

Handbook for

# Composting Onsite at Schools

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## About This Handbook

The handbook introduces the basics of onsite composting at K-12 schools that have been equipped with 2- and 3-bin composting systems. Learn why composting is important, the basic ingredients needed to produce good compost, steps to getting started, and how to troubleshoot should problems arise.

Unlike many food waste collection program in the cafeterias for offsite composting at an industrial site, onsite garden composting systems cannot handle all food waste. Meat, cooked food, dairy, and grease and oil are specifically excluded!

Onsite composting does not have to be a lot of work. The decomposer organisms are the work force doing most of the work. But by putting in more effort, the rate of composting can accelerate. Good compost can be made with very little effort – it just takes longer. The most rapid composting happens when you start with mixed brown and green materials, regularly turn (mix) the pile, and control the water content.

Questions? How can we improve this guide?

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## What & Why Compost?

### What Is Compost & Composting?

**COMPOST** is a dark, crumbly, earthy-smelling material produced by the natural decomposition of organic materials such as garden waste and food scraps. When added to soil, compost improves its biological, chemical, and physical characteristics, making the soil a better home for plants and beneficial soil organisms.

**COMPOSTING** is the transformation of raw organic material into compost, a humus-rich substance. It is a natural process that is driven by microorganisms, like bacteria and fungi, which use organic matter for energy. Composting is the way that nature recycles! We can speed the process by creating the ideal conditions for the microbes to thrive: adequate airflow, sufficient moisture, and the right recipe or food!



### Why Should We Compost at Schools?

**STUDENT ENGAGEMENT** – Composting is a direct way to be active in caring for the earth and our community. Students learn firsthand how garden waste and food scraps can be recycled into compost to grow more food.

**SOIL** – Compost enhances soil structure, fertility and health, and the ability of plants to fight pests and diseases. Without healthy soils, we cannot have healthy foods.

**WATER** – Compost helps soil hold more water, reducing the need for watering.

**WASTE REDUCTION** – Composting diverts garbage from landfills and trash burners, which are highly polluting.

**CLIMATE PROTECTION** – As garbage decomposes in landfills, it emits methane, a very potent greenhouse gas. But when added to soil, compost sequesters carbon. It's a win-win!

**CURRICULUM** – Soil-food-web curriculum goals can be reinforced in an active learning environment.







## Composting Basics: What You Need to Know

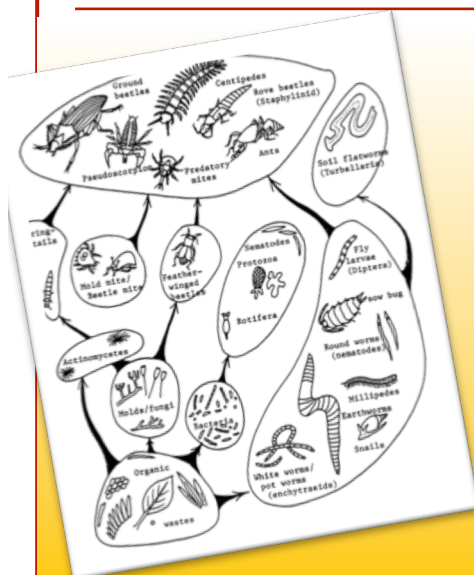
There are many different types and styles of composting. Composting is a biological process that can be sped up by making the decomposer organisms happy. Multiple 2- and 3-bin composting systems are designed to facilitate several stages of decomposition. But they are also designed to keep the process tidy, deter unwanted critters, and to retain heat and moisture during decomposition. When the first bin has new material or is filling up, the other bin(s) can be finishing.

### PASSIVE OR COLD COMPOSTING

Passive or cold composting is a low-effort method of composting that involves little attention to turning and watering or otherwise optimizing composting conditions. Because the pile may dry out, materials won't break down as quickly. Weed seeds may persist as temperatures in the 130-153°F range are needed to kill them. It may take more than a year for finished compost.

### ACTIVE OR HOT COMPOSTING

Active or hot composting is a method of composting that involves more attention. In order to reach optimal temperatures to kill weed seeds and speed the process, you will need to regularly turn the pile and maintain adequate moisture. You can expect finished compost in 3 to 5 months.



## COMPOST DECOMPOSERS

### MICROORGANISMS

Microorganisms, or microbes, are the powerhouses of your pile, chemically transforming raw materials into humus. They are too small to see. In a pile, BACTERIA rush to eat up the fruit and vegetable scraps, which are full of simple and energy-rich components such as sugars and starches. As they work, they generate heat in the pile and allow other microorganisms to begin their work. ACTINOBACTERIA and FUNGI both work to break down leaves, stems, nut shells, bark, and wood, which are full of more complex components called cellulose, hemicellulose, and lignin.

### MACROORGANISMS

Macroorganisms, are larger organisms that mostly act as “shredders,” chewing materials into smaller pieces that are more accessible to microbes. Animals and insects such as snails, earthworms, nematodes, millipedes, flies, and beetles are “shredders.”

## To Make Good Compost, You Need:

### GREENS



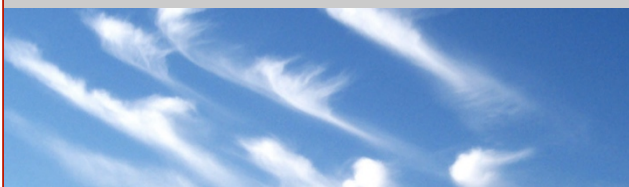
### BROWNS



### WATER



### AIR



### GREENS

Greens are fresh materials high in nitrogen such as raw vegetable and fruit scraps, coffee grounds, and fresh garden waste (such as tomatoes or kale leaves).

Microbes need carbon and nitrogen to grow and reproduce. High-nitrogen materials help the microbes produce proteins. They can also help provide needed moisture in the pile. Too many greens, however, can lead to odor problems. When in doubt, add more browns.

### BROWNS

Browns are materials high in carbon such as dried leaves, wood chips and shavings, straw, shredded newspaper, and woody garden waste (such as tomato plant stalks). High-carbon materials create air pockets in the pile and a balanced diet for the decomposer organisms. Browns provide carbohydrates, the primary energy source for microbes.

### WATER

Adequate moisture is essential for the microbes to thrive. The bacteria and fungi that drive the process live and swim in a water layer around the organic particles, and rely on that water to transport dissolved nutrients needed for their metabolic activities. Too little water, the microbes will go dormant. Too much water, the microbes will drown. The ideal moisture content is 50% to 60%, which feels like a wrung out sponge. Squeeze a handful of your mixed material. You want water droplets to appear between your knuckles but not to run down your arm.

### AIR

Just like us, decomposer organisms “breathe.” Composting is an aerobic, or oxygen-requiring process. If oxygen levels in the pile drop too low, the pile can go “anaerobic” and start to smell. Creating air and airflow in the pile are important.



# Typical Materials You Can and Cannot Compost Onsite at Schools – CHECK WITH YOUR SCHOOL

## YES!



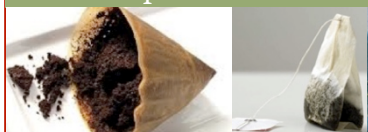
### GREENS



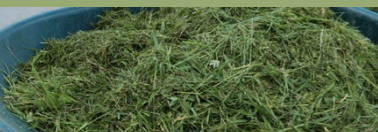
Fresh vegetable and fruit scraps



Egg shells (crush first)



Coffee grounds & filters, tea bags



Grass clippings (untreated with pesticides)



Flowers



Weeds (avoid weed seeds unless hot composting)

### BROWNS



Leaves (dry)



Wood chips



Straw (untreated)



Shredded paper



Plant stalks and branches



Wood shavings (untreated)

## NO!



Plate/lunch tray scrapings of cooked food



Cheese and other dairy products



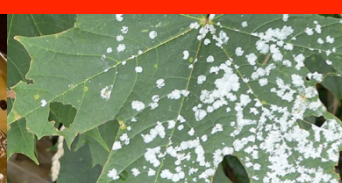
Meat (of any kind)



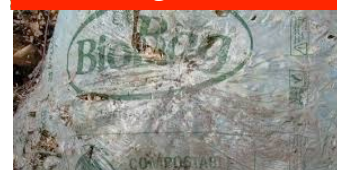
Bones



Oils and grease



Diseased plants



Compostable plastic bags



Glossy/coated paper



Dog, cat, or other animal poop



Treated or painted wood



## 2- and 3-Bin School Garden Composting Systems

Many school gardens are utilizing 2- to 3-bin enclosed wooden composting systems. ECO City Farms designed the 2-bin system shown below on the left. Urban Farm Plans designed the 3-bin system, known as the Compost Knox, shown in the right two photos. Each single bin is a 4 ft. x 4 ft. x 4 ft. cube. These systems are constructed to protect against rats and other animals, allow for airflow through the pile, and to facilitate access. The wood slats at the front of the bin can be easily removed to provide access to the bottom of each cube. The systems are raised off the ground to allow air to circulate and prevent water from accumulating at the bottom of the pile. The hardware cloth (a metal mesh cloth) helps make the system rat resistant.



### RULES OF THUMB FOR WORKING WITH THESE BIN SYSTEMS

- ✓ Don't allow anyone to stand on the system.
- ✓ If your wooden bins have pavers at the bottom, clean out the gaps between them every once in awhile to maintain airflow.
- ✓ Fix the bins if there are any holes in the hardware cloth at the sides or if the wooden slats begin to warp. Holes and gaps may allow pests to enter.
- ✓ Always close the bins when you are done turning or adding materials.

## Five Steps to Get Started

### Step 1: Clarify goals, method, team

There is no one way to compost. Do you prefer a more passive system that doesn't require as much attention to turning and watering? Or do you prefer the other end of the spectrum, where the composting process is optimized, hot temperatures are reached to kill weed seeds and any pathogens, and students are engaged in measuring and monitoring temperatures and weighing how much food scraps are diverted from landfills? Or perhaps you are somewhere in between. Composting is flexible! You can decide how much attention and activity to devote to it.

Who can help you? Are you one person or a team of teachers? How will students be engaged? Can parents help out? Do you have the support of your kitchen and custodial staff?

### Step 2: Assemble Your Tools

Regardless of where you are on the spectrum of effort, you will need some basic supplies and tools such as buckets to collect materials, a pitch fork and shovel for mixing and moving material, and shears or some other way to chop up long plant stalks.

If you opt for hot composting, a temperature probe is recommended (available for as little as \$15) along with a binder for tracking data.

### USEFUL TOOLS

- ✓ Pitchforks for mixing materials\*
  - ✓ Buckets for chopping and measuring materials\*
  - ✓ Shovels for chipping and mixing materials \*
  - ✓ Watering can or hose\*
  - ✓ Temperature probe / compost thermometer
  - ✓ Hardware cloth OR a bin to store browns
  - ✓ Sifter for sifting finished compost
  - ✓ Scales for weighing material composted as well as finished compost
  - ✓ Wheelbarrows for transporting heavy organic material
  - ✓ A mixing tray or a tarp, to make turning from bin to bin easier.
- Otherwise, you can mix in the bin. \* most important





### Step 3: Select and Collect Ingredients

Determine what green or high-nitrogen materials you have available and how you will collect these. Five-gallon buckets or small pails could be used in classrooms to collect leftover fruit or veggie scraps from snack time. Can coffee and coffee filters be collected from staff rooms? The materials you target for collection should be guided by your goals and the human labor you anticipate expending.

It is essential to have an adequate supply of carbon-rich material on hand when composting wet and putrescible food scraps. Best management practices in composting involve developing a blend of materials to create ideal conditions for microbes to function.

From where will you source your carbon or brown materials? How will you ensure you have an adequate supply onsite?



### Step 4: Determine Your Compost Recipe

The decomposer organisms in the compost pile need a balanced diet of carbon to nitrogen (this is often referred to as the C:N ratio). They need carbon for energy and nitrogen for protein production.

What we call “greens” are nitrogen rich, and materials referred to as “browns” are carbon rich. Though this categorization is a useful rule of thumb, not all “greens” are literally green, and not all “browns” are literally brown. Coffee grounds, for example, are high in nitrogen and considered a “green” material for the purpose of composting.

For every 1 bucket or wheelbarrow of high-nitrogen green material, add 2 to 3 buckets or wheelbarrows of high-carbon brown material.

You also want to pay attention to particle size and how dense the material is. If the mix is too heavy and dense, there will not be sufficient air pockets to allow airflow through the pile. Wood chips and cut up plant stalks, branches, or straw can help increase porosity in the pile and achieve the right “bulk density.” What is bulk density you may ask? It is the weight of a certain volume of a material. For example, the average bulk density of wet food scraps is 1,000 pounds/cubic yard. The ideal bulk density of a material mix for composting is lighter at ~800 pounds/cubic yard. Browns serve as a bulking material to decrease density and increase air space in the pile. One ideal mix of browns is 3 parts leaves, 2 parts wood chips/ chopped plant stems, and 1 part wood shavings/sawdust.

### 2 Browns to 1 Green

**At minimum, mix 2 buckets or wheelbarrows of BROWNS to every bucket or wheelbarrow of GREENS**



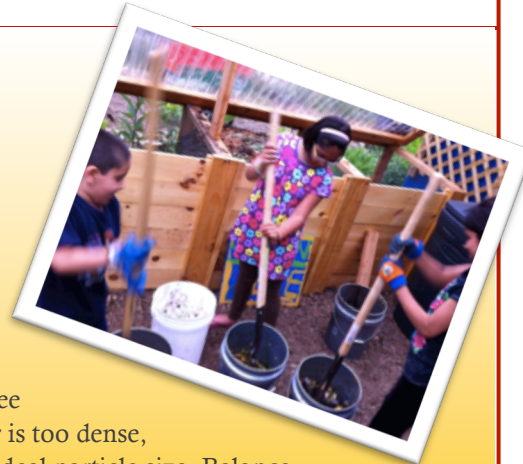


## A Word about Particle Size

Microorganisms work on the surfaces of the materials, breaking them down during composting. When a mass of material is broken into smaller pieces, it increases the available surface area. We can help microorganisms and other decomposer organisms do their job by chopping up food such as whole apples and corncobs as well as large garden stalks or branches. Smaller pieces of food scraps and carbon materials process faster and more completely than larger pieces, reducing the chance of attracting pests.

At the same time, using only fine-grained ingredients to build your pile (such as coffee grounds, wood shavings, ground food waste) will lead to a pile that lacks porosity or is too dense, creating anaerobic conditions. 1/8 inch is usually considered the smaller end of the ideal particle size. Balance smaller sized ingredients with bulking materials like wood chips or straw.

**RULE OF THUMB – Chopping or shredding big pieces of plant material or whole fruit and veggies before adding to the wooden bins will speed up the composting process.**



## Step 5: Build Your Pile

1. Prop up the lid (don't flip it over, this is bad for the hinges)
2. Take out the slats
3. Always make sure there is a layer of browns, like wood chips or straw, at the bottom of the cube. This layer will filter odors that could attract pests and allow air into the pile.
4. Chop up your garden waste and food scraps with a flat shovel. Use some sort of surface or container for chopping food scraps so they are not left on bare ground. You can use a metal tub (like you might wash a dog in) or a 5-gallon plastic bucket. Shred paper, napkins, and cardboard into strips.
5. Add 1 bucket of greens and a minimum of 2 buckets of browns onto the base layer of browns in the bin.
6. Mix the ingredients with a shovel or pitchfork.
7. Add water, until material feels like a wrung out sponge. Water = key ingredient! However, do not overwater; water should not leak out of the bin. Fresh ingredients such as leaves and straw are hydrophobic, meaning they repel water. Thus, it is best to shower water slowly as you mix the pile, as opposed to just pouring water on the pile.
8. Repeat steps 4-7. You need a pile that's at least 3 ft. tall, wide, and deep for active composting to take place. Pile everything into a DOME shape. If you can't build a 3-ft. pile at once, keep adding material to the bin over time until it's full. When the bin is full that means you have "charged" it.
9. Cover your pile with a layer of browns (wood chips are ideal) to keep flies out and smells down.
10. Replace the slats and close lid.



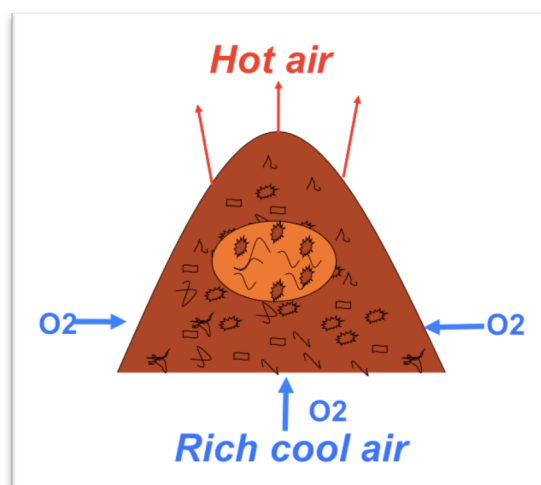
## Step 5: Build Your Pile (continued)

Why create a dome shape? So that it's highest in the middle. The middle of the pile is where the most microbial activity will take place and thus where the most heat will build up. As long as sufficient porosity exists, hot air will rise from the middle up via convection. Hot air and vaporized water will exit the top of the pile, drawing cool, fresh ambient air into the bottom of the pile. This is referred to as "the chimney effect." Because the sides of the pile are exposed to the ambient air, they will be cooler than the middle. This is one reason active turning will speed decomposition. Materials on the outside will be mixed into the middle.

**RULE OF THUMB** – In order for the compost pile to heat up, it should have a minimum volume of 3 ft. x 3 ft. x 3 ft.

**RULE OF THUMB** – Make sure your mix has adequate moisture. It is more effective to water the materials as you are mixing than to water the pile after it is built. Why? A pile watered on top will tend to shed the water rather than absorbing it.

**RULE OF THUMB** – A more thorough mix can be achieved by mixing on a tarp or a mixing trough before transferring to the first cube. If this is not possible, use the lasagna method by building your pile in layers, being careful to add browns and greens intermittingly, along with water if needed.



## Test for the Right Moisture Level with the Hand-Squeeze or “Armpit” Test!

Take a handful of material from the compost system and squeeze. Be sure to pull material from inside the pile, say at least 6 inches in.

If material is crumbly and does not stick together, and your hand is dry:

Pile Moisture < 40% = TOO DRY

No more than a few water drops appear between your fingers or knuckles, the material sticks together, and your hand is moist:

Pile Moisture  $\cong$  50% - 60% = IDEAL

If, as you squeeze, water drips down your arm (especially if it drips down to your armpit!), material sticks together and drips; hand is wet and dripping:

Pile Moisture  $\geq$  60% = TOO MOIST



## Managing Your Composting System

Tracking temperature, moisture, AND regularly mixing or turning are required for active or hot composting. If a pile is regularly turned to maintain air pockets, piled high and wide enough to keep heat in the middle of the pile, and has adequate moisture, it can thrive. Sample data tracking sheets are provided on pages 15 and 23. Sensory observations are important. Use your nose! As people tend to smell with their eyes, keep your site neat and tidy.

The first 3 weeks of composting is considered the active composting phase. Weekly turning is recommended during this period. After that, piles can be turned once or twice a month. When you turn a pile, your goal should be to move what was in the outside of the pile to the middle, and what was in the middle of the pile out. Practically, you can't really track each particle, so a good mix is important.

### Adding New Material

**RULE OF THUMB** – New compost “ingredients” should only ever be added to the first bin of your composting system (Bin 1).

If you have enough materials to build at least a full 3-ft. cube pile at once, that's great! If not, you can just keep adding materials bit by bit over time until you fill the bin. When the bin is filled for the first time, it is considered “charged.”

A week after Bin 1 has been charged, it can be flipped to Bin 2. This will fluff up and mix your ingredients and give you an opportunity to check the moisture level and decide whether or not water should be added.

If you have a 2-bin system, then Bin 2 should be where the pile will live out the rest of its days. You can mix the pile in place as often as needed (weekly for the first 3 weeks, every couple of weeks after that).

You can start adding fresh material to Bin 1 again. Pile size will be reduced over time from settling of materials and loss of mass due to decomposition. If you build a pile that is just big enough to get the composting process started, say 3-ft. cubed, it will soon shrink and be unable to hold the heat that our microbe friends need to do their work, resulting in an interrupted composting process. When this happens, you can combine the new Bin 1 material with the old Bin 2 material, and again let the material in Bin 2 continue to break down.

If you have a 3-bin composting system, then you have a couple of choices as to how to move the material through. You can mix the material in place, like







with the 2-bin system, and then move the material over after a week of when Bin 1 is fully charged.

The second option is that you can flip between Bin 2 and Bin 3 whenever the pile needs to be mixed.

Moving between bins, as opposed to mixing in place, is an easier way to fully mix your ingredients.

Yet another approach is to pull the material out of the bin and mix it in a staging area contained by a tarp or a large mixing trough. This is a more advanced mixing method but an effective one.

You should stop adding material when all the bins are full.

### Finishing or Curing the Material

Adding unfinished compost, or incompletely decomposed material, to a garden is not recommended. In unfinished compost, bacteria compete with plants for nitrogen in the soil, continue to consume oxygen, reducing the availability of oxygen to plant roots, and can also contain high levels of organic acids. These will all stunt plant growth. “Curing” is necessary to allow the compost to gradually complete degradation to produce a more chemically stable finished product.

Weeks after a well-built pile has been formed, assuming it has been properly watered and aerated through the course of its active life, the temperature will begin tapering off, heading towards ambient temperature, the temperature of the surrounding environment. Compost is ready for curing when it is at ambient temperature and no longer has recognizable food scraps, or intact pieces of decaying food.

At this point curing compost should be set aside from active compost piles, but this doesn't mean we should forget about our microbes! Our compost pile is now teaming with a diverse array of beneficial organisms and we want it to stay that way. They still need some water, though not as much as before, and plenty of air. Water may no longer need to be added as the moisture level only needs to stay around 40% (remember the hand-squeeze test!). Curing piles should continue to be turned twice a month, or at least monthly. A minimum of 4 weeks is needed for curing but 2 to 4 months is preferable.

## HANDBOOK TO COMPOSTING ONSITE WITH A BIN SYSTEM AT K-12 SCHOOLS

If you run out of space to create curing piles, one idea is to build a corral made from hardware cloth for storing the curing compost. It can be held together in a loop by weaving in zip-ties. Use enough zip-ties to withstand the pressure of the pile pushing out on the hardware cloth loop. Store on top of concrete pavers to add an extra layer of protection from the possibility of rodents digging under the hardware cloth wall. Position a broom handle vertically in the middle of the pile to prop up a cover. The pile will hold the broom in place. Cover with a heavy fabric tarp. The broom handle provides a peak for the cover to allow rain and snow to roll off and not seep into the curing pile. (See photos below.)



### Keep Browns Onsite

Unlike high-nitrogen green materials, browns can and should be stored onsite in some manner. Some compost sites simply have a pile of wood chips. Others prepare a recipe of browns and have that ready to add to greens when the time comes. You can also store your browns in containers to protect the browns pile from becoming a habitat for unwanted critters. One technique is to move the pile around so it doesn't become a hospitable home for rats.





## Why Monitor Temperature?

There are two tools for monitoring the compost process: (1) your nose, and (2) a thermometer or temperature probe. The heat produced during composting is directly related to the microbial activity. Thus, temperature is the primary gauge for assessing the process. If the pile is too cold, the microbes are not releasing energy, which means they are not happy. There are certain steps you can then take to improve the pile conditions. Furthermore, reaching certain temperatures will tell you whether you have reduced pathogens and killed most weed seeds. Temperatures that are too high are also an indication that conditions need to be adjusted. When the pile no longer heats after mixing and after a few weeks in the active hot phase, you will know it's time to allow it to cure (stand without mixing).

There are three distinct temperature phases.

### Mesophilic (50-104°F):

Once the pile is started, things immediately begin to heat up. During this stage, mesophilic bacteria will begin to eat substrates with high-energy yield like sugars, starches, and fats. As a result, the pile will start to warm up rapidly (just a few hours in ideal conditions). Under the right conditions, the mesophilic stage only lasts a few days before moving into the thermophilic stage.

### Thermophilic (104-160°F):

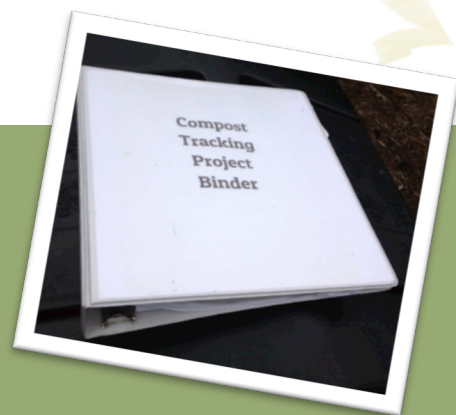
Once temperatures increase above 104°F, thermophilic bacteria continue to eat simple compounds with high-energy yield, bringing the temperature up to 160°F. Fortunately, most human pathogens and many weed seeds cannot handle such high temperatures. This stage can last a few days to a few months depending on the size of the pile and type of inputs. During this time, most of the organic matter is reduced to humus and materials begin to resemble finished compost.

### Curing (50-104°F):

Curing is marked by a sustained drop in temperature back into the mesophilic range. As the pile cools down, fungi and actinobacteria become more active, working away the more complex cellulose and lignin rich materials. While composting has slowed down during this stage, it is still occurring, and the humus content of the pile is increasing. After being given some time to mature (at least 4 weeks but 2 to 3 months is preferable), the compost has reduced plant toxins and will have a lower amount of oxygen and nitrogen.

## Keep Records!

Consider recording temperatures daily until you acquire a feel for the process. A pattern should emerge after several batches of materials have been composted. [*On-Farm Composting Handbook*]. Sample logs on pages 15 and 21.





## The Process for Further Pathogen Reduction (PFPR)

Large-scale commercial-industrial food waste composting sites have to meet PFPR – the Process for Further Pathogen Reduction. While school garden composting systems are not required to meet PFPR, it's useful to understand how you might. Basically, PFPR means compost processing time and temperatures should be sufficient to kill weed seeds, and reduce pathogens and vector attraction. To meet PFPR, material composted in enclosed systems must be maintained at a minimum average temperature of 55° C (131° F) or higher for 3 continuous days, followed by at least 14 days with a minimum of 45° C (113° F).



BK ROT COMPOST LOG			PILE TEMPERATURES	
DAY/DATE	WORKER	BIN #	TEMP	ACTIONS/OBSERVATIONS
5/22/16	Domingo	Window	100	used to Seal new pile
11	11	4	81	Sifted
11	11	3	84	moved over
5/22/16	DAN Felt / Domingo / Claudia	2	140	moved over
11	11	1	156	started new
11	11	1	135	Turned / Watered / Added
11	11	2	148	11
11	11	3	144	11
11	11	4	118	11
11	11	Window	150	Watered

### When Is Compost Ready?

Finished compost will appear dark brown and crumbly. Original material feedstocks should not be recognizable with the exception of a few wood chips (which can be screened out). It will smell earthy. The internal temperature will match the outside temperature.

Here is a simple way to test for compost maturity: place a handful of moist compost in a plastic ziplock baggie, close and refrigerate for 3 days. If you open it afterward and smell an ammonia odor, the compost is not finished! Give it more time to cure before using in the garden.



### Sifting or Screening Finished Compost

Sifting or screening the finished compost is not necessary but is a good idea in order to remove big pieces of wood chips and any other materials that may not have decomposed fully.

There are many screening options including wood framed mesh held horizontally over a wheelbarrow, bin, container, or tarp for collecting the finished material. Moving the screen side to side helps move the fine particles through (better than bouncing it up and down).

The screened out material is referred to as the “overs” and can be recycled as browns and bulking material into a new pile. The overs can actually help inoculate the new pile with the beneficial decomposers.





## Health & Safety Considerations

- ✓ Practice good hygiene. Anyone coming in contact with the compost bin or compost should practice good hygiene by either washing hands well or wearing gloves. Hands should be washed after gloves are removed. Anyone with cuts and abrasions should cover them with bandages and wear gloves.
- ✓ Protect those likely to be most sensitive. Involve the teachers, school nurse or physician, parents, and faculty/staff to discover any potentially susceptible students or staff (those with allergies, weakened immune systems or who are infection prone)
- ✓ Control exposure of these individuals by restricting who actually comes in contact with the compost. Other students or the teacher could feed the compost bin or take samples. Do not stir or otherwise disturb the pile or bin when people susceptible to inhalation of allergens are nearby.
- ✓ If the temperature of the compost pile is properly maintained, the risk of pathogens is decreased. Be sure to monitor temperatures and turn the pile frequently.
- ✓ Turning the compost pile will release airborne particles and gases that can cause symptoms in some people. So if a pile is turned, be aware of the wind direction and of the susceptibility of those nearby and those doing the turning. Susceptible children should not turn the compost.
- ✓ Keeping food scraps covered with high-carbon materials will keep down flies and dispersal of fungal spores. Make sure you always have high-carbon materials in storage or in a bin.

Adapted from *A Guide to Starting a Composting Program in Your School*, Green Mountain Farm to School, Newport, Vermont (2010), <http://greenmountainfarmtoschool.org>.



## Troubleshooting

While problems can arise, the beauty of composting (particularly small-scale, community composting) is that issues can generally be effectively remedied with a bit of effort and “elbow grease.” The Troubleshooting Guide Table, pp. 21-22, provides additional solutions to common problems.

### Question: What do I do if my pile is not heating up or “cooking”?

If the pile is not heating up, make changes to create hospitable conditions for microorganisms to thrive. This includes initially using or remixing in a proper ratio of 2 parts by volume browns to 1 part by volume greens, adding water to maintain an adequately moist system (ideal moisture content is 50-60%), and turning to fluff materials and create airflow within the pile.

### Question: My pile stinks. What do I do?

Maintaining an aerobic (i.e. oxygen-using) system helps to avoid unpleasant odors that often arise due to anaerobic (i.e. without oxygen) composting conditions. Composting systems that have too much nitrogen (i.e. C:N ratio is too low), are too wet, have a poor or compacted structure, and are turned too infrequently can have nuisance odors. Rebuild the pile adding more browns, especially bulky materials such as wood chips, and increase turning frequency to get rid of anaerobic pockets. While it is normal for composting to have some odors, proper maintenance prevents the odor from becoming objectionable.

### Question: How do I deter rats and other rodents?

Like most issues, the best way to minimize rat and pest issues is with preventative maintenance. Proper management is key. Promptly handle and process putrescible high-nitrogen materials. They should be mixed with browns immediately and not left to attract pests or go anaerobic. Utilize composting systems that make it extremely difficult for rodents to enter the system, such as a wooden bin system with spaces smaller than the size of a rat’s snout or head (e.g. using ¼-inch hardware cloth). Systems should be consistently secured (e.g. by locking lids and sealing any storage containers) and sites kept free of stray food scraps and trash that might attract rodents. Scrupulously incorporate all bits of food that may be around the pile. Controlling odors is key to avoid attracting pests. Properly maintain your system and always cover any exposed food scraps with a carbon source (such as wood chips) or finished compost. Piles “sealed” with a uniform depth of at least 6 inches will be of less interest to rodents. Selecting fruit, vegetable, and acceptable food scraps can also minimize rat problems. Rats seek out protein and fats found in unacceptable feedstocks like meats, fish, and oils.

Rodents do not like open spaces as open spaces make them nervous about predators. Consider where the system, storage containers, and curing piles are located. Place these with open space all around. To prevent habitat formation at the base of the composting system, where it’s nice and warm for rodents through the winter, bins ideally should have a barrier (like cement, a dug-out pit with sand or something else inhospitable).

If your site has pressure from urban rats, consider keeping browns, curing compost, and finished compost in above-ground tumblers (typically sold as backyard composting systems).



### Question: What materials do I need to be careful of composting?

Err on the side of caution and avoid any questionable material. Meat, cooked food, cheese, and oils can attract rodents. Page 5 lists acceptable material. Avoid hay, which can have a lot of seeds (opt for straw instead). Minimize woods with natural herbicides such as walnut, cypress, cedar, and white oak. Be careful of wood shavings from pressure treated woods or that might have toxic glues. Tea bags with staples could be a problem. Remember, the staples will end up in your garden soil. Avoid grass clippings from lawns treated with herbicides or pesticides.

### Question: Can I add pet or other animal poop to my pile?

No. Dog and cat feces can contain parasites and harmful disease organisms. While cow and horse manure are generally acceptable materials to compost, we do not recommend adding these to school garden compost systems due to the potential for pathogens. We recognize that not all its onsite composting systems will be actively maintained at the high temperatures required to reduce pathogens.

### Question: Should I layer materials (i.e. use a “lasagna” method)?

If you are unable to mix materials before transferring to Bin 1, then, yes, layer materials using the lasagna method. Thoroughly mixing all ingredients before building the pile is preferable but not always possible. (Never mix food scraps on bare earth.) If using the lasagna method, try to flip the pile into Bin 2 within a week.

### Question: Will composting kill weed seeds?

Most weed seeds will be killed if pile temperatures reach 131 degrees F for at least 3 continuous days. Some seeds, like tomato seeds, need temperatures of 153 degrees F. However, to be safe, one can use a solarization process before composting or refrain entirely from including weeds that are in flower or have seed heads.

### Question: How long does it take to produce finished compost?

While this can vary significantly, composters that maintain optimum conditions in small-scale, community-based composting operations can produce finished compost in approximately 3-5 months. Always allocate adequate time for the curing phase in which the compost becomes stable and mature.

### Question: What do I do about standing water near my pile?

You don't want standing water on your site. Bins or containers need to sit on a foundation that addresses any “contact water” (water that has come in contact with the active composting process). On cement, for instance, contact water can be spotted and soaked up quickly with wood shavings that are incorporated back into the bin. If a foundation, like bare earth, soaks up contact water, over time it can smell. Do not let “contact” water runoff or drain into streams or other surface water.

## Troubleshooting Guide Table

Composting System Condition	Possible Source or Reason	Other Clues	Recommended Remedy
<b>Composting system fails to heat</b>	Materials too dry	Cannot squeeze water from material	Add water or wet ingredients
	Materials too wet	Materials look or feel soggy; Composting system pile slumps; moisture content >60%	Add dry ingredients (leaves, straw, wood chips) and remix
	Not enough nitrogen, materials are slowly decomposing	Large amount of woody materials.	Add high nitrogen ingredients; alter composting recipe
	Poor structure	Composting system pile settles quickly; few large particles; not excessively wet	Add wood chips, straw, hay, build in dome shape
	Cold weather and small composting system pile size	Composting system pile size is less than 3 ft. cubed	Enlarge or combine composting system piles; add highly degradable ingredients (fruit and veggie)
<b>Temperature falls consistently over several days</b>	Low oxygen; need for aeration	Temperature declines gradually rather than sharply	Turn or aerate composting system pile
	Low moisture	Cannot squeeze water from material	Add water
<b>Uneven temperatures or varying odors in composting system pile</b>	Poorly mixed materials	Visible differences in the composting system pile moisture and materials	Turn/remix composting system pile
	Uneven airflow	Visible differences in the composting system pile moisture and materials	Remix composting system pile and build in dome shape
	Materials at different stages of maturity	Temperature varies within the composting system pile	None required
<b>Gradually falling temperatures; composting system pile does not reheat after turning or aeration</b>	Composting nearing completion	Approaching expected composting time period; adequate moisture available	None required
	Low moisture	Cannot squeeze water from materials	Add water and remix
<b>Composting system pile overheating (temperature &gt;150 degrees F)</b>	Insufficient aeration for heat removal	Composting system pile is moist	Turn composting system pile
	Moderate to low moisture; limited evaporative cooling	Composting system pile feels damp but not excessively wet or dry	Add water; continue turning and aeration to control temperature
<b>Extremely high temperatures (&gt;170 degrees F) in composting system pile, curing pile, or storage materials</b>	Pyrolysis or spontaneous combustion	Low moisture content; composting system pile interior looks or smells charred	Maintain proper moisture content; add water to charred or smoldering sections; breakdown pile and properly rebuild



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<b>High temperatures or odors in curing or finished compost storage pile</b>	Compost is not stable	Short active composting period	Compost is not in curing stage, keep turning compost and tracking temperature and moisture
<b>Composting System Condition</b>	<b>Possible Source or Reason</b>	<b>Other Clues</b>	<b>Recommended Remedy</b>
<b>Ammonia odor coming from composting system pile</b>	High nitrogen level	C:N ratio less than 20:1	Add high-carbon materials
	Slowly available carbon source	Large woody particles; C:N ratio <30:1	Use another carbon material such as leaves or increase the carbon proportion
<b>Rotten-egg or putrid odors coming from composting system pile</b>	Anaerobic conditions	Low temperatures	Turn composting system pile
	Anaerobic conditions - materials too wet	Low temperatures	Add dry materials
	Anaerobic conditions - poor structure	Low temperatures	Add wood chips, straw, hay and rebuild in dome shape
	Anaerobic conditions - composting system pile is compacted	Low temperatures	Remix, and rebuild in dome shape
	Anaerobic conditions - insufficient aeration	Low temperatures	Turn composting system pile to increase airflow rate
	Anaerobic conditions - pile too large	High temperatures	Break down composting system pile, remix with accurate recipe and rebuild smaller pile
	Anaerobic conditions - airflow uneven	High temperatures	Break down composting system pile, remix with accurate recipe and rebuild proper structure and size
<b>Odors generated only after turning</b>	Odorous raw materials	High temperatures	Frequent turnings; add carbon to absorb and mitigate odors
	Insufficient aeration; anaerobic interior	Falling temperatures	Shorten time interval between turnings; add high carbon materials, especially wood chips
<b>Site-related odors (composting system pile not odorous)</b>	Raw materials	Odor is characteristic of the raw material	Handle raw materials promptly with minimal storage
	Nutrient-rich puddles because of poor drainage	Standing puddles of water; ruts in ground surface or pad	Divert runoff properly; maintain pad surface
<b>Fly or mosquito problems</b>	Flies breeding in compost system pile	Fresh nitrogen materials exposed; flies hovering around composting system pile	Turn composting system pile every 2-3 days; cover with 6-12 inch layer of compost or carbon source
	Flies breeding in raw materials	Wet raw materials stored on-site longer than several days	Handle raw materials promptly; properly mix into composting system pile
	Mosquitos breeding in stagnant water	Standing puddles of water; nutrient-rich receiving waters	Water effectively by showering compost pile while mixing; keep standing pools of water away from pile
<b>Finished compost contains clumps of materials and large particles; texture is not uniform</b>	Poor mixing of materials or insufficient turning	Original raw materials discernable in compost	Screen/sift compost; improve initial mixing
	Airflow uneven	Wet clumps of compost	Screen/sift or shred/break compost into smaller bits; improve air distribution

# Using Compost in Your School Garden

## Soil Incorporation

Compost can be mixed into a garden bed prior to seeding or transplanting. Add a 1-3 inch layer to the soil surface, and till into the top 3-4 inches of the soil. This method is a great way to directly benefit the plants and soil, but the compost must be completely mature. Unfinished compost removes nitrogen from the soil and can starve plants, leading to inhibited germination and stunted growth.

## Mulch

Adding a layer of compost as mulch incorporates nutrients more slowly but is still beneficial. This method is useful for unfinished composts, preventing the removal of plant nutrients from the soil. Mulch can be added in a 3- to 4-inch layer on the soil surface, 2 to 3 inches away from plant stems. It will slowly decompose and add nutrients. Mulch also insulates the soil, moderates temperature, and limits water evaporation.

## Potting Mixes

Compost can also be used as a component in potting mixes. It can be added to commercial mixes, or used to make potting mix from scratch.

The following are potting mix recipes from the New York Compost Project:

### **For seedlings in small containers:**

Sift compost through a ½ inch mesh

Mix two parts compost, one part coarse sand, and one part loamy soil or coconut coir

Add ½ cup of lime per 8 gallons potting mix

Use liquid fertilizers when true leaves emerge

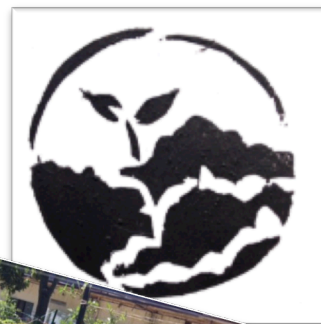
### **For growing transplants and plants in larger containers:**

Sift compost through a 1-inch mesh or remove larger particles by hand

Mix two parts compost; one part ground-up bar, perlite, or pumice, one part coarse sand; and one part loamy soil or coconut coir

Add ½ cup of lime and ½ cup of 10-10-10 fertilizer per 8 gallons potting mix

An alternative, organic fertilizer can be made from ½ cup bloodmeal or cottonseed meal, one cup rock phosphate, and ½ cup kelp meal





# Sample Data Log Sheet

**Pile Number/Name:**

**Date Constructed:**

**Name(s) of Builder(s):**

Container Tare

Weight:

	Feedstock 1	Feedstock 2	Feedstock 3	Feedstock 4	Feedstock 5	Feedstock 6
<b>Feedstocks Used:</b>						
<b>Weight of Feedstock Used:</b>						
<b>C:N Recipe Used (by Volume):</b>						

Poor, Fair or Good

Date	Time	Composter Name(s)	Moisture Rating	Odor Rating	Temp 1	Temp 2	Turned (Y/N)	Other Actions Taken

**Combined with another pile?**

**Notes/Observations:**

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