



COMPOSTING 101

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Why compost?

Composting recycles or "downcycles" organic household and yard waste into an extremely useful end-product called **compost**. Examples are fruit or vegetable kitchen waste and yard clippings. Ultimately this permits the return of needed organic matter and nutrients into the foodchain and reduces the amount of "green" waste going into landfills.

It is important to distinguish between terms such as "biodegradable", "compostable", and "compost-compatible".

- A **biodegradable** material is capable of being broken down completely under the action of microorganisms into carbon dioxide, water and biomass. It may take a very long time for a material to biodegrade depending on its environment (e.g. hardwood in an arid area), but it ultimately breaks down completely.
- A **compostable** material biodegrades substantially under composting conditions, into carbon dioxide, methane, water and compost biomass. Compost biomass refers to the portion of the material that is metabolized by the microorganisms and which is incorporated into the cellular structure of the organisms or converted into humic acids etc. Compost biomass residues from a compostable material are fully biodegradable. "Compostable" is thus a subset of "biodegradable". The size of the material is a factor in determining compostability because it affects the rate of degradation. Large pieces of hardwood may not be compostable under a specific set of composting conditions, whereas sawdust of the same type of wood may be.
- A **compost-compatible** material does not have to be compostable or even biodegradable. It may biodegrade too slowly to be compostable itself, or it may not biodegrade at all. However, it is not readily distinguishable from the compost on a macroscopic scale and does not have a deleterious effect on the compost (e.g. it is not a biocide). Compost-compatible materials are generally inert and are present in compost at relatively low levels. Examples of compost-compatible materials include sand particles and inert particles of plastic.

Although composting has historically focussed on creating garden-ready soil, it is becoming more important as a tool for reducing the solid waste stream. More than 60 percent of household waste in the United States is recyclable or compostable. But Americans only compost 8 percent of their waste. Surveys have shown that the #1 reason Americans don't compost their waste is because they feel the process is complicated, time-consuming or requires special equipment. However, especially in rural areas, much of the solid waste could be removed from the waste stream by promoting "extremely passive composting" where consumers simply discard their yard waste and kitchen scraps on their own land, regardless of whether the material is ever re-used as "compost".

Materials

Many different materials are suitable for composting organisms. Composters often refer to the carbon to nitrogen ratio requirements; some materials contain high amounts of carbon in the form of cellulose which the bacteria need for their energy. Other materials contain nitrogen in the form of protein, which provide nutrients for the energy exchanges. It would however be an over-simplification to describe composting as about carbon and nitrogen, as is often portrayed in popular literature. Elemental carbon - such as charcoal - is not compostable nor is a pure form of nitrogen, even in combination with carbon. Not only this, but a great variety of man-made, carbon-containing products, including many textiles and plastics are not compostable.

For home-scale composting, mixing the materials as they are added increases the rate of decomposition, but it can be easier to place the materials in alternating layers, approximately 6 inches thick, to help estimate the quantities. Keeping carbon and nitrogen sources separated in the pile can slow down the process, but decomposition will still occur.

Some people put special materials and activators into their compost. A light dusting of agricultural lime can curb excessive acidity, especially with food waste. Seaweed meal provides a ready source of trace elements. Finely pulverized rock (rock flour or rock dust) can also provide minerals, while clay and leached rock dust are poor in trace minerals.

Some materials are best left to a “commercial” composting system, as they decompose slower, attract pests and require higher temperatures to kill disease causing organisms than backyard composting provides. These materials include meat, dairy products, eggs, restaurant grease and cooking oil.

Aerated composting is an efficient form of composting from the chemical point of view as it produces ultimately only energy in the form of waste heat and CO_2 and H_2O . With aerated composting, fresh air (i.e. oxygen) is introduced throughout the mix of materials using any appropriate mechanism. The air stimulates the microorganisms that are already in the mix, and their by-product is heat. In a properly operated compost system, pile temperatures are sufficient to stabilize the raw material, and the oxygen-rich conditions within the core of the pile eliminate offensive odors. High temperatures also destroy fly larvae and weed seeds, yielding a safe, high-quality finished product.

Finally, aeration expedites the composting process through the mechanism of heating; elevated heat will drive biochemical processes faster, so that a finished product can be rendered in 60 to 120 days. Aerated compost is an excellent source of macro- and micro-nutrients as well as stable organic matter, all of which support healthy plant growth. In addition, the micro-organisms in compost aid in the suppression of plant diseases. Finally, compost retains water extremely well resulting in improved drought resistance, a longer growing season, and reduced soil erosion.

Passive Composting

Passive composting is composting in which the work needed to mix and turn the compost pile is kept to a minimum, and often as a result, the temperatures never reach much above 86 °F. It is slower but is the more common type of composting in most domestic garden compost bins. Kitchen scraps are put in the garden compost bin and left untended. This scrap bin can have a very high water content which reduces aeration, and so becomes odorous. To improve drainage and airflow, a gardener can mix in wood chips, small pieces of bark, leaves or twigs, or make physical holes through the pile.

Backyard composting

Home composters use a range of techniques, varying from extremely passive (throw everything in a pile and leave it for a year or two) to extremely active (monitor the temperature, turn the pile regularly, and adjust the ingredients over time). Some composters use mineral powders to absorb smells, although a well-maintained pile seldom has bad odors.

Moisture & Heat

An effective compost pile is about as damp as a well wrung-out sponge. This provides the moisture that all life requires. Microorganisms vary by their ideal temperature and the heat they generate as they digest. Mesophilic bacteria survive best at temperatures of 20 to 44 °C (70 to 120 °F). Thermophilic (heat-surviving) bacteria grow optimally at around 55°C (130 °F), and can attain the fastest decomposition, since metabolic processes proceed more rapidly under higher temperatures. Elevated temperature is also preferred since it causes the most rapid plant disease reduction, and is more destructive of weed seeds.

The necessary material should be added, or the pile should be turned to aerate it and bring the outer layers inside and vice versa. You should add water at this time to help keep the pile damp. One guideline is to turn the pile when the high temperature has begun to drop, indicating that the food source for the fastest-acting bacteria (in the center of the pile) has been largely consumed. When turning the pile does not cause a temperature rise, it brings no further advantage.

Bin/Pile Information

Composting can be practiced in most backyards in a homemade or manufactured composting bin or simply an open pile. Businesses, schools, and other facilities can also easily compost.

Homemade bins can be constructed out of scrap wood, chicken wire, or even old garbage cans (with holes punched in the sides and bottom).

Manufactured bins include turning units, hoops, cones, and stacking bins. These can be purchased from retail or mail order businesses. Take the time to consider your options and then select a bin that best fits your needs. If you would prefer to build your own bin, you can get instructions from California Integrated Waste Management Board publication #442-95-054 (www.ciwmb.ca.gov/Publications/Organics/44295054.pdf).

How to Compost

While a multitude of organisms, fungus and bacteria are involved in the overall process, there are four basic ingredients for composting: nitrogen, carbon, water and air. Composting is a lot like cooking, and the easiest compost recipe calls for blending roughly equal parts of green or wet material (which is high in nitrogen) and brown or dry material (which is high in carbon). Simply layer or mix these materials in a pile or enclosure; chop or shred large pieces to 12 inches or shorter. Water and fluff to add air. Then leave it to the microorganisms that will break down the material over time.

Nitrogen

Green materials such as grass clippings and landscape trimmings are ideal sources of nitrogen for composting. Vegetable and fruit trimmings and peels can also provide nitrogen. To reduce the potential for pests or odors, it is best to avoid meat or dairy scraps and bury any food scraps deep within the compost pile.

Carbon

Brown (dry) yard and garden material such as dry leaves, twigs, or hay can provide the carbon balance for a compost pile. Chop or shred large pieces to 12 inches or shorter (thick, woody branches should be chipped, ground up, or left out). Untreated wood chips and sawdust are a powerful carbon source, which may be useful if the pile contains excess nitrogen.

Water

One of the most common mistakes in composting is letting the pile get too dry. Your compost pile should be moist as a wrung-out sponge. Moisture content of 40 to 60 percent is preferable. To test for adequate moisture, reach into your compost pile and grab a handful of material and squeeze it; if a few drops of water come out, it's probably got enough moisture, if it doesn't, add water. When you water, it is best to

put a hose into the pile so that you aren't just wetting the top. You can also water as you are turning the pile. During dry weather, you may have to add water regularly. During wet weather, you may need to cover your pile. A properly constructed compost pile will drain excess water and not become soggy.

Air

The bacteria and fungus that are in your compost pile need oxygen to live and work. If your pile is too dense or becomes too wet, the air supply to the inside is cut off and the beneficial organisms die. Decomposition will slow and an offensive odor may arise. To avoid this and speed the process, turn and fluff the pile with a pitchfork often, perhaps weekly. You can also turn the pile by just re-piling it into a new pile; many composting bins make this easy to do by coming apart so you can easily re-pile the old pile back into the bin.

Size

Ideally, the compost pile should be at least three feet long by three feet wide by three feet high (one cubic yard). This size provides enough food and insulation to keep the organisms warm and happy and working hard. However, piles can be larger or smaller and work just fine if managed well.

Composting Techniques

Composting can be done "gourmet" style, requiring more effort, with quick results-- or can be done more casually. Both ways will have a positive effect on the environment and produce usable compost. It just depends on how much time you want to spend with your compost pile and how fast you want the compost.

"Gourmet" compost piles that have the right blend of nitrogen (greens) and carbon (browns) and are kept moist and fluffed regularly, will heat up to temperatures of 120 to 140 degrees Fahrenheit. The high temperature will kill most weed seeds and speed up the decomposition process so that the compost may be ready in 2 to 3 months or less.

"Casual" compost piles are also quite workable since compost will "happen" even if you just pile on yard and food waste, water sporadically, and wait. The pile won't get as hot, so it won't decompose as quickly and may not kill weed seeds. Casual composting can take several months.

If you are thinking about starting a "casual" compost pile in your back yard, you may want to familiarize yourself with the critters taking up residence in your pile.

"No-turn" Composting

The biggest chore with composting is turning the pile from time to time. However, with 'no-turn composting', your compost can be aerated without turning. The secret is to thoroughly mix in enough coarse material, like straw, when building the pile. The compost will develop as fast as if it were turned regularly, and studies show

that the nitrogen level may be even higher than turned compost. With 'no-turn' composting, add new materials to the top of the pile, and harvest fresh compost from the bottom.

Composting leaves

If you have too many leaves to incorporate into the compost pile, you can simply compost the leaves separately. Locate the pile where drainage is adequate; a shaded area will help keep the surface moist. The leaf pile should be at least 4 feet in diameter and 3 feet high. The pile should be damp enough that when a sample taken from the interior is squeezed by hand, a few drops of moisture will appear. The pile should not be packed too tightly.

The pile will compost in 4 - 6 months, with the material being dark and crumbly. Leaf compost is best used as an organic soil amendment and conditioner; it is not normally used as a fertilizer because it is low in nutrients.

How to Tell When it's Done

Your compost is finished when the original material has been transformed into a uniform, dark brown, crumbly product with a pleasant, earthy aroma. There may be a few chunks of woody material left; these can be screened out and put back into a new pile.

You may want to stop adding to your compost pile after it gets to optimal size (see above) and start a new pile so that your first pile can finish decomposing (during which time the temperature will drop).

Backyard composting is best learned by doing. Through practice and observation you will find what works best for your home situation, and you can modify the process to suit your needs. There are also a number of books written on backyard composting; check your local library or bookstore.

Backyard Composting Dos:

- Do chop compost materials into small pieces, which break down faster.
- Do cover food waste with soil or dry leaves to discourage flies.
- Do cover compost piles in winter and prolonged periods of heavy rain.
- Do use compost as a soil additive, and not as the 100 percent growing medium.
- Do add grass clippings and leaves gradually with other ingredients, or break them apart first.
- Do cover new additions to the compost pile with dry grass clippings or similar mulch.
- Do keep a large plastic container for kitchen waste, with a lid and a handle under the sink. Chop up any large chunks before you toss them in. When the container is full, then empty it into the compost pile. This reduces the number of trips you'll have to make.
- Do add garden soil to your compost. A layer of soil will help mask any odors, and microorganisms in the soil will accelerate the composting process.
- Do add lime or calcium to discourage flies.
- Do add sawdust to compost; but it should be mixed or scattered thinly to avoid clumping. Be sure sawdust is clean, with no machine oil or chain oil residues from cutting equipment.

Backyard Composting Don'ts:

- Do not add meat scraps, bones, fish scraps, grease, pet waste, diseased plant materials or lawn clippings that have been sprayed with chemicals.
- Do not add perennial weeds (they can be spread with the compost) or diseased plants.
- Do not compost banana peels, peach peels and orange rinds, which may contain pesticide residue.
- Do not add black walnut leaves.
- Do not compost rhubarb leaves-they contain chemicals that may be toxic to organisms in the soil if the leaves haven't fully decomposed before you use the compost.
- Do not add invasive plants or weeds with persistent root systems or seeds (weeds in flower are fine).



Troubleshooting

Problem	Solution
Bad odor (not enough air circulation or pile too wet)	Turn pile; add coarse, dry material such as straw and shredded leaves
Too dry	Mix in a few handfuls of soil and some moist kitchen scraps or coffee grounds; water pile, cover and let sit. Check weekly; if it's still too dry, repeat
Too wet	Turn pile and add dry materials such as straw, dry leaves (not fresh), sawdust, even lint from the dryer. Keep it uncovered (except in periods of prolonged heavy rain) and check weekly. Apply the touch test: a handful of material should be as moist as a wrung-out sponge
Problem	Solution
Too cold or too weedy	To heat things up (which helps to kill weed seeds), add some high-nitrogen materials such as kitchen scraps, fresh grass clippings or manure
Failure to decompose	If there are layers of fresh leaves or grass clippings, break them up by mixing in straw, hay (but no hay seeds) or dry leaves. If large chunks are not decomposing, sift pile through a screen or use a soil shredder. The resulting fine material can be used as the base for a new compost heap
Damp and warm in the middle but dry elsewhere	Pile is too small (minimum 3 feet long, 3 feet wide and 3 feet high; collect more material and mix it in. Or turn the heap more frequently
Damp and sweet-smelling but will not heat up	Needs more nitrogen; mix in fresh grass clippings
Pest infestations (dogs, rodents, insects such as flies, bees, wasps and ants)	Improper food scraps added; don't add meat, fats, bones or pet waste. Cover food scraps with soil or other carbon materials; turn pile weekly
Pile is easily accessible and provides daytime hiding place and breeding ground for slugs	Remove slugs and slug eggs from pile (eggs look like very small clusters of pearls). Locate compost pile far from vegetable gardens and/or create barriers around pile/garden (traps, copper flashing . . .)