Backyard Compost Workshop

What’s in your compost pile?
DECOMPOSERS IN A COMPOST PILE

Compost is produced through the hard work of a number of different decomposer organisms that break down organic material and convert it into finished compost. These decomposers are naturally present on the organic materials that you add to your compost pile, and also exist in the areas surrounding your compost system.

COMPOST ECOSYSTEM

Decomposers in a compost pile are part of a complex compost ecosystem in which food, water, air, and shelter are provided by the material within the compost pile. If any of those essential ingredients are missing, the organisms either slow down or stop working altogether. This web of interdependence is the driving force behind the production of compost.

Some organisms feed on decomposing plant materials, while others feed on other organisms. The two main categories of decomposers are chemical and physical decomposers.

Chemical decomposers work by using chemicals in their bodies to break down organic matter into simple compounds for energy. This is similar to how the acids in our stomachs dissolve the food we eat. Chemical decomposers are mostly microorganisms that cannot be seen without a microscope. Examples of chemical decomposers include bacteria, protozoa, and fungi.

Bacteria are the most abundant of the microorganisms found in a compost pile and perform the majority of the decomposition. An important by-product of their work is the generation of heat, which can warm up the pile and attract other heat-loving organisms to assist with the breakdown process.

Physical decomposers work by feeding on the organic materials in a pile. Similar to how we use our teeth to break up large pieces of food, physical decomposers chew, grind, and squeeze the materials into smaller pieces. After digestion, they excrete waste products which are then broken down even further by the chemical decomposers. Physical decomposers are mostly macroorganisms that can be seen without a microscope. Examples of physical decomposers are worms, mites, flies, and snails.

Earthworms do a large amount of the decomposition work among the macroorganisms. Several species of worms dig tunnels and feed on the decomposing materials in the compost pile. The spaces that the worms create as they move through the compost pile allow air, water, and nutrients to circulate, creating the necessary conditions for many of the other organisms to thrive.

COMPOST FOOD WEB

All of the decomposer organisms in the compost ecosystem are linked by a “what eats what” food web, wherein organisms are classified according to what they eat. There are three levels of consumers in the compost food web: primary, secondary, and tertiary. This web structure keeps the different populations under control and maintains a healthy and balanced compost pile.

Primary (first level) consumers feed directly on dead plant materials (and other decomposers that have died) in the compost pile. This group consists of chemical decomposers such as bacteria and fungi, but also includes larger physical decomposers such as snails, slugs, beetle mites, worms, and flies.

Secondary (second level) consumers feed on primary consumers and their waste products. This group consists of physical decomposers which include springtails, mold mites, nematodes.

Tertiary (third level) consumers feed on secondary (and sometimes tertiary!) consumers. This group consists of fast-moving consumers which include centipedes, pseudoscorpions, predatory mites, and rove beetles.
Decomposer organisms in a compost pile are an important part of the complex ecosystem that is required to decompose organic waste. Within this ecosystem, decomposer organisms are classified according to what they eat, or consume. The structure of this food chain keeps different populations under control, maintaining a healthy and balanced compost pile.

The decomposer food chain shows decomposer organisms according to what they eat and what eats them. Follow the guide below to identify decomposers in your compost pile and learn who may be eating whom.
Why Compost?

- Most efficient way to reduce food & yard waste
- Sustainably “closes the loop”, returning nutrients to the soil
- Mitigates climate change
  - Organics in anaerobic environment of landfill → methane production
- Reduces water pollution
  - Landfills leak toxic leachate
- Finished compost = gardeners’ “black gold”
  - Reduces the need for chemical fertilizers
  - Suppresses plant diseases and pests
  - Promotes higher yield
  - Improves water retention in soil & reduces erosion

Essential Habits for a Successful Backyard Compost Bin

Following these basic rules will go a long way in maintaining an effective compost pile. Most common problems – such as wildlife infestations, unpleasant odors, and slow rates of decomposition – can be avoided or remedied by adhering to these guidelines. For more information, visit www.BoulderCountyRecycles.org.

1) **Keep a 50/50 ratio of “browns” and “greens” by volume in your pile at all times.** If you add a handful of kitchen scraps (which are “greens”) to your pile, you’ll need to toss in a handful of “browns” (like dried leaves). This means you need to keep a stash of browns handy at all times.

2) **All materials going into your bin must be cut down to 1”-2” in size.** This is the ideal size – smaller isn’t better! There are some exceptions to this rule; for instance, coffee grounds are small particles, but are great for your bin in moderation.

3) **Feed your pile a balanced diet of greens.** In other words, no single food item should be the bulk of your bin’s “greens”. Usually this isn’t an issue, as the average household produces a variety of food scraps. This mostly applies to greens. While a variety of browns is great (dried leaves, dried grass clippings, twigs/sticks, etc.), dried leaves can be used as all your browns.

4) **Don’t “dump and run”.** Dumping your kitchen scraps on the top of your compost pile and walking away is the worst thing you can do, generating odors and attracting wildlife. Instead, when you head outside with your kitchen scraps, do the following:
   a. Remove the lid of your bin
   b. Dig a little pit in your compost pile
   c. Empty your kitchen scraps into the pit
   d. Add an equal volume of browns
   e. Cover up the material you’ve just added
   f. Put the lid back on

5) **Keep your pile damp as a wrung-out sponge, and turn often.**
   a. Turning should be done once a week, or once a month at the very least. When you head out to turn your pile, bring the garden hose over, stick it in the pile, and soak it for a minute or so.
   b. Then mix, mix, mix with a pitchfork.
   c. Grab a handful of stuff from your bin. Squeeze. When you let go, it should stick to your hand a bit. If water runs down your arm, it’s too damp (but will dry out in no time!). If nothing sticks to your hand, it needs to be watered and mixed again until it is damp as a wrung-out sponge.
What are Browns and Greens?

Food for your compost pile!

50/50 mix by volume

1-2” sized pieces

Browns (Carbon)
Dry, Woody, Crunchy

✓ Dried fallen leaves (ok to have all browns from this)
✓ Dried grass clippings
✓ Brown garden waste
✓ Twigs and sticks
✓ Small woodchips and pieces (not chemically treated)
✓ Straw
✓ Dried out animal bedding
✓ Natural fibers like cotton, linen, & wool (cut into small pieces)
✓ Dryer lint
✓ Shredded cardboard containers
✓ Newspaper (1” strips, no glossy ads)
✓ Dried pine needles (only small amounts)
✓ Sawdust (only small amounts)
✓ Napkins and paper towels

Greens (Nitrogen)
Moist, Fresh, More Recently Alive

✓ Fresh green plant trimmings
✓ Green grass clippings
✓ Fruit & vegetable waste from your kitchen
✓ Coffee grounds & filters
✓ Tea bags
✓ Green garden waste
✓ Breads and pastas (no fatty sauces or spreads)
✓ Eggshells
✓ Manure of plant eaters
✓ Hair (human & animal)
✓ Vacuum wastes
✓ Spent hops
✓ Most weeds (nothing gone to seed)
✓ Hay
✓ Dead insects

Do Not Backyard Compost

✗ Plastic-coated paper
✗ Treated wood or sawdust
✗ Pesticides or poisons
✗ Used kitty litter
✗ Human waste
✗ Waste of omnivores or carnivores

✗ Grease, fat, oil
✗ Coal or charcoal ashes
✗ Particle board or plywood
✗ Meat & bones
✗ Dairy products
✗ Heavily colored paper
✗ Shredded office paper

✗ Chemically treated lawn clippings
✗ Diseased plants
✗ Weeds gone to seed
✗ Ground bones or bone meal
✗ Compostable tableware
✗ Compostable bags

Items written in green should be commercially composted instead

What you put in your compost is what you get out!
Where to Get Extra Composting Materials

Need more greens for your browns? Need to start or revive your bin? Check with local vendors - many businesses give away great compostable material!

**Greens (Nitrogen)**

- Barbers: if concerned, try to make sure hair was not color-treated or permed
- Grocery Stores: usually stores will set aside bad produce and trimmings of sellable produce
- Pet Groomers: if concerned, find out if pet was sprayed with any flea-killing spray
- Juice Bars: Great place for pureed fruit, peels, and rinds
- Coffee shops: Call in morning, ask them to save the day’s coffee grounds for you
- Local farmers with chickens, rabbits, goats, cows: manure from herbivores is great to compost. Remember, you don’t want to use manure from any meat eater, including cats and dogs.
- Neighbors, friends: Ask them to save their produce scraps for you
- Breweries: Spent hops
- If not composting over the winter, can save your food scraps in the freezer

**Browns (Carbon)**

- Neighbors, friends: Ask them to save their leaves for you in the fall
- Leaf drop-off locations: Many cities have a leaf drop-off every fall, and composters frequently grab people as they enter these sites to get their bags of great, compostable leaves
- Yard waste collection sites: year-round yard waste drop-off centers. *Please visit their websites for locations, hours, and more info.*
  - Longmont
  - Superior
  - Boulder (Western Disposal)
  - Louisville
  - Nederland
  - Meeker Park/Allenspark
Soilsaver = #1 Recommended!!!

Get your bin at today’s workshop! Bins are only $55, cash or check only. Or contact Boulder County’s Resource Conservation Division at 720-564-2220 or resourceconservation@bouldercounty.org

Currently $97.00 on www.amazon.com

Features to Get
1. Solid wall construction
2. Locking lid
3. Fewer vent holes
4. Thick plastic build
5. Pieces held together by bolts, not plastic tabs
6. No bottom

Features to Avoid
1. Stacking pieces
2. Loose or no lid
3. Tumbling, turning bin
4. Large holes or vents
5. Anything not in direct contact with ground
6. Knock-offs of Soilsaver at Costco, etc.
7. Base plates (not required here)

Earth Machine or Compost Machine =
Next best recommended because cheaper, similarly priced, and works, but doesn’t hold up well.

This is a marketing ploy → by having a bottom door, compost will simply come out as finish material! Don’t be fooled!
Tools

Must at least have a pitchfork!

Compost Aerators

*Good tool options after you have a garden pitchfork*

<table>
<thead>
<tr>
<th>Best Metal Aerator</th>
<th>Alternative Metal Aerator</th>
<th>Best Plastic Aerator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Called the Yard Butler Compost Turner:</td>
<td>Bosmere Compost Aerator:</td>
<td>(Melanie’s favorite!)</td>
</tr>
<tr>
<td>Amazon.com ($20.87)</td>
<td>Amazon.com ($27.17)</td>
<td>Exaco Plastic Composting Tool</td>
</tr>
<tr>
<td>McGuckins ($29.99)</td>
<td></td>
<td>Amazon.com ($22.35)</td>
</tr>
<tr>
<td>Home Depot ($24.99)</td>
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</tbody>
</table>
Building A Backyard Compost Pile in Colorado

**Step 1 - Materials**

- Collect enough green and brown material to create a 1-cubic-yard (3’x3’) pile. If you don’t have enough materials for that, start with whatever materials you do have.
- Chop or shred the material to be 1-2” in size to increase surface area.

**Step 2 - Location**

- Pick the location of your pile that is close to you and the hose. Don’t make it too difficult to reach or you’ll never go. Ideal is a level space, in shade, but a sunny spot also works. Choose a site close to where material will be used.
- Pile must be in direct contact with the ground (on dirt or grass), not over weedcloth or on any gravel, stone, etc.

**Step 3 - Building a Compost Layer**

- Start the pile with a 3-inch layer of greens (nitrogen) material such as food waste or fresh grass clippings.
- Add onto the green layer a 3-inch layer of browns (carbon-based) material such as dried leaves.
- Mix the layers together with a pitchfork. Use the garden hose to make this compost layer damp as a wrung-out sponge (do squeeze test to make sure it’s the correct dampness).

**Step 4 - Repeat Step 3**

- Repeat by building another mixed layer (Step 3) on top of the first layer, and then repeat again, and again, until you either run out of either greens or browns, or the bin/pile is full.

**Step 5 - Cover**

- Put a locking, tight fitting lid over the pile on top of your bin.
- If not using a bin, use a tarp or an old piece of carpet to cover the pile to reduce evaporation, especially critical in dry Colorado.

**Caution**

- Despite what the internet says, **DO NOT add a layer of soil** or other compost or manure to the mix as a nitrogen starter.
- Only add a small handful of soil to your compost mix if you are using a tumbler/turning bin (one that is NOT in direct contact with the ground) or if you have extremely poor soil conditions (such as after new construction).
How to Use Compost

finished compost

Finished compost resembles dark, crumbly topsoil and should bear no resemblance to the original materials. Compost should have a pleasant, earthy smell to it. Using “unfinished” or immature material that contains food scraps can attract pests and can cause harm to young plants, so make sure your compost has fully decomposed before adding it to your garden beds.

how to tell if your compost is finished

The simplest way to tell if your compost is mature and ready to use is by doing the “bag test.” Put a handful of moist compost into a zip-lock bag and press out the air before sealing. Leave it for three days, then open the bag. If you detect an ammonia or sour odor, the microorganisms are still at work and you need to let your compost finish curing. Test another sample of compost again in a week.

using finished compost

There are various ways to utilize your finished compost. You can sprinkle compost on top or mix it into your flower and vegetable beds, gently rake compost into tree beds, blend it with potting soil to revitalize indoor plants, or spread it on top of the soil on your lawn as a soil amendment.

compost in the home garden

Adding compost to your garden helps improve the structure and overall health of your soil. It is rich in organic content and as such, will retain moisture and will increase your overall earthworm and microbial population, which will serve as biological controls against unwanted pests. In addition, compost will provide a slow release of macronutrients, which means that your plantings will get a steady supply of nutrients as needed rather than a one shot injection of conventional chemical fertilizers.

<table>
<thead>
<tr>
<th>USAGE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>amending soil</strong></td>
<td>Work one to two inches of compost into the top three to five inches of soil.</td>
</tr>
<tr>
<td><strong>growing vegetables</strong></td>
<td>Give your vegetable garden plenty of compost in the fall. Spread several inches of compost on top of the existing bed, then till it in come springtime. Put a handful of compost in each hole when you’re planting. Once plants begin to grow quickly, you can add a half-inch layer of compost around the base of the plants. Provide “heavy feeder” plants such as tomatoes, corn, and squash with half an inch of compost monthly—this will result in great produce!</td>
</tr>
<tr>
<td><strong>growing flowers</strong></td>
<td>In the spring, loosen the top few inches of annual and perennial beds and mix in a one-inch layer of compost. Or in the fall, apply a one-inch layer of compost as a mulch to protect plant roots from freezing and conserve moisture.</td>
</tr>
<tr>
<td><strong>replenishing soil in potted plants &amp; window boxes</strong></td>
<td>Even the best potting soil gets depleted of its nutrients as plants grow. To replenish nutrients, add an inch of compost to potted plants and window boxes twice a year. Or, make your own potting soil using two parts screened compost to one part sand or perlite.</td>
</tr>
</tbody>
</table>
### Using Finished Compost

#### Using Compost for Gardening Projects

<table>
<thead>
<tr>
<th>USAGE</th>
<th>WHAT TO DO</th>
</tr>
</thead>
</table>
| **rejuvenating lawn or turf** | When establishing new turf, incorporate up to three inches of compost into the existing soil base. If possible, till to a depth of five to eight inches before seeding. Otherwise, seed directly over the compost.  
On existing turf, you can treat bald spots by incorporating an inch of compost into the soil and then reseeding. This will fight compaction and help suppress soil-borne diseases.  
You can also topdress existing turf with as much as one-half inch finely screened compost. This is easiest with a spreader, but you can use a shovel for small areas where you want to add compost. Rake the compost evenly throughout the grass area to enable the compost to readily sift down to the soil. The compost will settle down into the soil, improving its structure and providing nutrients. Over time, this will mean less compaction, fewer bald spots, and a reduced need for synthetic fertilizers. |
| **tree planting** | When planting a new tree, it’s best to work one-half inch to one inch compost into the top two inches of soil from the trunk of the tree out to the dripline—the outermost parameter of the tree’s canopy. *(See image below)*  
Compost used in this way serves as a substitute for the layer of organic matter that naturally exists on the forest floor: it provides organic nutrients, reduces moisture loss, and keeps the soil cool.  
Don’t add compost to a freshly dug hole when planting a new tree, as applying compost in this way will discourage tree roots from going beyond the hole. |
| **tree and shrub maintenance (including NYC street trees)** | Apply compost as mulch to trees and shrubs to prevent weeds and make plants more drought resistant. Spread up to two inches of compost under the tree or shrub out to the drip line (the outermost leaves on a tree) or edge of the bed. This will help reduce moisture loss and stabilize soil temperature.  
You can also incorporate compost into the soil once or twice a year to provide organic nutrients. Before adding compost to compacted soils, gently cultivate the soil with a hand tool; this will prevent damage to shallow feeder roots while making nutrients more readily accessible to the trees or shrubs.  
Do not place compost or mulch directly against the bark of the tree or shrub or on exposed woody roots as this could cause rot and invite pests and disease. |
| **maintaining perennial & annual beds** | Spread one to two inches of compost on top in perennial and annual beds in the early spring or fall to prevent weeds from establishing and to make plants more drought-resistant. |
## COMPOST TROUBLESHOOTING GUIDE

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad odor (rotten smell)</td>
<td>Too much moisture</td>
<td>Turn the compost or add dry, porous material like leaves, straw, shredded cardboard or newspaper</td>
</tr>
<tr>
<td>Bad odor (ammonia smell)</td>
<td>Too much nitrogen compared to carbon</td>
<td>Add high-carbon materials like straw, sawdust, wood chips</td>
</tr>
<tr>
<td>Compacted leaves</td>
<td></td>
<td>Turn the compost or make the pile smaller</td>
</tr>
<tr>
<td>Inadequate air</td>
<td></td>
<td>Turn the compost</td>
</tr>
<tr>
<td>Low compost temperature</td>
<td>Pile is too small</td>
<td>Increase size, insulate sides</td>
</tr>
<tr>
<td></td>
<td>Too little moisture</td>
<td>Add water and turn the compost</td>
</tr>
<tr>
<td></td>
<td>Too much moisture</td>
<td>Turn the compost and mix in dry, brown materials</td>
</tr>
<tr>
<td></td>
<td>Too little air</td>
<td>Turn the compost</td>
</tr>
<tr>
<td></td>
<td>Lack of nitrogen</td>
<td>Mix in nitrogen source (greens): grass clippings, or manure</td>
</tr>
<tr>
<td></td>
<td>Cold weather</td>
<td>Increase pile size or insulate pile with a layer of straw or plastic</td>
</tr>
<tr>
<td></td>
<td>Particle size too large</td>
<td>Chip or grind materials</td>
</tr>
<tr>
<td>Pile is dry throughout</td>
<td>Not enough water; too much wood material</td>
<td>Turn pile and moisten material; add fresh green materials; cover pile</td>
</tr>
<tr>
<td>Compost pile is damp and warm only in middle</td>
<td>Pile is too small</td>
<td>Collect more material and mix the old ingredients into a new pile</td>
</tr>
<tr>
<td>Pest infestation: dogs, rodents, insects</td>
<td>Improper food scraps added</td>
<td>Don’t add meat, fats, bones or other animal products</td>
</tr>
<tr>
<td></td>
<td>Food scraps not covered</td>
<td>Place fruit and vegetable scraps in the center of pile, cover with soil or compost</td>
</tr>
<tr>
<td>Neighbor complains</td>
<td>Compost pile is ugly</td>
<td>Construct covered bin system to keep it neat</td>
</tr>
</tbody>
</table>
Composting Websites

**Overall Composting**

www.bouldercountyrecycles.org
Boulder County’s website for waste reduction. Has links to all kinds of info about composting, including where to buy a bin, upcoming workshops, etc.

www.ecocycle.org
Has a step-by-step guide on how to get started composting. Boulder-based zero waste non-profit organization.

www.ext.colostate.edu
CSU Extension office website for Boulder County. Contains all types of resources, including fact sheets on soil, gardening, composting, etc.

www.compostguide.com
A complete guide to composting.

www.epa.gov/composting
EPA’s website on composting.

www.planetnatural.com
A guide for the home gardener.

www.biocycle.net
Biocycle is the Journal of Composting & Organics Recycling...an industry standard.

www.gardeners.com
Great site to see all the different kinds of composting systems. Search for compost bins.

www.compostingcouncil.org
US Composting Council

**Worm Composting**

www.wormwoman.com
Website of Mary Appelhof, who wrote “Worms Eat My Garbage” Under construction. Check back for more.

www.redwormcomposting.com
Good overall about worm composting.

www.compost.css.cornell.edu/worms/basics.html
Good website about setting up a worm bin for a school group.
Eisenia fetida: Red Wiggler Worm

There are over seven thousand species of earthworms; however, one species in particular is well suited for indoor composting: *Eisenia fetida*. *Eisenia fetida* (also called red wiggler worm, tiger worm, manure worm, brandling worm, and a range of other names) are an important macrorganism decomposer in both indoor and outdoor composting systems.

red wiggler worm basics

Red wiggler worms live in the upper layer of soil where they feed on microorganisms and decaying organic matter. However, unlike other species of earthworms, *Eisenia fetida* don’t tunnel deeply or make permanent burrows. They reproduce quickly, thrive in habitats with high organic matter, can tolerate a wide range of temperatures and moisture conditions, and can live close to one another. An indoor worm bin mimics all of these natural conditions, which makes *Eisenia fetida* ideal for indoor composting.

fun worm facts

- Worms do not have eyes; they have cells in the front part of their bodies that can detect light.
- Worms do not have teeth; they grind up food by using the grit in their gizzard.
- Worms living in an indoor worm bin (*Eisenia fetida*) can eat half their body weight in food scraps every day!
- Worms have both male and female reproductive organs but still need another worm to reproduce.
- *Eisenia fetida* have 5 “heart-like” organs called aortic arches.
- *Eisenia fetida* start reproducing when they are about 2 months old.
- One mature worm can produce about 100 worms in a year.
- Worms live up to one year.
- Worms “breathe” through their skin, so it is very important to keep them and their environment moist, but not sopping wet as they can drown if it’s too wet.
- If you hold a worm long enough, you will likely see a yellow secretion on your hand, called coelomic fluid.
- Coelomic fluid is thought to be a defense mechanism against predators as the liquid can smell bad. This bad smell is thought to be the basis of their name *fetida* or *foetida* which is the Latin scientific term used for many foul-smelling species.
- Coelomic fluid is also a way for worms to remoisten their bodies when conditions are dry.
color a wiggly worm!

Color in the *Eisenia fetida* (red worm) image below to help you to identify the various parts of the worm.

- **esophagus:** connects pharynx with the crop
- **crop:** stores food in the earthworm's digestive system
- **intestine:** performs the final digestion and absorption of the nutrients from food
- **mouth:** entrance to the digestive tract of an earthworm
- **anterior:** head of worm
- **cerebral ganglion:** nerve bundle that serves as the brain
- **5 “hearts” (aortic arches):** regulate blood flow and produce a pulse
- **pharynx:** pushes food down into the digestive system
- **gizzard:** uses sandy grit from the soil to grind up the food
- **clitellum:** used in reproduction; makes mucus to form an egg-carrying cocoon; only found on adult worms
- **dorsal blood vessels:** carry blood to the front of the worm's body
- **ventral blood vessels:** carry blood to the back of the worm’s body
- **segments:** small rings that surround the worm’s body
- **posterior:** tail of worm
- **anus:** where worm manure (castings) are expelled from the worm
- **bristles (setae):** tiny hairs that help the earthworm to move and sense the environment