little longer in the winter.

The pile can be made by combining stored materials or by placing materials in the pile as they become available. Making the pile from green and brown materials enables one to judge easily the proper mix when building the pile. When gathering and storing organic materials ahead of time, brown and green materials should be kept in separate heaps or containers. *(See Chapter 5 on Storing Material).*

Building the Pile

1. Gather enough green and brown material to construct a pile that will be at least 3' x 3' x 3' (one cubic yard). Brown, woody materials need to be chopped or shredded into smaller pieces. *(See Chapter 5 on Shredding).*

2. Start the pile on the ground with a 4 to 6 inch layer of brown material.

3. Add a 4 to 6 inch layer of green materials on top of the brown layer. Kitchen wastes also should be added to this layer. If green materials are scarce, extra nitrogen in the form of a high nitrogen fertilizer may be needed. About 2-1/2 ounces of actual nitrogen per bushel of leaves or other brown

material, can provide extra nitrogen. The fertilizer should be mixed with the brown materials as they are added to the pile.

Approximate Amounts of Commonly Available Fertilizers Providing 2½ ounces of Nitrogen

FERTILIZER	OUNCES
Ammonium Nitrate	7
Calcium Nitrate	16
Blood Meal	20
Fish Meal	24
Urea	5

4. Mix the two layers with a spading fork or shovel.

5. Check the mix for moisture. If the materials are dry add water. The pile should be just wet enough that when a handful of the mix is squeezed, only a few drops of water should appear. If heavy wet leaves or grass clippings have been used, add enough extra coarse materials to the mix to lighten it up. Then add additional water or dry materials until the proper moisture level is achieved.

6. Continue adding green and brown layers and mixing until the pile has reached 3 feet or the bin is full. This may be done as organic material becomes available or all at once if materials have been stored and collected. Remember to check for the proper mix and moisture level after each green layer is added.

NOTE: *Once the pile is built, do not add new materials.*

After about two days the temperature of the pile will rise. It may be anywhere between 110 to 140°F. Small amounts of steam may be observed coming from the top of the pile, especially in cool weather. The steam indicates decomposition is in progress.

7. One week later, the pile should be mixed and turned. At this time, break up any compacted zones and check for proper

moisture levels. When mixing and turning, try to move the top most material to the bottom of the pile. Bring the material from the outside to the inside of the pile. Add water only if needed. If the pile is not warm or if foul odors are noticed, consult the Trouble Shooting Guide.

8. After the second week, mix and turn the pile again. Be sure to check for proper moisture. Turn the material top to bottom, outside to inside, as before. The innermost materials will be noticeably less identifiable. The temperature of the pile should now be between 120 and 150°F. The pile will have a clean, earthy smell.

9. Continue turning and mixing the pile each week. Always check and adjust moisture levels. During this time the compost will begin to look uniform and dark brown in color. The pile will shrink, losing from one-quarter to one-third of its volume.

10. After the fourth to sixth week, the C:N ratio of the pile will have dropped to about 15:1. Most of the carbon will have been used by the microbes and released as carbon dioxide. The pile temperature will have dropped to near air temperature. More turning will not cause to pile to develop heat. The compost will now have a dark and crumbly texture and a pleasant odor. The compost is now ready to be used as a soil amendment. Finished compost can now be removed from the bin and aged in another container. *(See Use of Compost).*

This standard method can usually handle the organic materials generated by medium or large gardening households. It is a good way to recycle organic waste while producing a top grade compost.

Fast Method

The fast method is recommended if there is a large supply of all the needed organic materials. This method requires more time for chopping and shredding materials and more frequent checking and turning of the pile. In this method, composting conditions are closely watched and controlled to guarantee ideal conditions at all times. Compost can be made by this method in less than one month.

Building the Pile

1. Follow steps 1 through 6 for the standard method. Chop or shred all coarse or woody materials. Pay close attention to making the proper mix and adding the correct amount of water. Be sure enough nitrogen is available. The pile will quickly begin to heat up.

2. After three days turn and mix the pile just as the standard method. Check for proper moisture and adjust if needed.

3. Turn and mix the pile every three days. Check and adjust the moisture at each turning. Temperatures should be very high, 130 to 160°F may be observed. These temperatures are high enough to kill most weed seeds, insect eggs and disease organisms, but some composting microbes also may be killed. The pile should be checked for overheating with a composting thermometer. If the temperature goes much above 140°F, cool the pile by turning and mixing.

4. After two weeks, the temperature will drop as the composting process slows. The compost will be dark brown and crumbly with an earthy smell. Some larger pieces of woody organic material may still be present. Large pieces may be sifted out and returned to the composter for the next batch. Allow finished compost to age for two weeks before using around plants.

Households requiring high volume of compost and having a lot of material available may find the fast method will meet their gardening needs. Both green and brown materials may be available from neighbors, farms or supermarkets.

Slow or Static Method

The slow method is recommended if a steady supply of organic materials is not available. This method takes very little of your time but requires about six months to two years to produce compost. A smaller compost area is used for this method because storage space is not needed since organic materials are added to the pile as they become available.

With the slow method, little time is spent checking for the proper mix or moisture. Since composting is a natural process, it will occur, in time, with little or no attention. Because the proper mix (C:N ratio) and moisture are not

checked, little if any heat is produced, and the microbes take a longer time to do their work.

Building the Pile

1. Build the pile with green and brown materials as they become available. It is recommended but not necessary to chop or shred and mix the material.

2. If kitchen waste is added, it must be buried in the pile. Dig a hole in the top of the pile and cover the kitchen waste with several inches of green or brown material. Kitchen waste left on the surface of the pile may attract pests and cause odors. If kitchen waste is a primary ingredient in the pile it should be best to obtain a rodent-proof bin.

3. After six months or more, finished compost may be found at the bottom or oldest sections of the pile. It may be collected and used as it is produced.

If recycling and waste source reduction are the main goals, the slow method will recycle organic waste and take very little time. This method is usually capable of handling the organic material generated by most small households or small gardens.

Composting Additives

When building a compost pile, the use of inoculants, activators and lime is sometimes recommended.

Inoculants contain dormant microbes. These inoculants are rarely needed, since soil, leaves, kitchen waste, and finished compost contain enough microbes to work on their own. If additional microbes are desired, add some finished compost or garden soil to the pile.

Activators may contain sugar or nitrogen. The only activator that might be helpful is nitrogen. Extra nitrogen is sometimes needed when composting large amounts of brown material. Extra nitrogen can best be supplied by adding more green material, manure or a high nitrogen fertilizer.

Although a working compost will initially experience an increase in acidity, this is a temporary condition and not usually of concern. ***Lime*** will raise the pH of compost but should not be added because it can lead to foul odors and the loss of valuable nitrogen.

Lime, as a soil conditioner, is used to change the pH value of soil. Compost will naturally develop a pH value of about 6.5. Lime will also act to drive out nitrogen. The use of lime is not recommended for use in the compost pile.

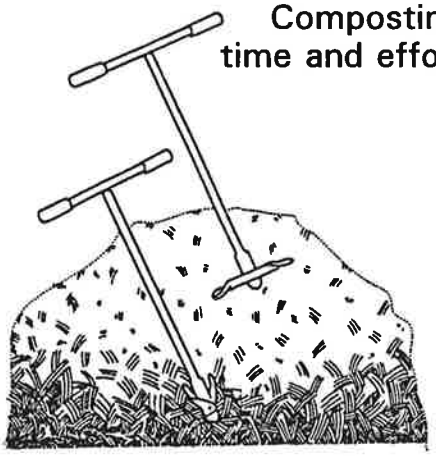
Pesticides

The question of composting organic material treated with pesticides, particularly weed killers, is often asked. Composting is an accelerated version of the natural decay process. Many compounds can be broken down more quickly in a compost pile than in the soil. The persistence of common weed killers in the soil are listed below. If it is believed that weed killers may have been applied to the lawn or plants, then the compost should be allowed to cure and age for one year. After this time, pesticide residues should not be a problem.

Persistence of Some Common Weed Killers

Active Ingredient	Persistence in Soil (in months)
2, 4-D	1 - 2
Benefin	4 - 8
Bensulide	6 - 12
DCPA	4 - 8
Dicamba	3 - 12
Glyphosate (Roundup)	less than 1
MCPP	1 - 2

Equipment, Tools & Bin Construction Techniques



Composting can take as much or as little investment of time and effort as you decide. The scale of your composting situation will determine which tools you need.

General Tools

Placing yard waste in a pile requires a few hand tools. A good yard rake and pitchfork work well. *(A shovel will work, but a pitchfork is easier.)* Some people like the convenience of a cart or wheelbarrow for moving debris or leaves.

Some gardeners stand a pole upright in compost piles and wiggle it each time new materials are added. *(Chinese gardeners do the same with thick bamboo rods).* Twigs or sticks would accomplish the same effect by creating air pockets in the pile.

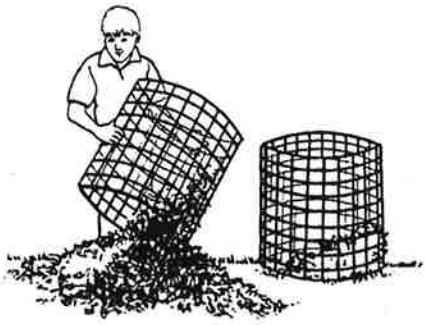
Some garden supply dealers now sell a compost-aeration tool or composting wand. This tool has a pair of small "arms" on the end that close as the end is inserted into the compost pile. When you pull the wand out, the arms open, aerating as it comes up.

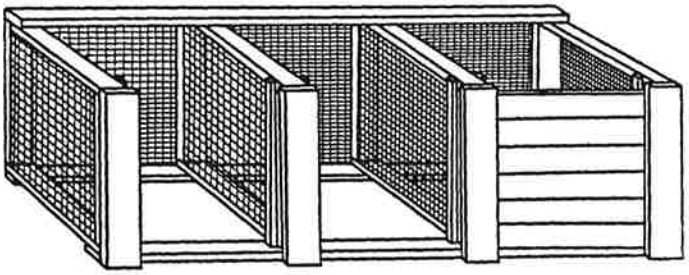
If you want to keep a watchful eye on your compost pile, you can purchase an insertable thermometer that tells you the temperature of the pile's center. Different bacteria thrive in various temperatures and the temperature partially controls the life cycle of the compost world. By watching the temperature, you can help control the composting process by turning the pile at strategic times.

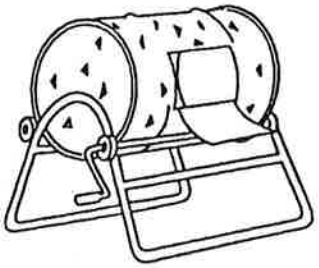
Composting Bins & Containers

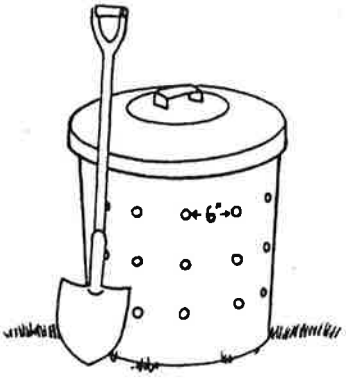
Many people prefer a holding bin of some sort to keep composting piles neater or confined to a smaller space. Bins can be purchased or built and come in a variety of sizes, prices, and complexities. Bins can be round or square and made of anything including bricks, blocks, lumber, or wire. Bin composting requires the same tools as compost piles. Be sure to keep the bin 4 feet or lower for easy access for turning. Compost tumblers or barrels are designed to take some of the work out of composting and require no tools.

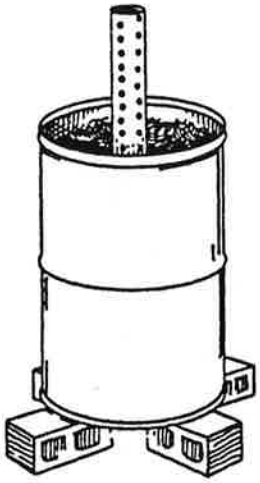
Following is a discussion of several types of bins and containers:

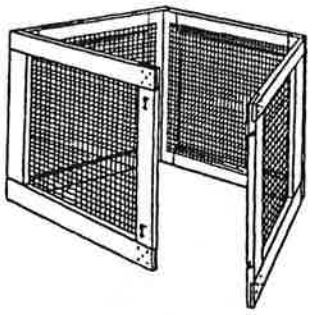






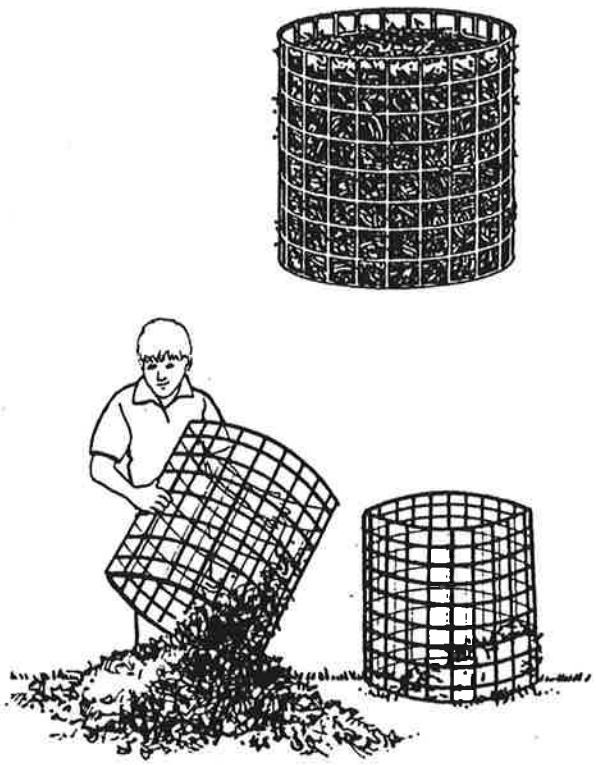






Moveable Compost Pen

A wire holding pen is inexpensive and easy to build. It allows easy access to the finished compost as the top is still breaking down. The wire may be lifted or the wire ties may be removed to unwrap the pen. Then the compost can be mixed by turning it back into the pen.



MATERIALS

- A 10 to 16 foot length of ½ inch hardware cloth. This length of hardware cloth will produce a compost pen that is about 3 to 5 feet in diameter. A smaller pen will result in slower composting. If the pen is larger, moving it will be difficult. ***(Note:** To calculate the pen diameter, divide the length of the wire by 3.14; to determine how much wire you want for a certain diameter pen, multiply by 3.14. For example, if you want a 4 foot diameter pen, multiply 4 by 3.14 to get 12½ feet.)*
- Heavy wire to tie the ends of the hardware cloth together.
- ***Tools:*** Wire cutters or tin snips, pliers, metal file, and work gloves.

Construction

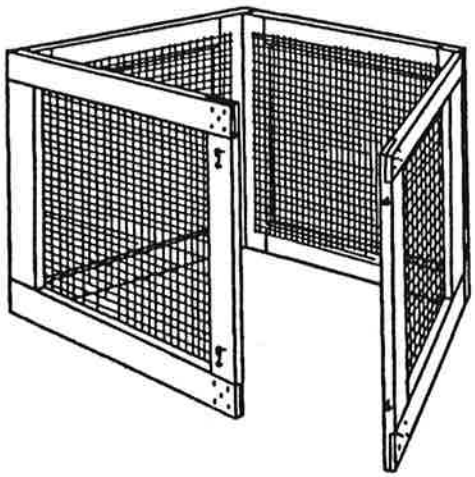
1. Trim the ends of the hardware cloth so that the wires are flush with a cross wire. This gets rid of edges that could puncture or scratch you when you are handling the pen. File the cuts to make a smooth edge.

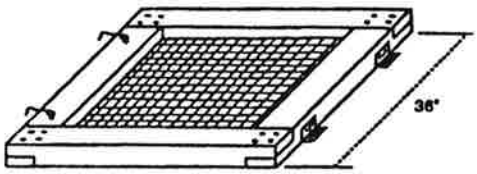
2. Bend the hardware cloth into a circle and stand it in place for the compost pile.

3. Cut the heavy wires into convenient lengths for the ties. Using pliers, connect the ends of the hardware cloth with the wire ties.

Moveable Compost Bin

Although many kinds of moveable compost bins can be built, this bin provides a convenient way to compost moderate amounts of yard and garden waste with very little effort. The bin can easily be moved to turn the piles or to collect finished compost and build a new pile by simply undoing the latches, pulling the sides apart, and moving it. Compost may then be turned into the bin at its new location.





MATERIALS

- 4 12 foot pressure treated 2x4s.
- 12 feet of 36-inch wide ½-inch hardware cloth.
- 100 1½-inch galvanized No. 8 wood screws.
- 4 3-inch galvanized butt door hinges.
- 150 poultry wire staples or power stapler.
- 1 10-ounce tube exterior wood adhesive.
- 6 large hook-and-eye gate latches.
- ***Tools:*** Hand saw and chisel or radial arm saw with dado blade, circular saw, or table saw, hammer, screwdriver, tin snips, pencils, small carpenter's square, and eye and ear protection.

Construction

1. Cut each 12-foot 2x4 into four 3-foot pieces. Cut a ¾-inch deep and 3½-inch wide section out of each end, for a total of thirty-two lap cuts. If using a handsaw and chisel, cut ¾-inch down at the 3½-inch line at A in Figure 3. Then cut a ½-inch deep groove into the end of the board at B in Figure 3. Place a thick wood chisel in the end groove and split the wood with a hammer to the 3½-inch cut. If using a radial arm saw, circular saw, or table saw, set blade depth to ¾-inch and make multiple passes until the whole section is removed.

2. Make four 3-foot square frames from the lap jointed 2x4 on each frame. Fill lap joints with adhesive and fasten each joint with four screws.

3. Cut the hardware cloth with tin snips into four 3-foot square sections. Bend the edges of the cloth back over 1 inch for strength. Lay one onto each of the four frames. Center and tack each corner with a poultry wire staple. Hammer a staple every 4 inches along all four edges of the hardware cloth. Try to tension the cloth so it will not sag when filled with compost.

4. Hinge each pair of frames together and use hook and eye latches on the other ends.

Construction details reproduced with permission of the Seattle Engineering Department Solid Waste Utility and the Seattle Tilth Association.

Three Bin System

One of the fastest methods of backyard composting is the three bin composting system *(see illustration below)*. It is designed for easy management of the compost so that decomposition can proceed as fast as possible. The three-bin system is relatively expensive to build ($100 to $200), but it is durable and one of the more attractive and effective composting systems.

Materials

BIN

- 2 18-foot pressure-treated 2x4s.
- 4 12-foot of 8 6-foot pressure-treated 2x4s.
- 1 16-foot cedar 2x6.
- 9 6-foot cedar 1x6s.
- 22 feet of 36-inch wide 1/2-inch hardware cloth.
- 12 1/2-inch carriage bolts, 4-inches long.
- 12 washers and 12 nuts for bolts.
- 3 pounds of 16-penny galvanized nails.
- 250 poultry wire staples or power stapler with 1-inch staples.
- ***Tools:*** Hand saw or circular power saw, drill with 1/2-inch and 1/8-inch bits, screwdriver, hammer, tin snips, tape measure, pencil, 3/4-inch socket or open-ended wrench, carpenter's square, 1-inch long galvanized staples, and eye and ear protection.

Construction

1. Cut two 31½-inch and two 36-inch pieces from each 12-foot 2x4. Butt-end nail four pieces into a 34½-inch x 36-inch "square" *(see Figures 2 and 3 on next page)*. Repeat for the other three sections.

2. Cut four 37-inch sections of hardware cloth; bend edges back 1 inch. Stretch the hardware cloth across each frame. Check for squareness of the frame

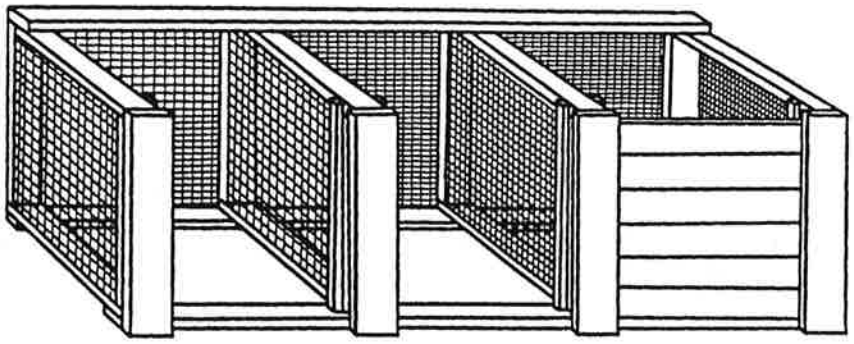
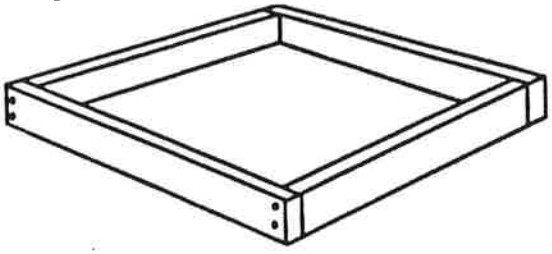


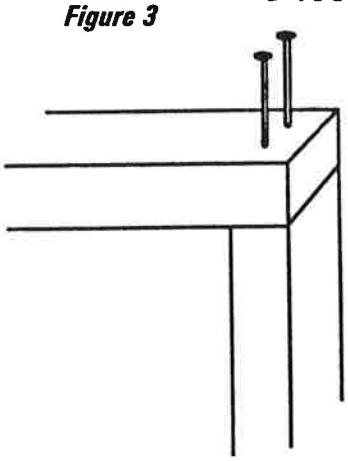
Figure 2



and staple screen tightly into place every 4 inches around the frame. These are the end pieces and dividers of the compost unit.

3. Set up dividers parallel to one another three feet apart. Measure and mark centers for the two inside dividers. Cut four 9-foot pieces out of the two 18-foot 2x4s. Place two 9-foot base boards on top of the dividers and measure the positions for the two inside dividers. Mark a center line for each divider on the 9-foot 2x4. With each divider, line up the center lines and make the base board flush against the outer edge of the divider. Drill a ½-inch hole through each junction centered 1-inch in from the inside edge. Secure base boards with carriage bolts, but do not tighten yet.

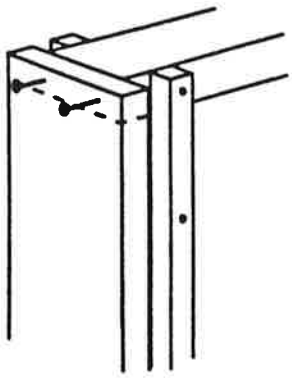
Figure 3



4. Turn the compost unit right side up and repeat the process for the top 9-foot board. Using the carpenter's square or measuring between opposite corners, make sure the bin is square and tighten all bolts securely. Fasten a 9-foot-long piece of hardware cloth securely to the back side of the unit with staples every 4 inches around the frame.

5. Cut four 36-inch-long 2x6s for front slat runners. Rip cut two of these boards to 4½ inches wide and nail them securely to the front of the outside dividers and baseboard, making them flush on top and outside edges. Save remainder of rip cut boards for use as back runners. Center the remaining full-width boards on the front of the inside dividers flush with the top edge, and nail securely *(see Figure 4)*.

Figure 4



6. To create back runners, cut the remaining 2x6 into a 34-inch long piece and then rip cut into four equal pieces, 1¼ inches x 2 inches. Nail the back runner parallel to front runners on side of divider leaving a 1-inch gap for slats (Figure 4). Cut all the 1x6 cedar boards into slats 31¼-inches long.

(see next page for Optional Lid instructions)

Fiberglass Lid (Optional)

Construction

1. Use a 9-foot 2x4 for the back of the lid. Cut four 32½-inch 2x2 and one 9-foot 2x2. Lay out into position on ground and check for squareness. Screw in corner braces and T-braces on bottom side of the frame. Center lid frame, brace side down on bin structure, and attach with hinges.

2. Cut wiggle board to fit the front and back 9-foot sections of the lid frame. Pre-drill wiggle board with a 1/8-inch drill bit and nail with 8-penny casement nails.

3. Cut fiberglass to fit flush with front and back edges. Overlay pieces at least one channel wide. Pre-drill fiberglass and wiggle board for each nail hole. Nail on top every third hump with gasketed nails.

MATERIALS

LID (optional)

- 1 9-foot 2x2
- 2 6 foot 2x2's
- 1 9-foot 2x4
- 1 12-foot and 1 8-foot sheet of 4-ounce clear corrugated fiberglass
- 3 8-foot lengths of wiggle molding
- 40 gasketed aluminum nails for corrugated fiberglass roofing
- 1/2 pound 8-penny galvanized casement nails
- 2 3-inch zinc plated hinges for lid
- 8 flat 4-inch corner braces with screws
- 4 flat 3-inch T-braces with screws
- ***Tools:*** Same as previous page

Procedure For Managing The Three-Bin Composting System

1. Add yard waste to one of the end bins. Mix in "green" materials like grass clippings or other fresh plant waste with "brown" materials like dried leaves, wood chips or shredded branches.

2. If a little green waste is available, add about 1 cup of a fertilizer that contains some nitrogen, such as an 8-8-8 or similar analysis fertilizer. Kitchen scraps or grass clippings will generally not need additional fertilizer since these already have a lot of nitrogen compared to carbon.

3. Add a layer of garden soil to introduce some of the microorganisms that do the composting. Once the composting process is under way, it is not necessary to add more soil.

Compost Thermometer

4. Check the temperature of the compost from time to time, ideally with a compost thermometer *(see graphic)*. The pile should be warm in the middle. After the middle has reached 140 to 150°F, turn the pile from the original bin into the adjacent center bin. Close monitoring of the temperature is essential only for the most rapid composting since the process will go on at varying rates even if close attention is not given to temperature.

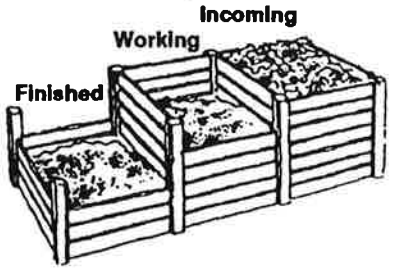
5. Additional yard waste can be placed on the recently turned compost, but turn the pile back into the original end bin when the temperature has been up around 150°.

6. Turning should be repeated whenever the temperature gets high enough. Over time, less frequent turning will be needed, and the composted material can be held in one of the end bins until you are ready to use it in the yard or garden.

7. Repeat the process using the vacant end bin and alternate turning between that bin and the center bin.

8. Use the compost in the original end bin until it is gone; then you can start the composting process again in the vacated end bin.

9. Once set up, the three-bin composting system will consist of one bin with yard waste being composted; one bin empty, to or from which the compost is turned; and one bin containing finished, or nearly finished, compost *(see graphic)*.



Nearly 1 cubic yard of compost can be produced per bin in the three-bin composting system. However, the rate of composting differs greatly according to the kinds of materials placed in the system and the precision with which you manage the composting process.

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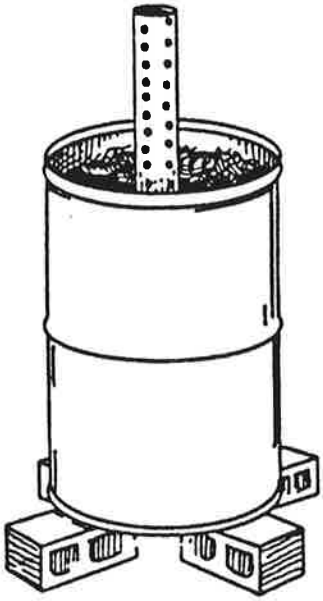
Compost Drums

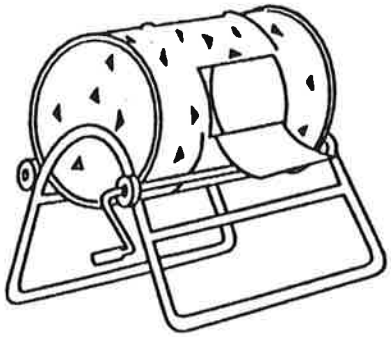


If you are limited by space and your generation of waste is small, a composting drum may be for you. Drums can be assembled and placed in the corner of a garage or other protected area.

If you are using a steel drum, ventilate the bottom by drilling or carefully punching holes in it; then set the drum on blocks or bricks to allow air to move underneath. Layer leaves, garbage, grass, or other waste in the drum. For ventilation, insert a perforated pipe, 3 or 4 feet tall, vertically into the center of the drum. Wet the entire contents and let it work for 6 weeks or so before turning. Other types of drums include wooden barrels or kegs and metal or plastic trash cans. Some people remove the entire bottom of the container and set the can on a frame covered with wire or hardware cloth. If you do this, you should put about 4 inches of coarse dry material on the bottom to help retain the moisture.

Compost Tumblers

More expensive than most compost containers, tumblers are available in a variety of shapes and sizes from many retailers. The advantages are the quick turnaround and the amount of effort. Once loaded, a tumbler will produce usable compost in as little as 2 weeks. All you have to do is turn the tumbler by handcrank once a day. Most are easy to assemble and are designed for ease of turning even when full. The barrels are usually made of plastic or aluminum and are suspended in a metal frame.



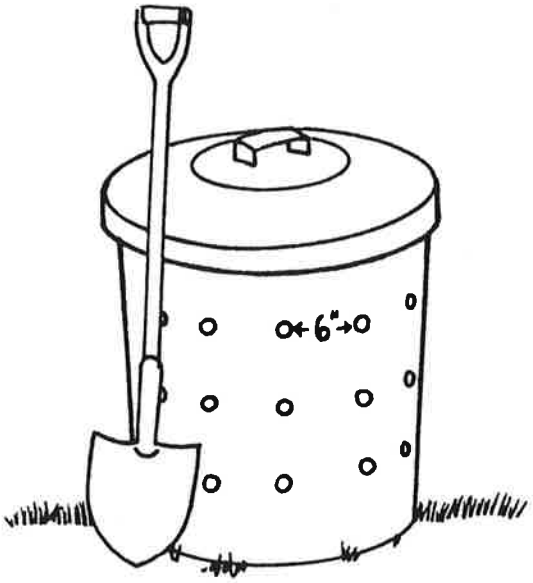
While styles vary, most tumblers have a hinged door of some sort, holes for aeration, a drain hole, a locking device to keep it in position for loading, and a crank system. Some heavy designs allow rain to get in and slow the composting process, but draping a large sheet of plastic over the drum or placing it in a protected area (in a garage, under a tree) will help alleviate this. Because daily rotating is

required with tumblers, composting with one cannot be a passive activity. In fact, there are "recipes" for good compost mixes to insure that the tumbler will produce a quality product. Some tumbler users recommend leaving a bit of the finished compost as a "starter" for the new batch, much like a sourdough starter.

Whether you purchase a tumbler (prices vary from $100 to $400) or improvise one of your own, the quality and turnaround of your compost will be determined by the design. Compost tumblers are a reasonable choice for gardeners who want a steady, but modest, amount of compost throughout the year.

Garbage Can Composter

A garbage can composter is inexpensive and easy to build. It can be used for food or garden wastes. You can also use a plastic trash can with a secure lid and actually roll it around on its side once a day to mix the contents. This method is not as efficient as other methods, but it will produce a coarse compost suitable for a soil amendment.



MATERIALS

- garbage can with cover
- coarse sawdust, straw, or wood chips
- ***Tools:*** Drill, pitch fork, shovel or compost turner, work gloves

Building a Garbage Can Composter

1. Drill three rows of holes 4 to 6 inches apart all around the sides of the garbage can. Then drill several holes in the base of the can. The holes allow air movement and the drainage of excess moisture.

2. Place 2 to 3 inches of dry sawdust, straw, or wood chips in the bottom of the can to absorb excess moisture and let the compost drain.

Adding Wastes

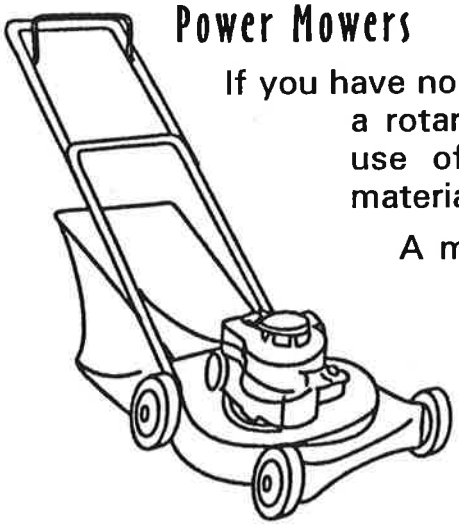
Add fruit, vegetable, and garden wastes. Make sure not to add too much of any one waste at a time.

Maintaining Your Compost Pile

Regularly mix or turn the compost with a pitch fork, shovel, or compost turner and keep it covered. This adds air and mixes up the different wastes, preventing the compost from getting smelly. A smelly compost pile may attract animals and cause neighbors to complain.

Equipment

Power Mowers



If you have no access to a shredder or grinder, you can use a rotary mower to grind up yard trimmings. The use of power mowers should be restricted to materials which are no wider than a pencil.

A mulching mower or mulching attachment will perform even better. If the mower can be adjusted, set it for cutting high. Lay the materials out in a row, or in low pile, and gently lower the mower gradually into the pile, lifting it and dropping it again several times. Be prepared to raise the mower quickly should it start to stall.

For mowers with side exit port, this method works best if the materials are blown against a wall to make collection easier. Be careful of any flying debris, and direct it away from people and animals.

Chipper/Shredders for Home Use

Equipment options for home use includes small electric units designed to shred leaves, units combining a chipper/shredder with a leaf vacuum/blower, and heavy-duty gas and electric powered chipper/shredders capable of reducing 3 inch thick limbs to a fine mulch. Prices are equally variable; chipper/shredders range in cost from about $100 for an electric leaf shredder to more than $1,500 for heavy duty chippers.

Gasoline-powered models tend to be faster than electric models, but they emit smoke and also make more noise. They are usually quicker at shredding twigs than leaves.

There are many factors to consider in the purchase of a shredder/chipper, such as: what type of materials need to be shredded (large or small, hardwood or softwood, etc.), the type of cutting/shredding mechanism used, price, electric vs. gas, horsepower, safety features, diameter of branches the machine can handle,

hopper size, speed, reduction ratio, (the greater the ratio, the smaller the wood chip), how the machine discharges, and warranty. Chippers and shredders are not only good for making mulch, but also speed up the composting process by making the job of the decomposers much easier. They can also be used to pulverize finished compost into a finer material for use on lawns or as a potting mix.

Since the cost of this equipment can be prohibitive, collective purchases can be made by residents who have the need for a chipper of shredder, but cannot justify the cost individually.

Chipper/ Shredder Safety

Always wear safety glasses, gloves and shoes when operating chipping or shredding equipment.

Homeowners associations, especially, can benefit from the purchase of a collective chipper/shredder: the cost to each household would be minimal, and any extra material generated could be used on common areas, trails, etc.

Grinding equipment can also be rented, by the day or the hour. Again, by going in on a rental with neighbors or friends, the costs can be reduced significantly.

Always wear safety glasses, gloves and shoes when operating shredding equipment, and always follow the safety guidelines provided by the manufacturer.

Mulching and Recycling Yard and Garden Waste

Yard and garden waste such as grass clippings, leaves, shrubbery trimmings, tree branches, and spent vegetable plants comprise roughly 20 percent of the solid waste in landfills nationally. Although composting is an effective means of reducing some of this waste, it may not be feasible for all residents to compost. Additionally, some home composting systems may not be large enough to handle all the waste generated in a yard. ***Yard and garden recycling can save homeowners and municipalities money as well improve the condition of garden soil.***

Since the cost of collecting, hauling, and handling solid waste is a large share of the solid waste management expense, keeping the waste at home can reduce the cost of waste disposal. Unlike other recycling efforts, recycling yard waste makes collection and disposal unnecessary. Additionally, plant waste can be valuable resources for use in the yard and garden. Depending on how it's managed, yard waste can be used for mulch, or to improve garden soil structure and drainage.

Making Mulch

There are many equipment options — from low-tech mowers to expensive grinders — available for making mulch. Follow manufacturers' instructions for operating the machines and for making the mulch.

Shredding/Chipping Tips

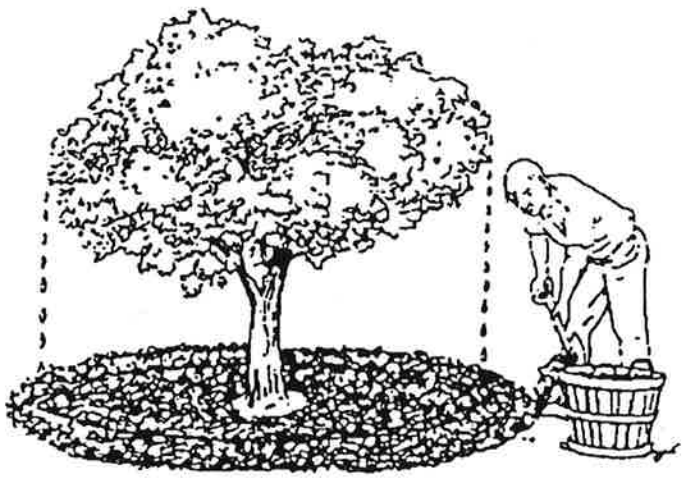
It's a good idea when chipping or shredding to avoid any material that might resprout from small pieces in the mulch, such as willows, acacias, alders, Bermuda grass, and various vines, like honeysuckle. If these materials are used, the key is to grind them as finely as possible. Stringy and fibrous plants such as palm and yucca should not be put in a chipper or shredder because they may wind around the blade or jam it up. Some hardwood chips, such as oak chips, and softwood

chips from conifer and pine, tend to be slightly acidic and are best reserved for shade-tolerant, acid-loving plants or for pathways. In addition, avoid using plant materials that have been recently treated with herbicides.

Applying Mulch

Trees and Shrubs

The feeding roots of most trees begin just inside the dripline *(the shadow cast at noon by the tree's foliage)* and extend to well beyond the branches. Therefore mulch should be laid in a doughnut shape around the tree beginning inside the dripline, and extending to several feet beyond the widest limbs. This can take a lot of mulch — one cubic yard covers 100 square feet about four-inches deep.



For shrubs, mulch can be laid closer to the trunk, however, some distance should always be maintained to prevent damage by pests and disease.

Trees and shrubs can be mulched with coarser, woody materials, such as wood chips or ground bark, which will protect the soil surface for a year or longer. Sawdust and other fine-textured materials should be used in thin layers (one inch), so that air and moisture can penetrate. Cardboard makes an excellent weed barrier when laid down before spreading wood chips or bark.

Perennial Beds

Newly planted beds will require a thick layer of mulch for weed and moisture control, especially during the first season. After planting, place 5 to 10 sheets of newspaper over the exposed soil two inches from the base of each plant. *(Most newspapers eliminated lead from newsprint over 15 years ago, so this should not be a concern; however, the slick glossy sections and ad supplements should not be used as*

they may contain inks with heavy-metal based pigments.) If it's a windy day, the newspaper can be soaked to keep it in place while being laid. The newspaper acts as a temporary barrier, stifling all seeds that germinate and some sprouting roots. In a season or two, the paper will have degraded into organic matter. Next, cover the newspaper with a two inch layer of an attractive mulch.

Established bed can be mulched over the entire bed, or by placing rings of mulch around each plant extending as far as the outermost leaves.

Annual Flower and Vegetable Beds

Planting bed which will be tilled under in a year should be mulched with a thin layer (1 - 2 inches) of non-woody materials, such as grass clippings (use thin layers of grass clippings to prevent matting), manure, or leaves. Layers of fresh lawn clippings should be kept thin because they tend to mat and reduce water penetration. If woody materials such as sawdust are used to mulch an annual garden, add a high-nitrogen fertilizer when they are tilled under to prevent the sawdust from robbing nitrogen from the soil for decomposition.

Pernicious Weeds

Certain stubborn weeds, like morning glory, wild onion, Bermuda grass, and Kikuyu grass, can sprout through 12 to 18 inches of dense mulch. For these plants, as well as troublesome plants such as poison oak and blackberry, carpet mulching is most effective.

The first step is to scavenge used carpeting (usually available from carpet stores). Next cut the weeds and vines down to stubs, and lay the carpet pieces over the area with the beige-backing facing up and a foot or two of overlap at all edges. Finally, cover the carpet with a relatively thin layer of wood chips. **A word of caution:** ***Mulched carpet is extremely difficult to remove so carpet mulch should only be used when it is certain the landscape design will not be altered.***

Pathways

Chipped or shredded material can also serve as a soft "paving" for paths or play areas. Woody materials, which are slower to decompose, work best.

Recycling Yard & Garden Waste, Recycling Lawn Clippings

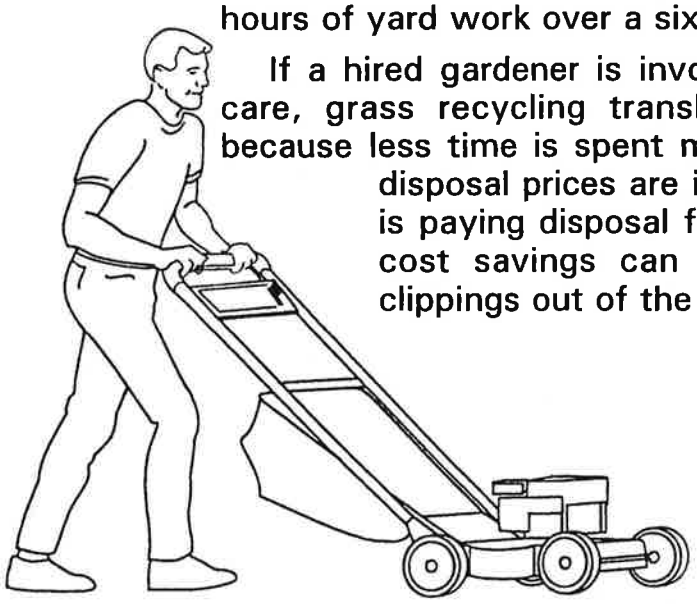
As with most things in our lives, there is more than one way to deal with a problem. Recycling grass clippings from the lawn may be a better method of disposing of this form of yard waste than composting. It is estimated that grass clippings comprise about one-half of yard waste and 12 percent of waste from a single family home.

With the capacity of local landfills shrinking daily, homeowners have the opportunity to examine alternatives to dumping lawn clippings. Grass recycling is a low cost way for individuals to make a major contribution to resolving the mounting solid waste disposal crisis.

Leave it on the Lawn!

Grass recycling is a simple, natural approach to lawn care. Clippings are left on the lawn to decompose and release their natural nutrients and fiber back into the soil. Grass recycling conserves landfill space and saves time, work and money.

According to ***"Don't Bag It,"*** a very successful program that resulted from a grass recycling study conducted by Texas A&M's Research and Extension Center, grass recycling can cut mowing time up to 38%. That can save seven to ten hours of yard work over a six month period.



If a hired gardener is involved in the homeowner's lawn care, grass recycling translates into direct cost savings because less time is spent mowing the lawn. Also, landfill disposal prices are increasing; so it the homeowner is paying disposal fees for this grass, a substantial cost savings can be realized by keeping grass clippings out of the landfill.

Proper Lawn Management

Grass recycling can be done with any healthy turf species. It is only necessary to establish a regular fertilizing and watering plan, along with a regular mowing and aeration schedule to have the very best lawn in the neighborhood.

Savings

There are many savings with grass recycling. It not only saves landfill space and cost but reduces the amount of water needed on a lawn. Clippings quickly decompose into humus, which increases the soil's water holding capacity.

Watering

The best time to water lawns is in the morning. Lawns require more water in hot, dry weather. Lawn grass needs up to one inch of water every 5 to 7 days. *(One inch of water is equal to ½ gallon per square foot).* Avoid runoff by watering for short periods of time, let the soil absorb each application, and then water again for a short period.

Fertilizing

Properly timed fertilizing and top-dressing *(sifted compost is the best material for top dressings)* is essential for a healthy lawn. Over-fertilization weakens the lawn by causing excessive top growth. Proper feeding and deep watering will result in larger, deeper roots. Though grass clippings do contain organic nitrogen, grass recycling is not a substitute for fertilizing or top dressing.

The decomposed grass clippings will provide organic material and slow release nitrogen for the lawn. The total amount of nitrogen in the clippings could equal the amount needed for one regular feeding of the lawn.

Mowing

Before mowing, the lawn should be dry and free of a heavy leaf cover. The grass should be cut regularly, every 5 days in the fast growing months and every 7 to 10 days when the lawn is growing more slowly. Ideally, the clippings should be about ½-inch in length, never more than 1/3 the height or the grass blade. Keep mower blades sharp and set at the proper height.

Recommended Mowing Heights	
GRASS TYPE	**MOWING HEIGHT (INCHES)**
Kentucky & Bluegrass	**3.0"**
Fescue & Ryegrass	**3.0"**
St. Augustine	**2.0"**
Bermuda Grass	**1.0 - 1.5"**
Bent Grass	**1.0"**
Zoysia	**1.0 - 1.5"**

While all mowers may be adapted to grass recycling, several companies have developed special grass recycling or mulching mowers. Removing the grass catcher from a standard mower will work, because the clippings fall on the lawn. If the clippings blow from the side of the mower, set up the mowing pattern to blow the clippings into the unmowed area. These clippings will then be picked up and cut again. If the mower does not have a safety flap that covers the exit hole, check with a lawn equipment company for a retrofit kit.

The following is a list of recommended mowing heights. These guidelines may appear higher than normal. Taller grass is less dense and allows for easier penetration of the clippings. Taller grass also will have longer, deeper, healthier roots.

What is Thatch?

Does grass recycling cause thatch build-up? No! A study conducted by the U.S. Department of Agriculture showed that grass roots and runners, not clippings, are the cause of thatch. Generally, clippings are at least 85% water and, when left on the lawn, begin to decompose in a matter of hours.

The Los Angeles Department of Recreation and Parks has been grass recycling for years at all parks and golf courses. People who have tried grass recycling continue to express great satisfaction. ***In fact 98% of the participants in the Texas A&M study report they will never bag their grass again.***

Recycling Leaves

Leaves can be used either for use as a mulch or, in decomposed form, as compost for amending soil.

Leaves as Mulch

Leaves make an excellent mulch for outdoor plants and shrubs. Whole leaves may be used for mulch, but you can reduce their volume *(to as much as one-tenth the size)* by shredding or chopping them. Shredded leaves not only take up less space, they also make a more uniform mulch. Mulch conserves water, suppresses weeds, and moderates fluctuating soil temperatures that can disturb roots.

If your soil drains well *(is sandy or loamy)*, spread up to 5 inches of chopped leaves on all garden beds and under all shrubs, hedges and trees. This layer will settle down to 3 or 4 inches, the maximum application you can make without risking oxygen depletion in the soil. If your soil is predominantly clay, spread 2 to 3 inches for best results. By next autumn, when the next batch of leaves is about to fall, the previous year's mulch will have decomposed almost completely. Refer to the prior section on mulching for greater detail.

Leaves as Compost

Leaves can also be turned into compost. If you have a compost bin, fill it in the fall and keep any remaining leaves in a holding bin or in plastic bags stored near the bin. If you don't have a bin you can designate an unused area in your yard that

has good drainage to compost the leaves. As leaves settle in the bin or pile, add another bag or two of the remaining leaves. The settling process will go faster if some microorganisms are added to the leaves. Mix a few shovelsful of soil or finished compost into the pile at the beginning of the process. A cup of a nitrogen fertilizer added to the pile will then encourage microorganism reproduction and growth. By spring, all leaves should be in the bin or pile. By early fall, they will have decomposed enough to be spread around the landscape as winter mulch or to be tilled into garden soil to improve the soil for growing plants next spring.

Soil Incorporation

Introduction

Soil incorporation of fresh, compostable material simply allows composting to occur underground with little effort and no maintenance.

Although one of the simplest methods for composting kitchen scraps, soil incorporation is discouraged by health officials, because burying "wastes" in the ground is technically landfilling. Their concern is that people will not do it correctly and will create a public nuisance or health threat.

However, soil incorporation is a common practice among gardeners, and therefore one with which Master Composters should be familiar. Other methods of composting should be encouraged over soil incorporation whenever possible.

Materials

For the average home, soil incorporation is limited to kitchen scraps and relatively small volumes of yard trimmings. Soil incorporation can also be used for pet feces, but this should never be done in food growing areas.

Those with larger yards, and/or power equipment for digging or tilling, can incorporate larger amounts of landscape and garden materials.

Do not bury meat, bones, oils, grease, fatty foods, and dairy products. Weeds or lawn clippings that have gone to seed and woody stems more than ¼-inch in diameter should also not be buried.

Methods

Three methods of burying compostables will be discussed. Overall, these soil incorporation methods are easy and effective ways of returning organic matter to the soil. ***The drawbacks of soil incorporation are the slowness of***

decomposition and the possibility of nitrogen-borrowing from the surrounding soil. Whichever method is used, it is a good idea to irrigate the area where the materials are buried to hasten decomposition. Following is a description of three common methods of soil incorporation:

- *Posthole composting*
- *Meandering trench*
- *Pit and trench composting*

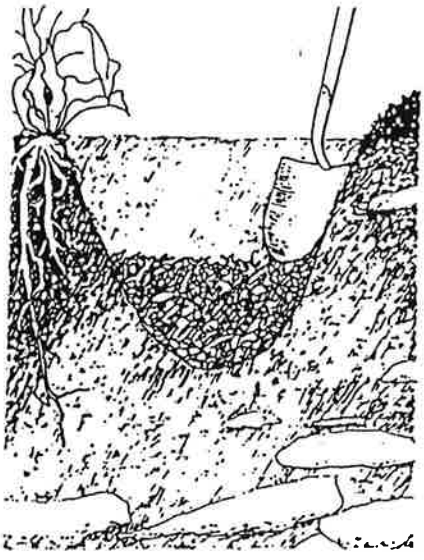
Posthole Composting

Some gardeners use the traditional posthole digger as a quick and convenient tool for spot composting. Holes can be dug randomly in fallow garden areas or organized into a system.

One system is to bury scraps in holes dug around the drip line of trees or shrubs. Holes should be dug 12 to 18" deep and the materials covered with at least 8" of soil.

Another method is to dig holes in the vegetable garden after planting, either in the center of a row or between plants, and fill them as described. Feeder roots will seek out the fresh compost as the plants grow. The compost holes also serve to hold moisture, resulting in the leaching of a weak compost tea to feed nearby plants.

Meandering Trench



Some gardeners dig an endless trench which meanders throughout the landscape. First, a short, 1 foot deep trench is dug. Yard trimmings and food scraps are chopped and mixed into the soil in the bottom 4 inches of the trench. Then the digging of the trench is resumed until the materials are covered and a new trench is formed.

By making burial a continuing operation, there is always an open trench for scraps, and eventually the entire yard (except the lawn) can get a generous application of high quality organic matter and fertilizer.

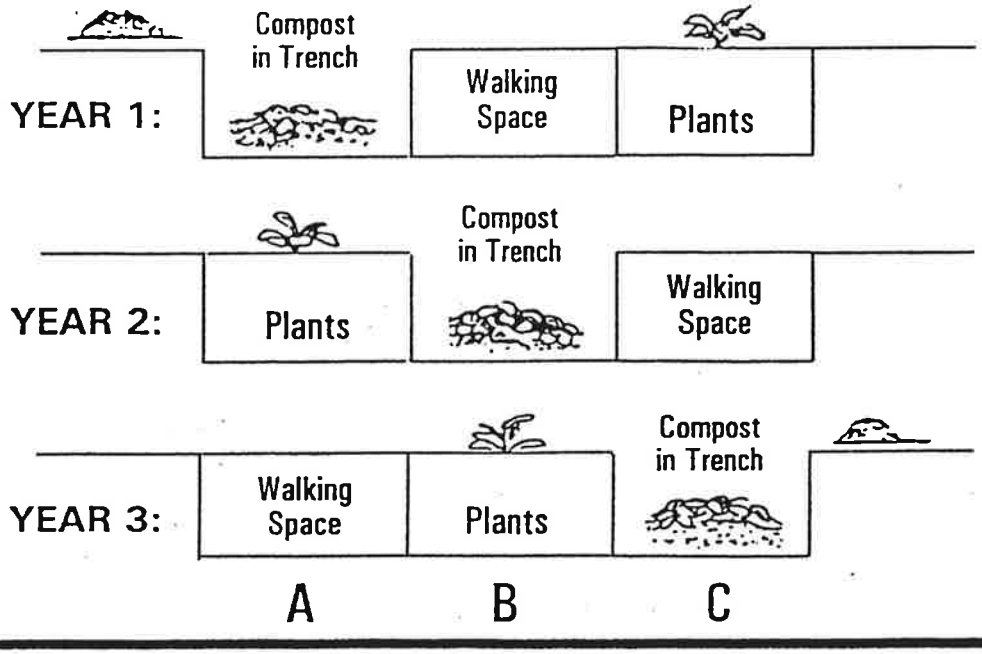
Pit and Trench

An English system, known as "pit and trench" composting, maintains a three-season rotation of soil incorporation. The garden includes a trench to fill with food scraps, a row for growing crops and a third "row" to use as a path.

In the next season, the fertile soil of the former compost trench is used to grow crops, the former crop row is left fallow and used as a path, and the compacted path is loosened and dug as a new trench. After a third season of rotation, the cycle starts over again. This form of composting keeps the garden perpetually fertile with a small organizational effort.

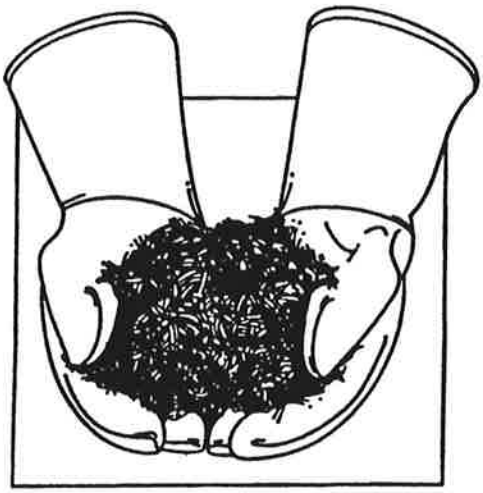
In whatever system is used, it is important that the materials are buried at least one foot deep, and are immediately covered with at least 8 inches of soil. Replace all excavated soil in a mound over the green material so that a depression will not be left when it settles. Rodents, dogs, flies, and odors can become a problem with materials that are shallowly buried. Also, burying materials this deep ensures that by the time the roots reach the buried nutrients, the materials have decomposed some, earthworms have begun to digest the materials, and there is no chance that a clump of high-nitrogen materials will harm tender roots.

Depending on soil temperature, the supply of microorganisms in the soil and the carbon content or the materials, decomposition will occur in one month to one year.



Use of Compost

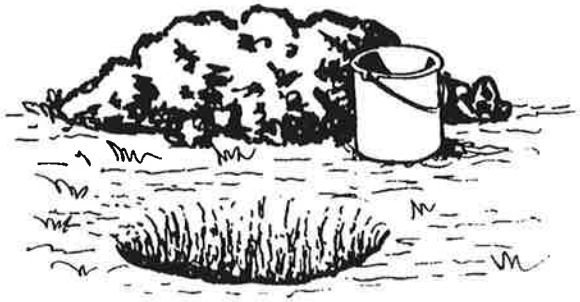
Introduction



Humus — another name for the end product of composting — will improve the quality of almost any soil. ***The main benefit is to improve the "structure" of the soil.*** The structure of a soil determines its ability to drain well, store adequate moisture, and meet the many needs of healthy plants. ***Compost is considered a soil conditioner, rather than a fertilizer***, but it can contain a good range of plant nutrients. More important than the nutrients supplied by compost is its ability to retain and make existing nutrients more easily available to plants.

Compost is a much needed resource. It is not only useful to the home gardener, but is essential to the restoration of landscapes where topsoil has been removed or destroyed during construction or mining operations. Compost is increasingly being applied to agricultural and forest lands depleted of their organic matter. The most common use of compost today is probably in topsoil mixes used in the landscape industry.

Compost is typically applied in three ways:



- *To mulch or "top dress" planted areas*
- *To amend potting mixes*
- *To amend soil prior to planting*

Mulch and Top Dressings

Gardeners and landscapers use mulches and top dressings over the surface of the soil to:

- *suppress weeds*
- *keep plant roots cool and moist*
- *conserve water*
- *maintain a loose and porous surface and prevent soil from eroding or compacting*

Compost serves all of these purposes and also gives plants an attractive, natural appearance. Compost can be used to mulch around flower and vegetable plants, shrubs, trees and ground covers. The following chart shows recommended uses of compost as a mulch.

Using Compost as Mulch

SITUATION	PREPARATION	APPLICATION
Flower and vegetable beds	**Screen or pick through compost to remove large, woody materials. They are less attractive and will compete for nitrogen when mixed into the soil.**	**Apply 1" to 2" of compost over the entire bed, or place in rings around each plant extended as far as the outermost leaves. Always keep the compost 1 to 2 inches away from the base of the plant to prevent damage by pests.**
Lawns	**Use screened commercial compost, or sift homemade compost through a ½" or finer mesh.**	**Spread compost in ¼" to ½" layers. Top dressing is more effective after thatching or when reseeding thin areas.**
Trees and shrubs	**Remove sod from around trees and shrubs as far as branches away. If it is impractical to remove sod out to the drip line, a minimum 4 foot diameter clearing is recommended.**	**Spread compost in ¼" to ½" layers over entire planting area or in rings extending several feet beyond the drip line.**
Erosion control	**Use coarse compost or material left after sifting. Remove only the largest branches and rocks.**	**Mulch exposed slopes or erosion prone areas with 2 to 4 inches of coarse compost.**

Potting and Seedling Mixes

Sifted compost can be used to make a rich, loose potting soil for patio planters, house plants or starting seedlings in flats. Compost can be used to enrich purchased potting mixes or to make your own mixes. Plants growing in containers are entirely reliant on the water and nutrients provided in the potting mix.

Compost is excellent for container growing mixes because it stores moisture effectively and provides a variety of nutrients not typically supplied in commercial fertilizers or soil-free potting mixes. However, because of the limits of the container, people may choose to amend compost-based potting mixes with a "complete" fertilizer to provide an adequate supply of macronutrients. Some simple "recipes" for making your own compost mixes are shown in the following chart.

SANDY SOIL has quick drainage and is low in nutrients.

Soil Amendment

The value of humus as a soil amendment is suggested by its appearance. Even a casual observation of soil amended with compost shows that it is made up of many round, irregular ***"aggregates."*** Aggregates are groups of particles loosely bound together by the secretions of worms and compost bacteria. If these aggregates are rubbed between a finger and thumb, they break down into smaller aggregates. In between and within the aggregates themselves are many small air channels-like the empty spaces left in a jar of marbles.

CLAY SOIL can store important nutrients, but is difficult for roots and water to penetrate.

A well-structured soil with lots of small aggregates stays loose and easy to cultivate. The channels that aggregates create through the soil allow plant roots and moisture to penetrate easily. The smaller pores within the aggregates loosely hold moisture until a plant needs it. The larger pore spaces between the aggregates allow excess water to drain out and air to circulate and warm the soil.

By encouraging the formation of aggregates, humus improves the structure of every type of soil — silt, sand or clay. In loose sandy soils, humus helps to bind

unconsolidated particles together to retain water and nutrients that would normally wash through. Added to a clay or silt soil, humus breaks up the small tightly bound particles, and forms larger aggregations, which allow water to drain and air to penetrate.

Compost also attracts earthworms and provides them with food, so they breed rapidly. The tunnels that earthworms create aerate the soil and improve drainage, and the earthworms' burrowing brings up minerals from the subsoil, making them available to plants.

Using Compost as a Soil Amendment

SITUATION	PREPARATION	APPLICATION
Flower and vegetable beds; and ground covers	**Dig or till base soil to a minimum 8" to 10" depth.** 	**Mix 3" to 4" of compost through the entire depth. For poor soils, mix an additional 3" of compost into the top 3" of amended soil. In established gardens, mix 2" to 4" of compost into top 6" to 10" of soil each year before planting.**
Lawns	**Till base soil to 4" depth.**	**Mix 4" of fine textured compost into loosened base soil.**
Trees and shrubs 	**Dig or till base soil to a minimum of 8" to 10" depth.**	**Mix 3" to 4" of compost through the entire depth. For poor soils, mix an additional 3" of compost into the amended topsoil. Do NOT use compost at bottom of individual planting holes or to fill holes. For individual specimens dig compost into an area 2 to 5 times as wide as the root ball, then mulch the suface with wood chips or coarse compost.**

Other Values of Compost Use

Depending upon how compost is used, it can have many other valuable qualities:

- *Nutrient content*
- *Nutrient storage and availability*
- *Drought protection*
- *Erosion control*
- *pH buffer*
- *Beneficial to soil life*
- *Reduces energy inputs*

Nutrient Content

Dark, loose compost looks like it should be rich in nutrients. Indeed, compost contains a variety of the basic nutrients that plants require for healthy growth. Of special importance are the ***micronutrients*** present in compost, such as iron, manganese, copper and zinc. They are only needed in small doses, like vitamins in our diets, but without them, plants have difficulty extracting nutrients from other foods. Micronutrients are often absent from commercial fertilizers, so compost is an essential dietary supplement in any soil.

Compost also contains small amounts of the ***macronutrients*** that plants need in larger doses. Macronutrients include nitrogen, phosphorous, potassium, calcium and magnesium. These nutrients are usually applied in measured amounts through commercial fertilizers and lime. The three numbers listed on fertilizer bags (e.g., 10-10-10) refer to the percentage of the three primary macronutrients-nitrogen, phosphorous and potassium (N-P-K)-available in the fertilizer.

Although compost generally contains small amounts of these macronutrients (e.g., 1-1-1 or 1-2-1), the percentages can vary greatly between batches of compost. When applied in 4 to 6 inch layers, compost may provide significant amounts of these nutrients. However, due to the variability

and slow release of major nutrients, compost should be considered as a supplement to fertilizer with more readily available nutrient sources.

Nutrient Storage and Availability

To understand how humus is able to store nutrients and make them available when needed by plants requires a closer look. When viewing humus through a microscope that enlarges things 1,000 times, individual humus particles resemble the aggregates that are observed with the unaided eye. Like the aggregates, individual particles of humus contain may porous channels. Just as the channels in the aggregates provided space to store water, these spaces in the humus particles provide spaces to store nutrients.

The sides of the channels provide vast surfaces inside the particles where individual ions of minerals and fertilizers can cling. These ions are given up to plant roots as the plants require them. Thus, compost is able to store nutrients that might otherwise wash through a sandy soil or be locked up in the tight spaces of a clay soil.

Drought Protection

Soil improved with compost soaks up moisture like a sponge, and stores it on the soil granules — 100 pounds of humus can hold up to 195 pounds of water! Composting, therefore, is actually an important strategy for water conservation.

Erosion Control

Erosion is often the end result of a gradual loss of soil fertility. Humus helps to build the good structure that encourages optimum fertility and resists erosion.

pH Buffer

pH is a measure of soil ***acidity*** or ***alkalinity***. The acidity or alkalinity of a soil affects the availability of nutrients to plants. Most important plant nutrients are relatively easily available to plants at a pH range of 5.5 to 7.5. At pH levels above this range (alkaline) or below this range (acid), essential nutrients become chemically bound in the soil or are leached away and are unavailable to plants. By adding humus to the

soil, compost can help plants overcome soil pH levels that are either too low (acidic) or too high (alkaline). Often, plants that are known to "prefer" acidic or alkaline soils are actually in need of nutrients that become unavailable when the pH falls out of a desired range. Compost makes those nutrients more available and helps keep extreme pH from rendering them insoluble or too soluble.

Most soil in Placer County is on the acid side. With less lush growth, less natural composting occurs. In moist areas which are dense with naturally occurring mulch and compost, the soil is more acidic.

Beneficial Soil Life

Taking a step back from the microscopic view, another beneficial characteristic of compost is evident. The presence of compost soil life — ***redworms, centipedes, sow bugs*** and others — shows that compost is a healthy, living material. The presence of decomposer organisms means that there is still some organic material being slowly broken down and releasing nutrients. They are also indicators of a balanced soil ecology, which includes organisms that keep diseases and pests in check. Many experiments have shown that the rich soil life in compost helps to control diseases and pests that might otherwise overrun a more sterile soil lacking natural checks against their spread.

Reduced Dependence on Energy-Intensive Chemical Fertilizers

The chemical system of gardening and agriculture depends extensively on the use of nonrenewable energy reserves which are increasingly expensive and tied to geopolitical issues. Using compost and organic gardening practices will help us work toward local sustainability and energy independence.

Outreach

It goes without saying that Master Composters must have a good grasp of composting. Presenting what you know in a way that is helpful and will motivate people to start composting is equally necessary.

Your job as a Master Composter is to encourage people to compost at home, so it is useful to understand what motivates people and how people learn. The following chapter gives useful information on how to prepare effective presentations and learning experiences.

Designing Programs

- Content should be appropriate to learner and organizational needs.
- Content should relate to learner's job and be practical.
- Elements of the program should be within the facilitator's range of competence.
- Program agenda should be flexible; allow time for changes and evaluation.
- Goals and format should be clear to participants.
- Learning environments should be comfortable.
- Allow time for climate-setting.
- Choose an appropriate format.
- Analyze available resources.
- Select appropriate educational techniques.

Successful design depends on knowing the needs of the participants and their organization.

Program Formats

Individualized learning:

- Home-study/correspondence course
- Self directed learning projects

Group learning:

- action projects
- institutes
- workshops
- clinics
- conferences
- conventions
- courses
- large meetings
- exhibits
- fairs
- festivals
- trips
- tours

Teaching Methods

Lecture

Over-used; learners are passive; can be dull unless presenter very skilled. Effective to present ideas to a large group in a short time. Usually more effective when combined with visual aids and handouts.

Discussion

Without thorough preparation discussion can meander and deteriorate; can be time consuming. Effective because participation sparks interest; is stimulating, sharing ideas can be very productive.

Demonstration

Involves four fundamental steps; explanation, demonstration, imitation/practice, correction/application.

Inquiry

Using thoughtfully phrased questions that are challenging, to the point, easily understood, and clear.

Preparing For Your Presentation

- There is no such thing as being too well prepared
- Proper preparation will make you less nervous and more effective
- Organize rather than memorize your words
- Prepare presentations and materials that suit you and your style.

Leading Discussions

- Develop your own style...don't try and imitate someone else. Remember that the purpose of a discussion is not to present ideas but to draw ideas and experiences from participants.
- Begin by giving the purpose of the discussion. Pose a well-thought out question to the group. If no one responds, ask someone.
- Adults will often discuss and participate more if they are in small groups. Consider breaking them into small groups for the beginning of the discussion.
- Every member of the group should have a chance to have their say.
- In some cases as a discussion leader you may have to take opposite roles or pose leading questions in order to ensure that all aspects of a topic are examined. Don't be afraid to play the "devil's advocate" role.
- Always keep the group on the topic. This is one of your most important tasks. If you've clearly stated goals and objective this should not be difficult.
- Keep the atmosphere constructive. As discussion leader you should be neutral...remind the group that the purpose of the discussion is to explore different opinions not to change each other's thinking.

The most common complaints about discussions are that people don't stay on the topic and there isn't equal participation. How will you solve this?

Effective Presentations

- Know your content; have a viewpoint.
- Use gestures and facial expressions.
- Make and hold eye contact for 3 to 5 seconds.
- Move your eyes around the room.
- Have good posture, move for emphasis.
- Involve the audience; be dramatic.
- Project your voice, vary the speed and pitch.
- Use clear language.
- Show a sense of humor, avoid jokes.
- Be yourself

Four Rules of Participation

Adults will participate if:

- The program is structured to make them feel comfortable about participating.
- The facilitator in sincere about inviting participation.
- The program is of interest.
- The facilitator knows how to deal with group participation.

Participation Checklist

- Are the participants comfortable? Is the temperature of the room alright? Is the seating comfortable?
- Is it time for coffee or a meal?
- Do the participants know you well enough and trust you?
- Is your presentation interesting and lively?
- Is the language in your presentation too complex/too simplistic?
- Have you structured the program so participants get a chance to talk to each other?

- Are the participants tired from previous evening's activities? What can you do to accommodate this?
- Have you emphasized to the group how much you value their opinion? Are you sincere when you say this?
- Do you honestly want participation? Do you feel comfortable dealing with participation?
- Is your program relevant to the group?

Giving A Workshop

A workshop is a method of providing a group of interested people with information about a subject in a relaxed setting.

People come to workshops because they are interested in learning. They come to hear what you have to say. They are being selective; they have chosen to join this group. It is your job to make sure that they have not wasted their time.

Every salesperson knows that the secret to selling is product knowledge. You have a product to sell: composting. Your complete understanding of this product is vital to your mission to interest this group in the product.

A workshop can be a meeting of a few people or many. Some may already have knowledge about the subject; others may not. People come to our workshops to obtain more understanding of the subject. They have invited you to give them this information.

Preparation is everything. Find out all you can about the group you will be addressing; what information do they need? If, for example, the group lives in apartments or small townhouses, your presentation should be tailored to meet their needs. Try to find out if the group is interested in gardening, ecology, or a mix of both. Ask the group contact person how much time you're allowed for your presentation.

Leading a workshop for the first time can be a frightening experience, but it does not have to be. This method of passing on your information to someone else is no different than telling a friend your best recipe for chicken soup or how to construct a dog house. You are only allowing them to have the benefit of your knowledge and experience in doing this task. They can then decide if they want to follow through.

Keep your presentation simple. If you are using words or expressions that may be new to some of this group, stop and explain the meanings: do not make them ask.

Prepare an outline of the material you would like to cover with the group. Use the sample outlines provided as a guide. If aids such as handouts, slides, video, blackboard and chalk are required, arrange for them ahead of time.

Study your material, practice your presentation for timing. You may find that there are some rough spots that need to be changed.

Arrive at the workshop location early. Allow yourself to relax. Ask for a glass of water to be placed where you will speak: it will be welcome later. Make sure all your materials and audio-visual aids are in place. Enlist someone from the group to hand out any information sheets. If you are working alone, ask someone in the group to take charge of the sign-in sheet.

Have someone from the group introduce you as the workshop leader. This will establish your credentials. Always thank the group and the chairperson for inviting you to address them.

Keep eye contact with the people to whom you are speaking. Let your eyes move from person to person. Speak to each member of the audience as if he or she were the only person in the room. Speak slowly. Make sure every one of your words can be heard and understood. If you find it necessary to work on the blackboard, do not talk when your back is turned to the group. Draw or write whatever is required, then turn around to the front and explain what you have done.

Whatever you say, however you say it, there will be questions from the group. Some workshop leaders save a period of time at the end for questions; others take questions from the floor during the presentation. Both methods work.

Taking questions from the floor is a good way to deal with these questions and concerns while they are topical; the person with the question may forget to ask it later and never get the answer. The danger of this method is that great care must be taken not to lose control of the workshop. Do not allow discussions to take place between members on the floor. Do not allow questions that will lead you off the subject. Offer a good simple set of guidelines.

Exercise this same controls if you are going to take all questions after the presentation. Know how to stop. The question period is a good way to get to a stopping place. At some point in the questions, announce that you will take three more questions; stick to this.

Thank the group and the chairperson again for allowing you to meet with them.

If the group has a "mixer", coffee and snacks, after the meeting, plan to stay for awhile. This will turn into an informal question and discussion period. You will make many friends for the program.

Examples of outreach activities:

- *Leading workshops*
- *Giving slide show presentations to community groups*
- *Setting up and staffing displays at special community events*
- *Leading tours of the demonstration site*
- *Developing small demonstration sites*
- *Giving presentations to children in local schools or youth groups*
- *Developing children's activity sheets for use at the demonstration garden*
- *Creating curricula for teachers*
- *Creating new outreach tools (displays, coloring books, etc.)*

- *Showing off your composting system at home*
- *Generating media attention*
- *Distributing literature*
- *Providing composting consultations to residents and businesses*
- *Gathering material diversion data from composters in the community*
- *Translating educational materials into other languages*

The master compost coordinator will assist you in scheduling your outreach. Whatever outreach path you choose, it is important that you clarify your goals and outline specific activities.

Reporting

Reporting is an essential part of this program. Contact reporting forms are included in this manual. Additional forms may be obtained from the master composter coordinator. In order to evaluate the effectiveness of the program, the contact reporting forms provide spaces to record the following basic information:

- *Number of outreach hours*
- *Locations of activities*
- *Number of contacts made*

The contact form serves as a record for the number of people viewing demonstrations and attending presentations. There is also space for you to record your comments (unexpected problems, suggestions for improvement) about your activities. You are responsible for submitting these contact forms to the master composter coordinator after each of your outreach activities, or at the end of each month.

This formal training is just the beginning. It is your outreach efforts that will determine the impact of this educational program. In the end, you are the one who will make the difference. You will help others learn how they too can make a difference - and shape a better world for us all.

Thank you for your commitment to this goal!

Planning & Presenting Compost Workshops

Compost Workshop Presentation Outline

The manual includes a suggested outline for a 15-minute presentation, a 45-minute workshop and a 90-minute workshop.

The 15-minute presentation can be used when speaking to a civic group as an introduction to home composting. Promise to come back and give more information at a later date.

The 45-minute program and the 90-minute program are designed to aid the volunteer Master Composter in delivering a complete story about home composting in an urban setting.

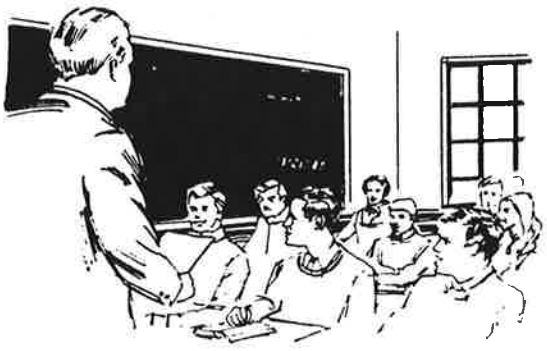
The outline may be broken into segments and delivered by more than one volunteer.

Material and tools needed to form a compost pile should be gathered in advance of the scheduled workshop.

At the earliest possible time, volunteers must inform Cooperative Extension's Master Composter Coordinator of the planned workshop. Include the location, date, time and the names of all volunteers taking part in the workshop.

Handout materials should be obtained for the Cooperative Extension office. Contact the Master Composter Coordinator at least one week before the workshop.

After the workshop, forward the sign-up sheet and your Report Cards to the Master Composter Coordinator. Any comments or notes that you or your volunteer team would care to make about the workshop will be most welcome.



15-Minute Presentation

Introduction (3 min.)

- Thank the group for inviting you
- Introduce yourself and team members
- Cover main points of presentation
  - ⇒ *Reduce landfill pressure*
  - ⇒ *Meet AB939 goals*
  - ⇒ *Produce wonderful, usable product*
  - ⇒ *Have better landscape & garden*

Grass Cycling (3 min.)

- Best left on lawns
- Does not cause thatch
- Provides needed nitrogen and organic matter
- Promotes better lawn growth

What is Composting? (2 min.)

- Controlled decay of organic material
- Natural process
- Living organisms

Compost Bins (2 min.)

- How to select a compost bin
  - ⇒ *How does if look in your yard?*
  - ⇒ *Is it easy to maintain?*

Use of Compost (2 min.)

- Mulch
- Soil additive
- Planting Mix
- Seed flats

Summary (3 min.)

Questions and Answers

45-Minute Workshop

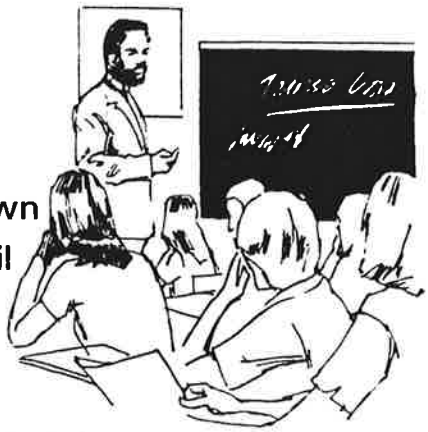
Introduction (4 min.)

- Welcome
- Introduce yourself and team members
- One minute outline of Master Composter Program
- What are we going to talk about
- Sign-in sheet and hand-outs
- Refer to compost brochure for hot-line phone numbers

Why Backyard Composting? (3 min.)

- Save water
- Save landfill space
- Help the County and Cities meet the AB939 goal
- Help save collection and disposal cost

Grass Cycling (3 min.)



- Best left on lawns
- Does not cause thatch
- Provides needed nitrogen to lawn
- Supplies organic material to soil
- Promotes deeper roots

What is Composting? (2 min.)

- Controlled decay of organic material
- Natural process

How to Make Compost (7 min.)

- Recipe for compost
- Define carbon and nitrogen sources
- Browns, greens, air and water
- What food wastes can be used
- Things not to put in compost

The Compost Process (4 min.)

- Living organisms
- Heat
- Time
- Importance of reducing particle size of material
- Importance of air in the pile
- Need to turn material

Compost Bins and Tools (5 min.)

- How to select a compost bin
- Bin style, manufactured vs. home-made
- Compost forks and turning tools

Demonstration (12 min.)

- Hands-on demo, layer material, water, mix
- How to maintain pile
- Turning pile
- Trouble shooting
  - ⇒ *Odor problem*
  - ⇒ *No heat*
  - ⇒ *Too wet, too dry*
  - ⇒ *Insects*
  - ⇒ *Rodents*

Finished Compost (2 min.)

- Color, smell, texture
- Storage or finished product

How and Where to Use Finished Compost (5 min.)

- Use direct from pile
  - ⇒ *Mix in soil*
  - ⇒ *Spread as mulch*
- Screened compost
  - ⇒ *Mix with other material for potting mix*
  - ⇒ *Use in seed flats to start seedlings*
  - ⇒ *Use as topping over seeded areas in garden*

Summary (3 min.)

- Why compost?
- Why grass cycle?
- Recipe
- Process
- Bins and tools
- Use of compost

Questions and Answers

90-Minute Presentation

Introduction (6 min.)

- Welcome
- Introduce yourself and team members
- One minute outline of Master composter Program
- What are we going to talk about
- Sign-in sheet and hand-outs
- Refer to compost brochure for hot-line phone numbers

Why Backyard Composting (5 min.)

- Save money on purchase of soil amendments
- Save water
- Save landfill space
- Help the County and Cities meet the AB939 goal
- Help save collection and disposal cost

Grass Cycling (5 min.)

- Best left on lawns
- Does not cause thatch
- Provides needed nitrogen to lawn
- Supplies organic material to soil
- Promotes deeper roots

What is Composting? (3 min.)

- Controlled decay of organic material
- Natural process

How to Make Compost (7 min.)

- Recipe for compost
- Define carbon and nitrogen sources
- Browns, greens, air and water

- What food wastes can be used
- Things not to put in compost

The Compost Process (7 min.)

- Living organisms
- Heat
- Time
- Importance of reducing particle size of material
- Importance of air in the pile
- Need to turn material

Compost Bins and Tools (7 min.)

- How to select a compost bin
- Bin style, manufactured vs. home-made
- Shredders and chippers
- Compost forks and turning tools
- Where to stop

Demonstration (15 min.)

- Hands-on demo, layer material, water, mix
- How to maintain pile
- Turning pile
- Trouble shooting
  - ⇒ *Odor problem*
  - ⇒ *No heat*
  - ⇒ *Too wet, too dry*
  - ⇒ *Insects*
  - ⇒ *Rodents*

Finished Compost (5 min.)

- Color, smell, texture
- Storage of finished product

How and Where to Use Finished Compost (10 min.)

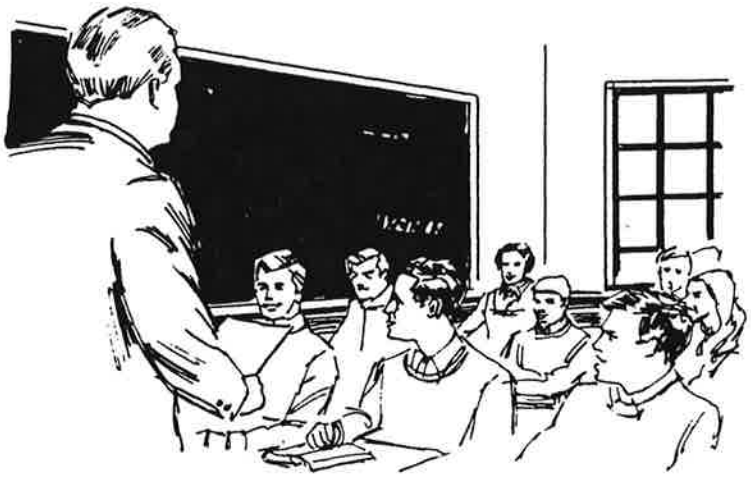
- Use direct from pile
  - ⇒ *Mix in soil*
  - ⇒ *Spread as mulch*

- Screened compost
  - ⇒ *Mix with other material for potting mix*
  - ⇒ *Use in seed flats to start seedlings*
  - ⇒ *Use as topping over seeded areas in garden*

Summary (5 min.)

- Why compost?
- Why grass cycle?
- Recipe
- Process
- Bins and tools
- Use of compost

Questions and Answers (15 min.)



Commonly Asked Questions About Composting

It is a natural process for things that were once living to decompose. Composting is simply managing the natural breakdown or decomposition of organic materials to work faster. Individuals who have gotten serious about composting some of their yard and garden wastes realize that what appears to be a very simple process can generate questions. These have been raised by those who have tried backyard composting.

Can you add kitchen scraps to a compost pile?

Yes, almost any organic kitchen waste like food scraps and paper can be composted. However, meat, bones, and foods high in oils and fat can generate foul odors. They are also attractive to a wide range of insect and animal pests. Vegetable and fruit scraps, egg shells, and coffee grounds are much better to compost.

Will weeds added to the compost pile increase weed problems later in the garden and flower beds?

Most weeds and many weed seeds will be killed by the heat generated in the compost pile. However, weeds that have large storage roots like nutsedge, Bermuda grass, morning glory, or greenbriar should be left out or dried and chopped up before composting to reduce the chance of survival during composting. Frequent turning of the pile promotes more uniform and thorough decomposition and therefore decreases risk of survival of weeds.

Is it absolutely necessary to turn a compost pile?

No, but by turning the pile, fresh organic matter, in essence food for microorganisms, is more uniformly distributed to those organisms. This promotes more rapid and uniform decomposition than simply letting the pile rot. A frequently turned and carefully managed compost pile can decompose in

weeks while a neglected pile can take a year or more to produce a finished compost.

Can you use plant material that is diseased in a compost pile?

High temperatures that develop during composting kill many plant pathogens. Also, organisms that attack plant pathogens thrive in the compost pile and can reduce potential plant diseases. As long as the pile is turned so the whole pile has a similar chance to heat up and be exposed to those microbes that suppress diseases, the pathogens can be reduced to a level that should not be a problem in the garden. Thorough and well-managed composting is most important if diseased plants are added to the pile.

Can you compost yard waste that has a waxy coating and thorny waste, such as evergreen shrubbery clippings, and rose and holly waste?

Yes. However, plant material with a waxy coating may take longer to decompose. Shredding these materials will help break apart the waxy cuticles, exposing more surface area to the microorganisms for faster decomposition. The only problem with thorny waste is that it may be difficult to handle without gloves.

Do you have to have some kind of a structure to make compost?

No. Compost can be made in an open pile. A structure helps keep the pile neat and in a size and shape that will allow it to heat up in the middle and decompose faster. It will also hide the waste from the view of you or your neighbor. Where multiple bins are used, turning the compost from one bin to another is a convenient and effective way to manage the compost pile.

What size should a compost pile be?

A compost pile should be at least 3 to 4 feet high for it to adequately heat up in the middle. The width of the pile can be any size you can manage, but a general recommendation is 3 to 4 feet wide. One or two 3 x 3 foot compost bins are

adequate for handling most, if not all, of the yard waste from a city lot.

Are odors a problem in a compost pile?

Although not usually a problem, under some conditions odors do occur. The most common problem that causes a compost pile to smell bad is lack of adequate aeration in the pile. This could be remedied by mixing in materials that are coarse and will help create air spaces in the pile. Add waste that is higher in carbon: the drier, brown (woody) materials.

Is there any problem with composting newspaper?

No. True newsprint, the inexpensive paper made from wood pulp, is a good source of carbon if shredded and mixed with other materials. The inks used with newsprint, even colored newsprint, are considered non-toxic.

How can you tell when the compost is "finished"?

When the compost appears dark, crumbly, and looks much like soil, it is ready to use. Any large, woody pieces still not completely decomposed may be sifted out, if desired.

What are compost "activator or starter" materials?

Compost "activators" are dehydrated bacteria in a package. The numbers of bacteria existing on the organic material and soil used in a compost pile are more than enough to start the composting process. These bacteria also multiply very rapidly, so it is probably not necessary to use such a product.

Do you ever need to add fertilizer to a compost pile?

If you have a good mixture of green and brown waste materials (an average carbon to nitrogen ratio of about 30:1), you should not need to add fertilizer to the pile. However, if you have high carbon materials, a nitrogen source of fertilizer could be used to hasten decomposition.

Should limestone be added to compost piles?

There is no need to add lime to a compost pile. Too much lime, in fact, could create a loss of available nitrogen in the pile. Finished compost generally has neutral to slightly acid pH.

Is it all right to mix pet (dog of cat) or human wastes into the compost pile?

It is not recommended to add pet or human wastes to a compost pile. Studies have shown that there is a potential for health problems to occur where compost with pet waste has been used in vegetable gardens. Human waste has the potential for transmitting diseases as well and therefore should not be used. If you have to deal with pet waste, bury it away from garden areas.

Should a compost bin have a top on it?

Two reasons you might want to cover compost are to control the amount of moisture added to the pile and to keep out rodents and pets. However, these two factors are not always a problem. Unless we have an unusually wet season, a compost does not generally get too soggy. If you don't add scraps of meat, bones, or grease, pests aren't a serious problem.

Is it all right to mix fireplace ashes into the compost?

A limited amount of wood ashes can be used in the compost pile. Wood ashes can add potassium and other nutrients, but they also have the capacity to raise the pH very rapidly. Overuse could create problems with the compost pile.

Can compost feed all of my plants?

It is not a good idea to view compost as a plant food. Although it does have some food value, your plants will need other nutrients. Compost serves best in the garden as a superior soil conditioner.

Do compost piles attract slugs?

Slugs live happily in compost piles and help to break down organic wastes. Often they are so happy there that they don't bother garden plants. However, compost piles can provide daytime hiding places for slugs who may graze in gardens at night. Place compost piles in areas away from vegetable gardens or create barriers (traps, metal flashing...) around the pile to contain slugs.

How can I stop flies and other insects from becoming pests around the compost pile?

Flies are attracted to food scraps and animal manures. To discourage flies dig in food waste each time you add to your heap, and cover scraps completely with soil, dead leaves, or straw. Compost piles made entirely from yard wastes do not usually attract flies or other flying insect pests in large numbers.

Can yard wastes treated with chemical pesticides and herbicides be put in the compost? What happens to them in the compost pile?

There are no simple, clear answers to this question. Individual chemicals react in different ways and break down under unique conditions. Decomposition of most pesticides and their byproducts have not been studied thoroughly. Often the byproducts are more toxic than the original chemicals. Some fungicides contain heavy metals which can build up in your soil.

You should never purposely dump any chemical into a compost pile. At a minimum, thoroughly compost yard wastes that have been treated with pesticides *(or chemicals of certain origin)* in a hot pile and leave to cure for a full year.

Can grass clippings treated or suspected of having been treated with a herbicide be composted or mulched safely?

Lawn clippings with herbicides on them may kill garden plants if used as a mulch or a "young" compost. If herbicide use is suspected, materials should be thoroughly composted and allowed to cure for several months before using in the garden. Do not use compost made from wastes of unknown origin on food crops.

Can vacuum cleaner dust be composted?

Natural fibers from wool and cotton rugs will decompose, and are fine to put into your compost heap. Fibers from synthetic carpeting will not decompose, so although the fibers will probably not be noticeable in the finished compost,

vacuum cleaner dust (or dryer lint) that contains synthetic fibers would be best left out of the compost heap. Synthetics take many, many years to breakdown, and you would be accumulating them on whatever place you would use your finished compost. It is not known how, or whether, the addition of synthetic fibers to soil affects soil life.

Can I compost plywood sawdust?

To be on the safe side, no. Glues in the plywood may be inorganic and, therefore, will not decompose. In addition, the plywood may contain chemicals to protect the wood from insects. These could be harmful to the organisms in the pile.

What do you do about a neighbor who complains about composting even though it doesn't smell?

a) Set a good example by keeping your compost system as neat as possible.

b) Remember the essentials when you compost, especially the C:N ratio because too much nitrogen can cause an odor problem.

c) Be sure to explain the benefits of composting every chance you get. Tell them why you do it and how it works for you. They'll catch on.

How do you compost when you have too many materials that are high in nitrogen?

a) Store high carbon materials (sawdust, leaves, shredded newspaper) and use them when needed.

b) Buy peat moss and combine with the materials that are high in nitrogen.

How can food scraps be stored and used to make compost?

Store them in sealable plastic containers and layer with sawdust or high carbon to minimize odor problems. They can be used by burying them under at least eight inches of soil, composted by earthworms, or turned in a hot compost.

Should the compost pile/bin be placed in the shade or sun?

The heat of the sun would speed the process somewhat, but it would also dry it out faster. If sunny space is limited in your garden, keep your compost in the shade.

When is a pile too small to heat up?

For a hot compost, we recommend a minimum dimension of 3' x 3' x 3'. Insulation of the sides or top would help hold the heat of the process.

Can a rotary mower be used to shred materials?

Yes, it works best on dry materials that are not too woody. For example, leaves can be shredded effectively by a rotary mower. It is best to use it on a hard, level surface and not have soil or, of course, rocks mixed in.

What kind of wood chip/saw dust is best for composting?

The chips or dust of deciduous, hardwood trees are best for making compost. Cedar can have inhibitory substances and the sawdust from pressure-treated woods (or plywood) also contain various toxic materials and are not recommended for use in compost.

Can fruit waste be composted? How?

Yes. With citrus, it is best to chop the rinds as much as possible to aid decomposition. Compost them like other food wastes — in hot piles, by burying them, or with earthworms.

Compost Troubleshooting Guide

The compost pile is a thriving little world or ecosystem in which a wide array of microorganisms develop and multiply. In the process, these microorganisms convert waste into useful humus-like organic matter. But like most ecosystems, a number of factors can alter the environment within the compost world causing problems that ultimately make managing the compost a less successful effort.

The following page containss a troubleshooting guide that offers suggestions for correcting some of the problems that might occur in your compost pile.

Compost Troubleshooting Guide

PROBLEM	CAUSE	SOLUTION
Bad odor (rotten smell)	Too much moisture.	Turn the compost or add dry, porous material like straw.
Bad odor (ammonia smell)	Too much nitrogen a compared to carbon.	Add high-carbon materials like straw, sawdust, wood chips, or dry leaves.
	Compacted leaves.	Turn the compost or make the pile smaller.
	Inadequate air.	Turn the compost.
Low compost temperature	Pile too small.	Increase size, insulate sides.
	Too little moisture.	Add water and turn the compost.
	Too much moisture.	Turn the compost and mix in dry materials.
	Too little air.	Turn the compost.
	Lack of nitrogen.	Mix in nitrogen source like grass clippings, manure, or fertilizer.
	Cold weather.	Increase pile size or insulate pile with a layer of straw or plastic.
	Particle size too large.	Chip or grind materials.
Pile is dry throughout	Not enough water; too much wood material	Turn pile and moisten material; add fresh materials; cover pile.
Compost pile is damp and warm in middle but nowhere else	Pile is too small.	Collect more material and mix the old ingredients into a new pile, then moisten.
Pest infestation – dogs, rodents, insects	Improper food scraps added.	Don't add meat, fats, bones or other animal products.
	Food scraps not covered.	Place fruit and vegetable scraps in the center of pile, cover with soil. Use rodent-resistant bin.
Neighbor complains	Compost pile is ugly.	Cover with pretty bedspread or throw flowers on it.

GLOSSARY

Acid:

Normal product of decomposition. Redworms do best in a slightly acid (pH just less than 7) environment. Below pH 5 can be toxic to worms. Addition of pulverized egg shells and or lime helps to neutralize acids in a worm bin.

Actinomycete:

A group of microorganisms, intermediate between the bacteria and the true fungi, that usually produce a characteristic branched mycelium – These organisms are responsible for the earthy smell of compost.

Aerated Static Piles:

A composting technique in which material is formed into piles that are aerated without turning. The piles are placed over pipes which are connected to a blower that supplies air for the aerobic organisms that turn organic discards into compost. The controlled air supply makes possible the construction of large piles, decreasing the amount of land needed.

Aeration:

The process of exposing bulk material, such as compost, to air to allow exchange of gases.

Aerator:

A tool used to create new passages for air and moisture in a compost pile.

Aerobic:

An adjective describing an organism that can live only in the presence of oxygen gas (e.g., an aerobic organism).

Agricultural Discards:

Discards of plant and animal origin, which result from the production and processing of farm or agricultural products, including manure's, orchard and vineyard prunings, and crop residues, which are removed from the site of generation for solid waste management.

Alkaline:

Containing bases *(hydroxides, carbonates)* which neutralize acids to form salts.

Aluminum Can or Aluminum Container:

Any food or beverage container that is composed of 99% or more aluminum.

Ambient air temperature:

The temperature of the air in the vicinity of the compost pile.

Amendment, soil:

Any substance *(such as lime, sulfur, gypsum, or sawdust)* used to alter the properties of a soil (generally, to make it more productive) — fertilizers are one type of soil amendment. However, many soil amendments (such as soil conditioners) do not have significant fertilizer value.

Anaerobic:

An adjective describing an organism that can live or function in the absence of air or free oxygen.

Anaerobic Digester:

A closed vessel with a controlled environment in which anaerobic fermentation takes place.

Backyard Composting:

Composting of organic materials by the residential generator of the materials.

Bacteria:

Single-cell, microscopic organisms with rigid cell walls. They may be aerobic, or facultative; some can cause disease, and some are important in the stabilization and conversion of organic discards.

Baling (Bailing):

A volume reduction technique where refuse material is mechanically compacted into cubes or bricks and may be held by wire or steel straps.

Bedding:

Moisture retaining medium used to house worms.

Biodegradable:

The breaking down by microorganisms of the physical or chemical structure of a compound. In California, *"biodegradable"* labels can only be applied to products that decompose within one year to non-toxic carbonaceous soil, water or carbon dioxide in the "most common" environment these products end up in.

Browns:

Carbon rich compostable materials. Usually dry as well.

Buffer:

A substance which renders a system less sensitive to fluctuations between acidity and alkalinity. Humus serves as a buffer in soil.

Bulking Agent:

Material, usually carbonaceous such as sawdust or woodchips, added to a compost system to maintain airflow by preventing settlement and compaction of the compost.

Bulky Discards:

Items whose large size precludes or complicates their handling by normal collection, processing, or disposal methods *(includes furniture, tree branches, stoves, refrigerators, etc.)*.

Buy-Back Recycling Center:

A facility which pays a fee for the delivery and transfer of ownership to the facility of source separated materials, for the purpose of recycling or composting.

Carbohydrate:

Any compound containing only carbon, hydrogen, and oxygen *(such as sugars, starches, and cellulose)*.

Carbon Nitrogen Ratio:

Ratio representing the quantity carbon (C) in relation to the quantity of nitrogen (N); determines the composting potential of a material.

Cellulose:

A long chain of tightly bound sugar molecules that constitutes the chief part of the cell walls of plants.

Chemical persistence:

The time a chemical remains in the environment essentially unchanged.

Co-Composting:

The composting of sewage sludge with a bulking agent such as yard debris to form a soil amendment.

Commercial Discards:

Discards originating from stores, business offices, commercial warehouses, hospitals, educational, health care, military, and correctional institutions, non-profit research organizations, and government offices.

Comingling:

The mixing of two or more recyclable materials into one container. This is in contrast to material segregation.

Compost:

The product resulting from the controlled biological decomposition of organic materials that are source separated from the municipal solid waste stream.

Compost Tea:

Water in which finished compost has been 'steeped' to concoct a liquid fertilizer for plants.

Composting:

A method of discard treatment in which organic discards are biologically decomposed under controlled, aerobic or anaerobic conditions.

Composting, Mechanical:

A method in which the compost is continuously and mechanically mixed and aerated.

Composting, Windrow:

An Open-air method in which compostable material is placed in rows, piles, or ventilated bins or pits and is occasionally turned or mixed. The process may be anaerobic or aerobic.

Composting Facility:

A permitted solid waste facility at which composting is conducted.

Contaminant:

A material that is harmful to the recycling process when included with the recyclable material, or a material that is not recyclable.

Construction and Demolition Waste:

Includes discards, such as building materials; and packaging and rubble resulting from construction, remodeling, repair and demolition operations on pavements, houses, commercial buildings, and other structures.

Corrugated Containers (OCC):

A paperboard container *(usually a cardboard box)* fabricated from two layers of kraft linerboard sandwiched around a corrugating medium.

Cover Material:

Soil that is used to cover compacted discards in a sanitary landfill.

Cullet:

Clean, generally color-sorted, crushed glass that is used to make new glass.

Curing:

The final phase of composting. Microbial activity continues, but at a slower rate. As the compost cures, less heat is generated by the microorganisms, and the pile begins to cool down. Curing can take several days to months.

Decomposition:

The process of breaking down complex materials into simpler substances. End products of much biological decomposition are carbon dioxide and water.

Demolition Debris:

Insert discards resulting from the demolition or razing of buildings, road, and other man-made structures. Demolition debris consists of, but is not limited to, concrete, brick, bituminous concrete, wood and masonry, composition roofing and roofing paper, steel, and minor amounts of other metals such as copper. Plaster *(i.e., sheet rock or plaster board)* or any other material, other than wood, that is likely to produce

gases or a leachate during the decomposition process and asbestos wastes are not considered to be demolition debris.

Digester:

Specially designed equipment in which organic materials are softened or decomposed, usually for further processing.

Dripline:

A line on the ground defined by the outer edge of a plant's branches.

Drop-Off Recycling Center:

A facility which accepts delivery or transfer of ownership of source separated materials for the purpose of recycling or composting without paying a fee.

Enzymes:

Any numerous complex proteins that are produced by living cells to catalyze specific biochemical reactions.

Evaporative cooling:

The cooling that occurs when heat from the air or compost pile material is used to evaporate water.

Fast composting:

An intensive composting method that produces finished compost in one to two months — this method requires frequent turning to maximize aeration. When temperatures of 140°F (60°C) are achieved, a "thermal kill" of pathogens, or "partial sterilization" occurs.

Flow Control:

A legal or economic means by which discards are directed to particular destinations. For example, an ordinance requiring that certain discards be sent to a combustion facility is waste flow control.

Food Scraps:

All animal and vegetable discards generated by food facilities, or from residences, that result from the storage, preparation, cooking, or handling of food.

Fungi:

A group of simple plants that lack a photosynthetic pigment—the individual cells have a nucleus surrounded by a membrane, and they may be linked together in long filaments called hyphae. The individual hyphae can grow together to form a visible body.

Gizzards:

Region in anterior portion of digestive tract whose muscular contractions help grind food.

Greens:

Nitrogen rich compost materials *(usually wet)*.

Heavy Metals:

Metallic elements which are persistent in the environment, poisonous, and are subject to biological magnification. These elements are regulated because of their potential for human, plant, or animal toxicity, including cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn).

Herbicide:

A chemical used to kill plants; a kind of pesticide.

HDPE:

An acronym for high density polyethylene plastic, commonly used in milk jugs.

Humic Acid:

Proteins and lignins, the main constituent of humus; dark brown to black in color.

Humus:

Complex, highly stable organic material formed during breakdown of organic matter. Humus is usually dark in color.

High-Grade Paper:

Writing, ledger, and computer papers fairly free of contaminants.

Household Hazardous Waste:

Those discards resulting from products purchased by the general public for household use which, because of their

quantity, concentration, or physical, chemical, or infectious characteristics, may pose a substantial known or potential hazard to human health or the environment when improperly treated, disposed, or otherwise managed.

Household Hazardous Waste Collection:

A program activity in which household hazardous materials are brought to a designated collection point where the household hazardous materials are separated for temporary storage and ultimate recycling, treatment, or disposal.

Indore Method of Composting *(pronounced "indoor")*:

A composting method in which materials are layered sandwich fashion, then are turned during decomposition. Developed in the 1930's by Sir Albert Howard who is considered the father of the organic method of gardening and farming.

Inert Solids or Inert Waste:

A non-liquid discard including, but limited to, soil and concrete, that does not contain hazardous material or soluble pollutants.

Inorganic:

Of mineral origin; not belonging to the large class of carbon compounds which are termed organic.

Integrated Solid Waste Management:

A practice of using several alternative discard management techniques to manage and dispose of specific components of the municipal solid waste stream. Discard management alternatives include source reduction, recycling, composting, energy recovery and landfilling.

Intermediate Processing Center (IPC):

A facility for processing recyclable materials into a form marketable to industry.

In-Vessel Composting:

A fully enclosed, often fully automated, composting operation involving mechanical devices with feedback controls and/or forced aeration. In this closed system, more types of materials can be composted, and odors and pests are not a problem. Sometimes called a *"digester"*, this system also offers a short residence time.

Landfill:

A permitted disposal facility or part of a facility at which discards are permanently placed in or on land and which is not a landspreading disposal facility.

Leach:

To run water through a medium, causing soluble materials to dissolve and drain off.

Leachate:

Liquid that has percolated through buried discards or other medium and has extracted dissolved or suspended materials from it.

LDPE:

An acronym for low density polyethylene, generally plastic film.

Lignin:

Substance involved in the structure of wood and responsible for its rigidity.

Lime:

A calcium compound which helps reduce acidity in worm bins. Use calcium carbonate, ground limestone, egg shells, or oyster shells. Avoid caustic, slaked, and hydrated lime.

Limestone:

Rock containing calcium carbonate.

Macroorganism:

Organism large enough to see by the naked eye.

Manual Separation:

The separation of discards by hand - sometimes called hand picking or hand sorting. Manual separation can be done in the home or office, for example by keeping food scraps separate from newspaper, or in recovery plant by picking out large cardboard or metal objects.

Mandatory Recycling:

Programs which by law require consumers to separate trash so that some or all recyclable materials are not burned or dumped in landfills.

Market Development:

A method of increasing the demand for recovered materials so that end markets for the materials are improved or stabilized and thereby become more reliable.

Materials Recovery Facility (MRF):

A permitted solid waste facility where discards are sorted or separated, by hand or by use of machinery, for the purpose of recycling or composting.

Methane:

An odorless, colorless, and asphyxiating gas that can explode under certain circumstances; can be produced by buried discards undergoing anaerobic decomposition.

Microorganism:

Any living thing that is microscopic or submicroscopic in size.

Mulch:

Ground or mixed yard trimmings, which may not or may have been composted, that are placed around plants to prevent evaporation of moisture, suppress weeds and to reduce soil temperature extremes.

Municipal Solid Waste (MSW):

All solid waste generated by residential, commercial, and industrial sources, and all discards generated at construction and demolition sites, at food processing facilities, and at treatment works for water and waste water, which are collected and transported under the authorization of a jurisdiction or are self-hauled. Municipal solid waste does not include agricultural crop residues, animal manures, mining, fuel extraction, and forestry discards, and ash from industrial boilers, furnaces and incinerators.

Mycelium:

The collective term for fungus filaments or hyphae.

NIMBY:

Acronym for Not In My Back Yard. Refers to the fact that people want the convenience of products and proper disposal of the discards generated by their use of the products, provided the disposal area is not located near them.

Non-Ferrous Metals:

Any metal scraps that have value, and which are derived from metals other than iron and its alloys in steel, such as aluminum, copper, brass, bronze, lead, zinc and other metals, and to which a magnet will not adhere.

Non-Recyclable Paper:

Discarded paper which has no market value because of its physical orchemical or biological characteristics of properties.

Old Newspaper (ONP):

Any newsprint which is separated from other types of discards and made available for reuse and which may be used as a raw material in the manufacture of a new paper product.

Organic:

Pertaining to or derived from living organisms.

Organic Discards:

Non-petroleum based discards originating from living organisms and their metabolic waste products, which contain naturally produced organic compounds, and which are biologically decomposable by microbial and fungal action into the constituent compounds of water, carbon dioxide, and other simpler organic compounds.

Pathogen:

An organism, chiefly a microorganism, including viruses, bacteria, fungi, and all forms of animal parasites and protozoa, capable of producing an infection or disease in susceptible host.

Peat Moss:

Sphagnum moss which is mined from bogs, dried, and used as an organic mulch. Although acidic, its light fluffy texture and excellent moisture retention characteristics make it a good component for worm breeding.

Pesticides:

Any organic or inorganic chemical used to kill an organism *(microbe, plant, insect or animal)* considered to be a pest, i.e., one that causes loss, inconvenience, health hazard, etc.

PET:

An acronym for polyethylene terephthalate, commonly used in plastic soft drinks bottles.

pH:

An expression for degrees of acidity and alkalinity based upon the hydrogen ion concentration. The pH scale ranges from 0 to 14, pH of 7 being neutral, less than 7 acid, greater than 7, alkaline.

Phytotoxic:

Poisonous to plants.

Post-Consumer Waste:

A discard generated by a business or residence. Post-consumer waste does not include discard from industrial and manufacturing processes.

Recovered Material:

Material which has been retrieved or diverted from disposal or transformation for the purpose of recycling or composting. "Recovering material" does not include those materials generated from and reused on site for manufacturing purposes.

Recyclable:

In California, for a good to be sold as "recyclable," consumers must be able to conveniently recycle the product in every county with a population of over 300,000 people. In addition, the product must be redeemable or returnable to a permanent recycling location within five miles of the point of purchase in every county in California with a population of over 300,000.

Recycle:

The process of collecting, sorting, cleansing, treating, and reconstituting materials that would otherwise become "waste," and returning them to the economic mainstream in the form of raw materials for new, reused, or reconstituted products which meet the quality standard necessary to be used in the marketplace.

Red worms:

Lubricus rubellus, commonly known as red worms. They thrive only in manure or garbage and are rarely found in ordinary soils.

Repairablility:

The ability of a product or package to be restores to a working or usable state at a cost which is less than the replacement cost of the product or package.

Residential Discards:

Discards originating from single-family or multiple family dwellings.

Residue (or Residual):

Materials remaining after processing, incineration, composting, or recycling have been completed. Residues are usually disposed of in landfills.

Resource Recovery:

A general term used to describe the extraction of economically usable materials or energy from wastes. The concept may involve recycling or conversion into different and sometimes unrelated uses.

Reuse:

The use, in the same form as it was produced, of a material which might otherwise be discarded.

Reverse Vending Machine:

A mechanical device which accepts one or more types of empty beverage containers and issues a cash refund or a redeemable credit slip with a value not less than the container's redemption value and applicable redemption bonus, if any. The bonus payments may be aggregated over more than one container and them paid. *(effective January 1, 1990)*

Roll-Off Container:

A large waste container that fits onto a tractor trailer that can be dropped off and picked up hydraulically.

Salvage:

The controlled removal of valuable materials at a permitted solid waste facility for recycling, composting, or transformation.

Salvaging:

The controlled removal of materials from disposal for utilization.

Sanitary Landfill:

A site where discards are disposed using sanitary landfill techniques.

Scavenger:

One who participates in the uncontrolled removal of materials at any point in the solid waste stream.

Scrap:

Discarded or rejected material or parts of material that result from manufacturing or fabricating operations and are suitable for reprocessing.

Sewage Sludge:

Residual solid and semi-solids resulting from the treatment of waste water, but does not include waste water effluent discharged from such treatment processes.

Slow composting:

A minimal-effort composting method that produces finished compost in a year or more — slow composting requires little maintenance.

Soil Amendment/Soil Conditioner:

A soil additive which stabilizes the soil, improves its resistance to erosion, increases its permeability to air and water, improves its texture and the resistance of its surface to crusting, and makes soil easier to cultivate or otherwise improves its quality.

Soil conditioner:

A soil additive that stabilizes the soil, improves its resistance to erosion, increases its permeability to air and water, improves its texture and the resistance of its surface to

crusting, makes it easier to cultivate, or otherwise improves its quality.

Solid Waste:

All putrescible and nonputrescible solid, semi-solid, and liquid discards, including garbage, trash, refuse, paper, rubbish, ashes, industrial discards, demolition and construction debris, abandoned vehicles and parts thereof, discarded home and industrial appliances, dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste, manure, vegetable or animal solid and semisolid wastes, and other discarded solid and semisolid wastes. "Solid waste" does not include hazardous waste.

Solid Waste Management:

The systematic administration of activities which provide for the collection, source separation, storage, transportation, transfer, processing, treatment, and disposal of solid waste.

Source Separated:

The segregation, by the generator, of materials designated for separated collection for some form of materials recovery or special handling.

Source Reduction:

Any action which causes a net reduction in the generation of solid waste. "Source Reduction" includes, but is not limited to, reducing the use of non-recyclable materials, replacing disposable materials and products with reusable materials and products, reducing packaging, reducing the amount of yard debris generated, establishing garbage rate structures with incentives to reduce the amount of discards that generators produce, and increasing the efficiency of the use of paper, cardboard, glass, metal, plastic, and other materials in the manufacturing process. "Source reduction" does not include steps taken after the material becomes solid waste or actions which would impact air or water resources in lieu of land, including, but not limited to, transformation.

Steel Can:

Any food or beverage container that is composed of steel with a tin coating.

Thatch:

Dead and drying grass plant parts (such as roots, stems, and shoots) that accumulated above the soil surface of a lawn.

Thermophilic:

Heat-loving microorganisms that thrive in, and generate, temperatures between 113 and 155°F (45 - 68°C).

Tilth:

The physical state of the soil that determines its suitability for plant growth taking into account texture, structure, consistence and pore space; a subjective estimation, judged by experience.

Tipping (or Tip) Fee:

The charge imposed for taking discards to a disposal site. The tipping fee is normally determined in dollars per ton.

Tipping Floor:

Unloading area for vehicles that are delivering discards to an incinerator or other processing plants.

Ton:

A unit of weight in the U.S. Customary System of Measurement, and avoirdupois unit equal to 2,000 pounds.

Topdressing:

Applying a layer of compost, or other material, to the surface of soil.

TPD,TPW,TPY:

Acronyms for tons per day, tons per week, and tons per year, respectively.

Transfer or Processing Station:

Those facilities utilized to receive discards, temporarily store, separate, convert, or otherwise process the discarded materials, or to transfer the discard directly from smaller to larger vehicles for transport, and those facilities utilized for transformation. Does not include: 1) a facility, whose principal function is to receive, store, separate, convert, or otherwise process in accordance with state minimum standards, manure; 2) a facility, whose principal function is to

receive, store, convert, or otherwise process discards which have already been separated for reuse and are not intended for disposal; 3) the operating premises of a duly licensed solid waste handling operator who receives, stores, transfer,or otherwise processes discards as an activity incidental to the conduct of a refuse collection and disposal business.

Transformation Facility:

A facility whose principal function is to convert, combust, or otherwise process discards by incineration, pryolsis, destructive distillation, or gasification or to chemically or biologically process discards, for the purpose of volume reduction, synthetic fuel production, or energy recovery. Transformation facility does not include a composting facility.

Turning unit:

A system used to compost large amounts of yard and kitchen wastes in one to two months — wastes are stored until enough are available to fill an entire bin. Materials are then chopped, moistened, and layered to ensure a hot compost. Piles are turned regularly *(weekly)* to enhance aeration.

UBC:

An acronym for used beverage cans. The acronym is limited typically to used aluminum cans.

Vector:

A living insect or other anthropoid or animal *(not human)* which transmits infectious disease from one person or animal to another.

Vermicompost:

Mixture of partially decomposed organic debris, bedding, worm castings, cocoons, worms and composting with worms.

Vermiculture:

The raising of earthworms under controlled conditions.

Virgin Materials:

Raw or primary materials.

Waste Diversion:

To divert discards, in accordance with all applicable federal, state and local requirements, from disposal at solid waste

landfills or transformation facilities through source reduction, recycling or composting.

Waste Exchange:

System for transferring discards from one company to another that can use it, to prevent them from becoming "wastes".

Waste Stream:

A term used to denote the discard output, transport, and disposal of an area, location,or facility.

White Goods:

Discarded, enamel-coated major appliances, such as washing machines, clothes dryers, hot water heaters, stoves and refrigerators.

Windrow:

An elongated, open air compost pile, usually about 6 to12 feet high and up to hundreds of feet long.

Wood Discards:

Discards consisting of wood pieces or particles which are generated from the manufacturing or production of wood products, harvesting, processing or storage of raw wood materials, or construction and demolition activities.

Worms Castings:

Undigested material, soil, and bacteria deposited through the anus of worms. Worm manure.

Xeriscaping:

Landscaping practices appropriate to a dry climate. This includes efficient irrigation, limiting turf areas, the use of water-efficient plants, and the use of mulches. Xeriscaping generally relies on slower growing or otherwise less litter-producing landscape practices.

Yard Trimmings:

Any materials generated from the maintenance or alteration of public, commercial or residential landscapes including, but not limited to, yard clippings, leaves, tree trimmings, prunings, brush, and weeds.

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