

DIRT TO DIRT, COMPOSTING 101



Brooke Alford, Marion County Extension, Urban Agriculture & Natural Resources
Spring Garden Clinic, 2023

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Tenga en cuenta todas las preguntas / formularios de elegibilidad relacionados con SNAP, diríjase a

<https://www.fns.usda.gov/snap/recipient/eligibility>

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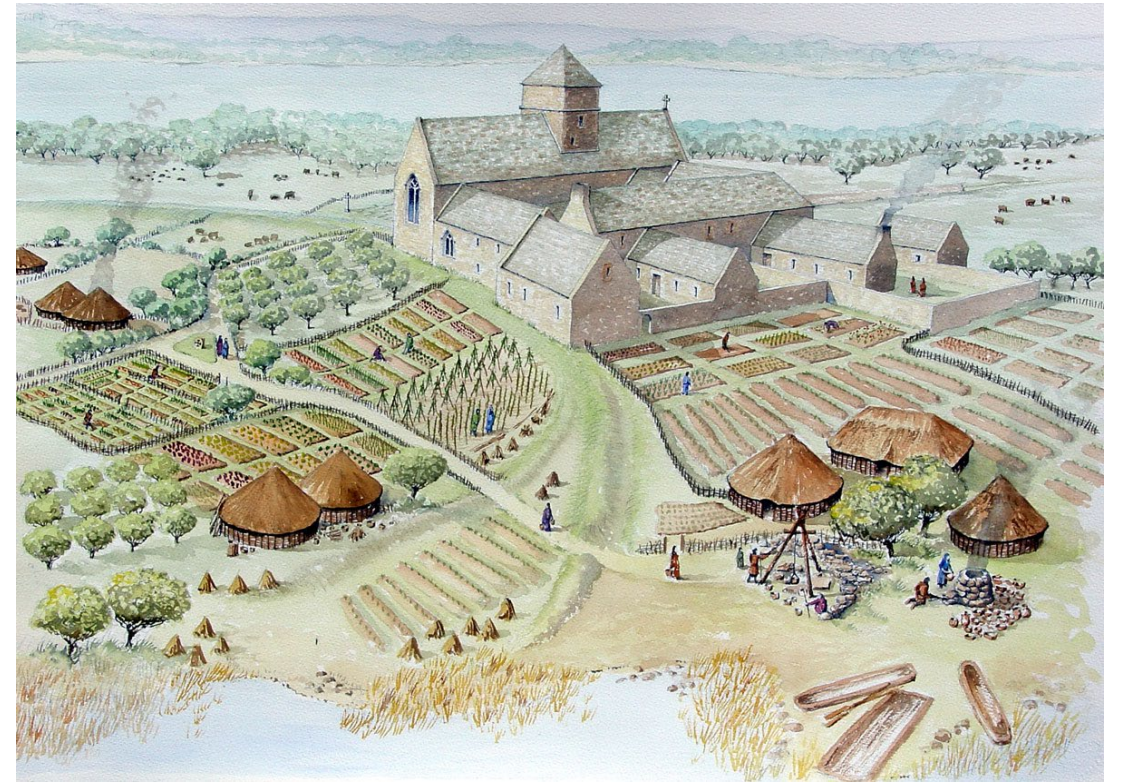
COMPOST HISTORY

- The first reference to composting is found in clay tablets from the Akkadian Empire which flourished in **2300 BC**
 - Manure based composting
- China in the **1st Century BC**
 - Utilized cooked bones, manure and silk worm debris
- A retired Roman general, Marcus Porcius Cato, who lived from **234 BC to 149 BC**, wrote a book titled "De Agri Cultura" Concerning the Culture of the Fields in which he describes composting



MIDDLE AGES COMPOSTING

- The medieval church preserved ancient knowledge of composting through writings stored in **monasteries**.
- Sound agricultural practices were applied by devoted monks, who in some instances taught them to local peasants and farmers



USA COMPOST HISTORY

- **George Washington** brought the art of composting to new heights in the form of a manure repository at his house at Mount Vernon.
- **Thomas Jefferson** preferred acquiring more land over composting until land became more expensive than the labor to properly tend it.
- **Thomas Jefferson** wrote to Washington to learn about composting.



WHAT IS COMPOSTING?

- “Composting”, as practiced today, is the controlled **aerobic, biological decomposition of organic materials into nutrient-rich humus.**
- Thermodynamic Composting is **HOT Composting**
- Mouldering, is **COLD Composting**
 - Mouldering: To decay or crumble away from neglect



WHAT IS A COMPOST PILE WITHOUT THERMODYNAMICS?

- If the pile is **too dry** it is dessicating
- If the pile is **too wet** it is rotting or putrefying
- If the pile is **cold** it is mouldering



COMPOSTING WITH THERMODYNAMICS

- If the moisture, the air, the carbon to nitrogen ratio, and the temperature in the pile are just right your pile is COMPOSTING!

- **MOISTURE**

- **AIR**

- **C:N**



SIX FACTORS IN COMPOSTING

- Carbon to Nitrogen Ratio
- Moisture Content
- Oxygen
- Size of Ingredients
- Size and Shape of Bin or Pile
- Temperature



FOUR ESSENTIAL INGREDIENTS

CARBON

NITROGEN

AIR

WATER

FOUR ESSENTIAL INGREDIENTS

1. CARBON

- Provides both an **energy source** and the **basic cell building material** for the decomposing microbes in the pile
 - Think *Carbohydrates*

FOUR ESSENTIAL INGREDIENTS

2. NITROGEN

- Is a crucial component of **nucleic acids, amino acids, and enzymes** necessary for **cell growth and function**
- Think **muscle building protein powders**

MATERIALS HIGH IN CARBON/ BROWNS

- Autumn Leaves
- Straw
- Wood Chips or Sawdust
- Bark
- Napkins
- Paper Towels
- Mixed Paper
- Newspaper
- Corrugated Cardboard
- Dried Pine Needles



MATERIALS HIGH IN NITROGEN

- Vegetable Scraps
- Coffee Grounds
- Grass Clippings
- Alfalfa Pellets
- Animal Manures
- Brewers Spent Grains (BSG)



What are your local sources?



BROWNS= HIGH CARBON

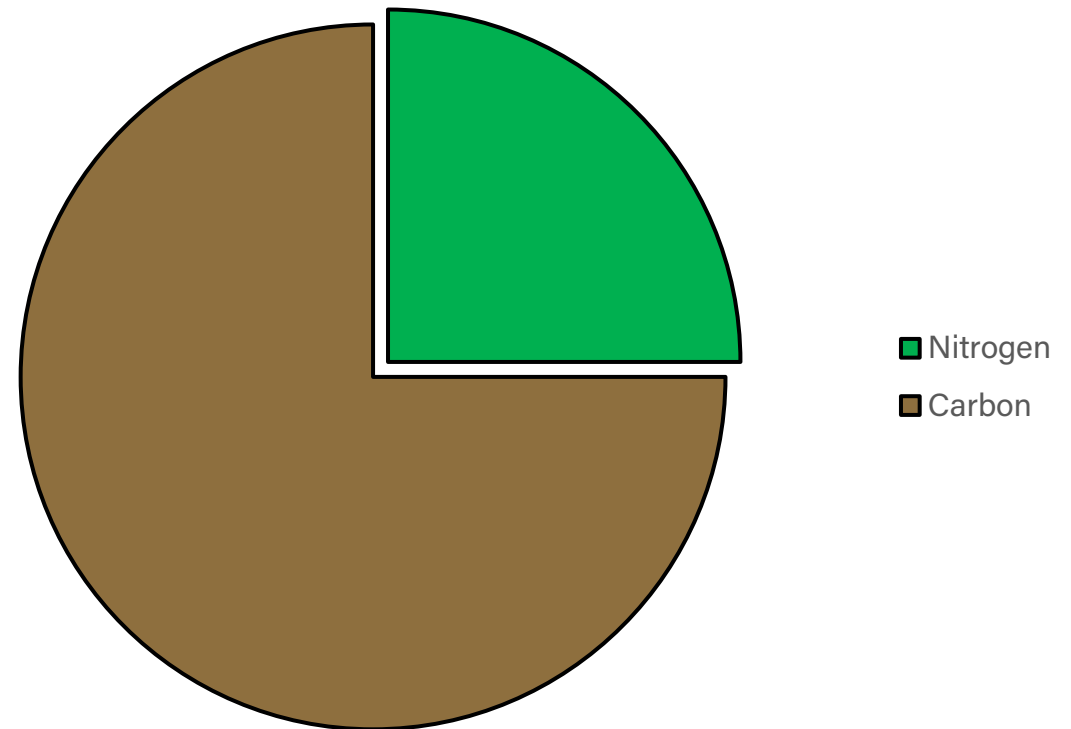
Carbon Source	C:N	High Carbon Sources	C:N
Fruit Waste	35:1	Dry Pine Needles	80:1
Peanut Shells	35:1	Newspaper	175:1
Leaves	60:1	Sawdust	325:1
Corn Stalks	75:1	Cardboard	350:1
Straw	75:1	Wood Chips	400:1

GREENS= HIGH NITROGEN

Nitrogen Source	C:N
Alfalfa	12:1
Grass Clippings	20:1
Clover	23:1
Hay	25:1
Veggie Scraps	25:1
Garden Waste	30:1
Weeds	30:1

CARBON TO NITROGEN RATIO

- The Ideal Carbon to Nitrogen Ratio (C:N) for Compost is **3:1**
- Or 3 parts carbon to 1 part nitrogen



FOUR ESSENTIAL INGREDIENTS

3. Water

- Provides **Habitat** for Many of the Decomposers Living in the Pile
- Ideal Moisture Content is between **40-60%**.



FOUR ESSENTIAL INGREDIENTS

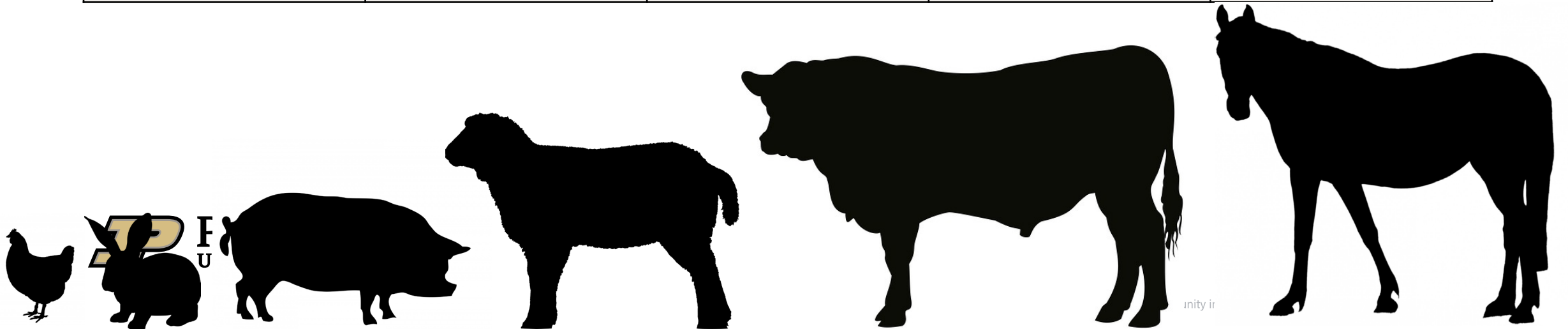
4. Air

- Most of the Life in a Compost Pile is Aerobic, **Requiring Oxygen to Survive, Thrive, and Multiply.**



MANURES PROVIDE NPK AND C:N

Manure Source	%N	%P	%K	C:N
Chicken	1.1 %	0.8%	0.5%	5-15:1
Rabbit	2.4%	1.4%	0.6%	12:1
Pig	0.5%	0.3%	0.6%	10-20:1
Cattle	0.6%	0.2%	0.5%	10-30:1
Sheep	0.7%	0.3%	0.9%	13-20:1
Horse	0.7%	0.3%	0.6%	22-50:1

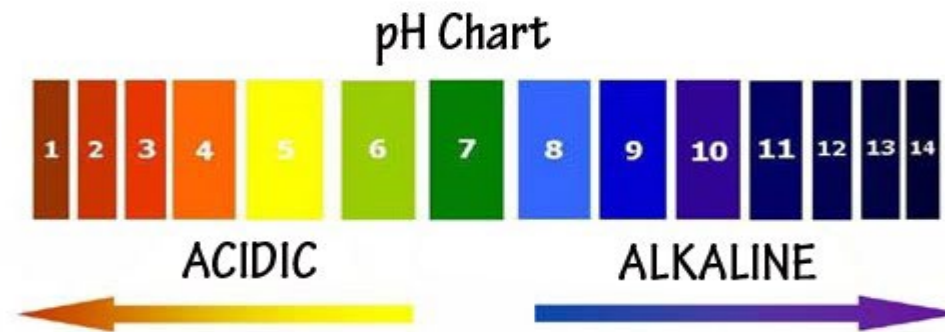


PH- ACID OR ALKALINE?

- As bacteria and fungi digest organic matter they release organic acids.
- In the early stages of composting, these acids often accumulate.
- The resulting drop in pH encourages the growth of fungi, and the breakdown of lignin and cellulose
- Usually the organic acids become further broken down during the composting process.
- ***If the system becomes anaerobic, acids can accumulate and lower the pH to 4.5 severely limiting microbial activity.***

PH- ACID OR ALKALINE?

- A **pH between 5.5 and 8.5** is optimal for compost microorganisms
- Controlling excess moisture and aeration, (turning the pile), is usually sufficient to return the compost pH to acceptable ranges.
- Extremely alkaline materials like wood ashes should be balanced with acidic materials, like GREEN oak and beech leaves or GREEN pine needles



WHAT NOT TO COMPOST IN A HOT PILE!

- Never add
 - Meat
 - Fish
 - Dairy Products
 - Bones
 - Pet Food
 - Pet Waste



- These materials will draw flies, wildlife, and have the potential to introduce *Salmonella enterobacteria* to the bin
- Cat feces can transmit toxoplasmosis



DECREASE PARTICLE SIZE

- The composting process can be sped up by **shredding or chopping** materials before adding them to the pile or composter.
- Increased surface area = increased microbial activity
 - Leaf shredders
 - Lawnmower
 - Mow materials/ leaves with a bagging lawnmower before adding to pile
- *If you have the time, add materials in **thinner layers** to increase contact between greens and browns, it will speed up decomposition*



NECESSARY PRACTICES

- **Turn the pile** to create pore space (every 3-7 days)
 - Allows air and water to enter the pile
- **Monitor moisture** content frequently
 - Squeeze a fistful
 - Goal is only 1 or 2 drops of water expressed
- **Adjust as needed**--add water or bulking/drying (browns) material as necessary to maintain moisture content at **55-60%**
- Use a **compost thermometer** to monitor and maintain the **ideal temperature**.



HOW HOT IS HOT ENOUGH?

- To **kill weed seeds** and pathogens a compost pile should be kept at 104 degrees F for at least five days.
- Temperatures should meet or exceed 131 degrees for at least 4 hours during this period.
- At temperatures above 140 degrees beneficial bacteria begin to perish

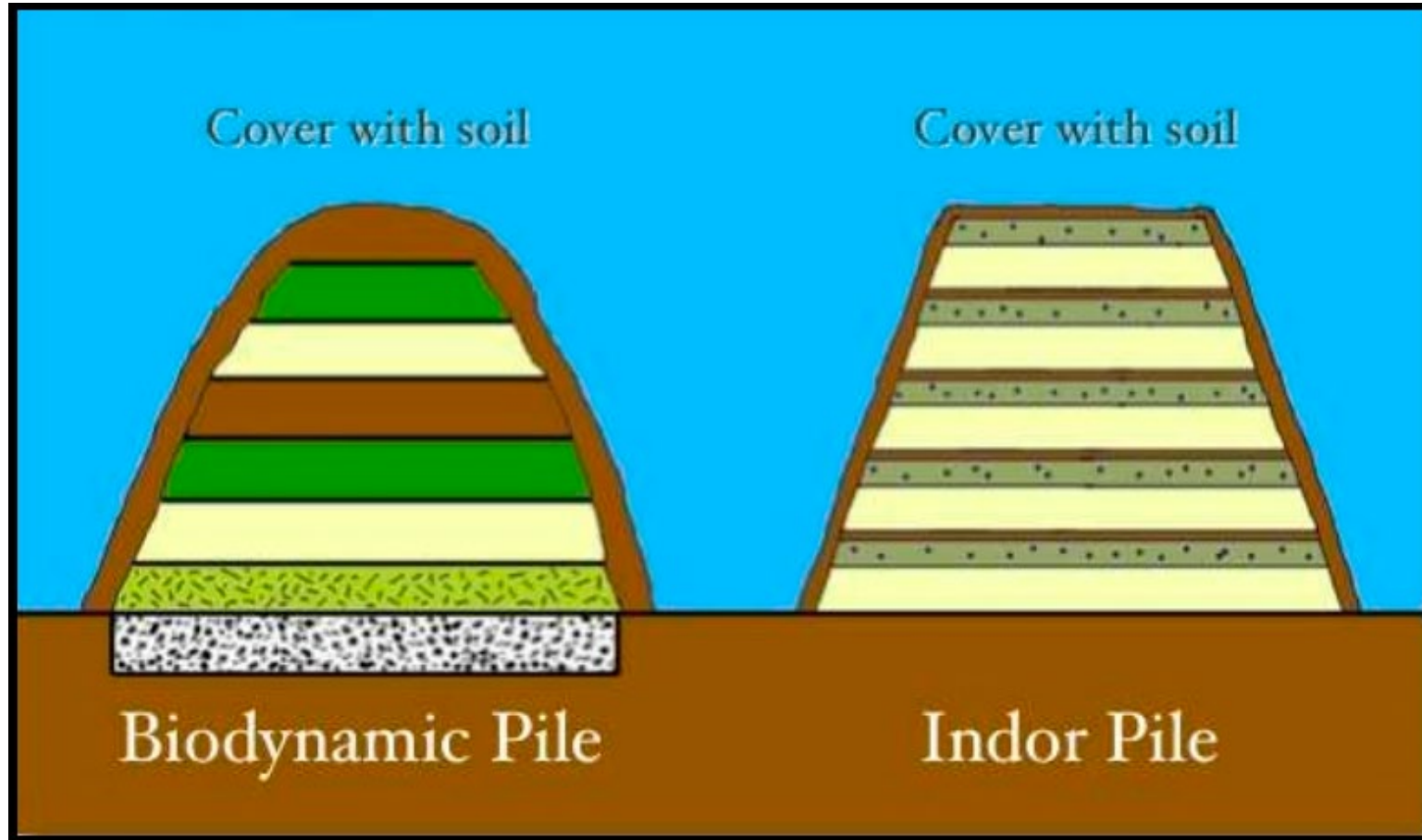


MAKING A COMPOST PILE

- Size and shape of bin or pile
 - **Simple piles or rows**
 - **No smaller than 3' x 3' x3'**
 - Piles that are too small will not heat up or retain sufficient moisture
 - **No larger than 5' x 5'x 5'**
 - Piles that are too large may spontaneously combust
 - Labor intensive to turn every 3-7 days



LAYERING COMPOST- SOPHISTICATED PILES



COMPOST BASICS- LAYER OF GREENS



COMPOST BASICS- LAYER OF BROWNS



COMPOST BASICS- LAYER OF SOIL OR COMPOST



COMPOST BASICS- WATER



COMPOST BASICS- A FEW WEEKS LATER...





E



DIY WHEEL BARROW COMPOST SCREEN



Work the compost over the screen with gloves until only the larger pieces remain.

FINAL PRODUCT



TROUBLESHOOTING COMPOST- ODORS

- **Strong, unpleasant odors** from a composter or compost pile indicate that one or more of the materials, (carbon, nitrogen, air, and water) are out of balance.
- When everything is correct, the materials should have a fresh invigorating aroma.



What's that
smell?!

TROUBLESHOOTING COMPOST- AMMONIA ODORS

- **Ammonia** odors are due to **excess nitrogen** rich, or green material, especially when wet, will begin decomposing into ammonia gas, which smells like glass cleaner.
- To remedy this situation simply **add carbon** rich material (browns)
 - Fall leaves
 - Shredded paper or cardboard
 - Wood shavings or sawdust



TROUBLESHOOTING COMPOST- SULFUR ODORS

- **Sulfur*** odors are due excess **carbon** rich material may create a “rotten egg smell”.
- This odor can be remedied by **adding nitrogen** rich material, such as grass clippings or alfalfa pellets and then turning the pile.



TROUBLESHOOTING COMPOST- SLOW DECOMPOSITION

There are a number of things that can prevent compost from maturing optimally:

1. **C:N ratio** is below 25:1 or above 40:1
2. Pile is consistently **too wet or dry**.
3. Pile is **not well aerated**.
4. Outside **ambient air temperature is low** enough to prevent the pile from reaching optimum temperatures.



TROUBLESHOOTING COMPOST- MANAGING TEMPERATURE

There are a number of factors that affect the temperature in a composter or pile.

1. **Size of pile** or style of container
2. **C:N ratio**
3. **Moisture and Air**
4. Ambient outside **air temperature**



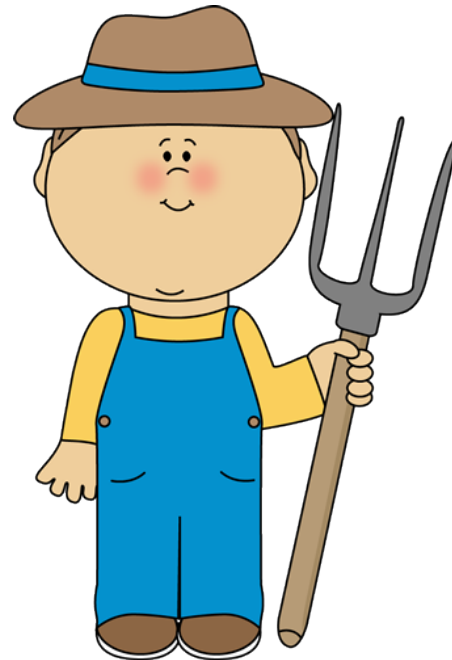
TROUBLESHOOTING COMPOST- MANAGING TEMPERATURE- TOO COLD?

- **Increase mass** (size of pile)
 - Small piles will not self insulate
- **Add greens**
 - Does the pile need more nitrogen?
- **Turn Pile**
 - Aerating the pile stokes the **biological “fire”** with life-giving oxygen.
- **Add water**
- **Inoculate** with soil, compost, or compost tea.
- **Insulate** pile/composter if the outside ambient air temperature is below 32 degrees



TROUBLESHOOTING COMPOST- MANAGING TEMPERATURE- TOO HOT?

- **Turn** pile to aerate it
- **Drench** with cold water
- **Add topsoil or browns**



PLANT PATHOGENS AND WEED SEEDS

- Some insect pests, nematodes, and a number of plant pathogens and diseases can survive the mouldering process or over-winter in a cold composter
 - Early and late blight, asparagus rust, downy mildew, smut
 - Apple scab, cedar-apple rust, and anthracnose.
 - Scale insects, tomato hornworm, squash vine borers, Colorado potato beetles, cabbage maggots and cucumber beetles

PESTS AND PATHOGENS- BEST PREVENTION

1. **Remove all infected plants and vegetative matter**, bag them and immediately send to land fill.
 1. *Alternatively bag the material in a brown paper bag and bury 1 foot in deep at least 100 feet away from your garden.*
2. Never add infected material to composter.
3. Practice HOT composting
4. Rotate plants.
5. Allow areas of refuge for beneficial predatory insects



ANIMAL PESTS

- Raccoons
- Opossums
- Deer
- Dogs
- Mice
- Rats
- Voles



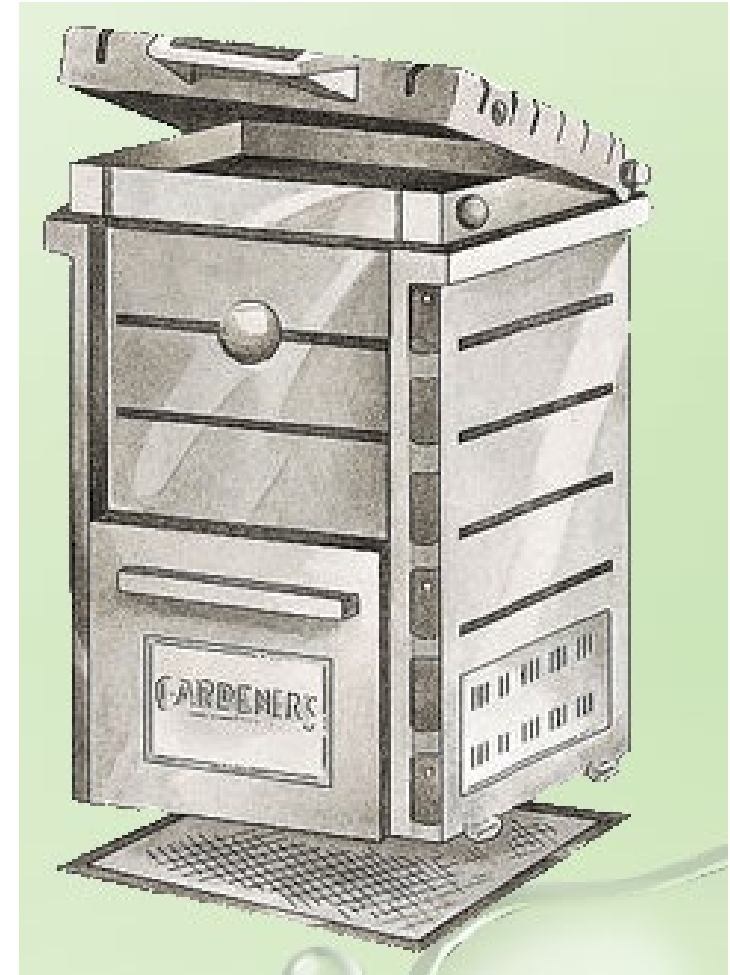
ANIMAL PESTS- CONTROL

- Compost piles can become free buffets for many animals
- **Prevention** is the best deterrent!
 - Make certain that all composter lids or doors are shut tightly, then secure with bungee cords or heavy weights.
 - Mice can enter through a ¼ inch opening!



ANIMAL PESTS- CONTROL

- Site your composter/ pile at least 10 feet away from your house foundation or any buildings.
- Consider composting food scraps only in tight sealing, container type composters
- Never put meat scraps, oily foods or oily seed in your compost pile
- Install rodent screen or hardware cloth underneath or in the bottom of open-bottom style composters.



ANIMAL PESTS- CONTROL

- Bury all food scraps deep in composter or cover with grass clippings, leaves, soil or compost (*coffee grounds?*)
- For winter composting, store grass clippings (greens), and leaves (browns), in galvanized metal trash cans near your composter.



WORM COMPOSTING: MAKING GARDENER'S GOLD

- Worm composting kitchen scraps and leftovers can be done year-round, indoors, and is faster than traditional composting.
- 2 pounds of red wigglers can eat 1 pound of food scraps a day.
- Worm castings can be used as part of a potting mix.



WORM COMPOSTING

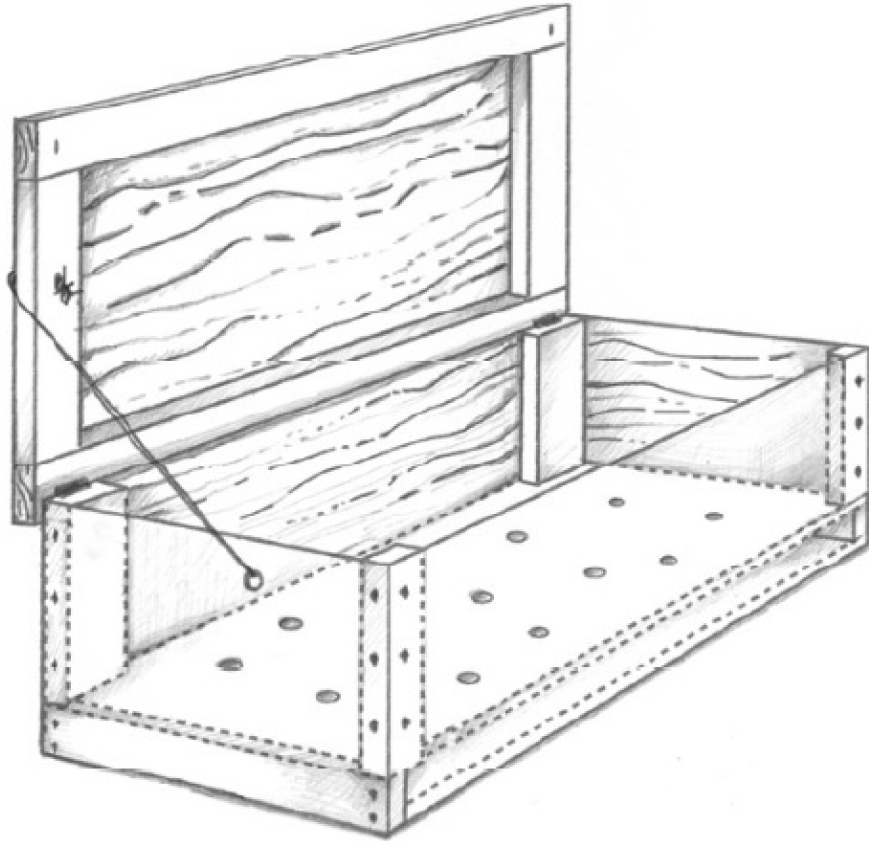


Image of wood constructed worm bin from Seattle Tilth Alliance document

WORM COMPOSTING



Indoor plastic worm bin



ELECTRIC COMPOSTERS

- Great for indoor composting of kitchen scraps and leftovers, especially during the winter
- Easier to maintain than a worm composter with less chance of pest problems
- Can be odorous if poorly maintained!



WHAT COMPOST SYSTEM IS BEST FOR YOU?

What are your GOALS?

Recycle food and other compostable household waste—
Vermicompost or electric composter

Manage yard waste—Hot pile compost

What is your space?

Indoor only—Vermicompost in plastic bin or electric
composter

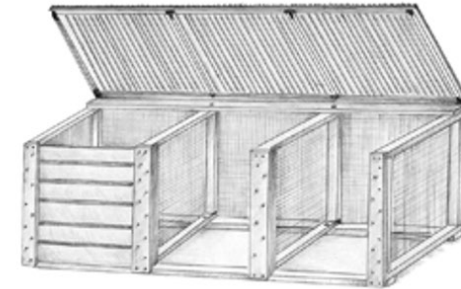
Backyard--Hot pile compost or worm bin

HOT PILE 3-BIN



Microfarms.com

Wood and Wire Stationary 3-bin System



Seattle Tilth Construction
Document

COMPOST TUMBLERS



Mantis Compost Tumbler



DIY Tumbler (Pinterest)

JOHNSON-SU COMPOSTING BIOREACTOR



Source: CSU, Chico

BLACK SOLDIER FLY COMPOSTING



COMPOST USE

- **On the lawn**
 - Establish a New lawn
 - 4-6 inches of compost tilled to a depth of 5-8 inches
 - Existing Lawn
 - Apply thin layer 1/8-1/4 inch to lawn and water well.
 - Can be applied year round.



COMPOST USE

- **Potted Plants**

- Potting soil recipe
 - $\frac{1}{4}$ to $\frac{1}{3}$ compost
 - $\frac{2}{3}$ to $\frac{3}{4}$ sterile soil
- Already potted plants
 - Thin layer over soil

- Don't put plants in pure compost



COMPOST USE

- **Tree and Shrub Planting**

- Mix compost with soil from the planting hole
- 1/3 compost and 2/3 soil

- In poor soil, roots may become the equivalent of pot bound staying in the nutrient rich soil.
- Consider making the planting hole bigger with compost amended soil.



COMPOST USE

- **In the Garden!!**
 - **Spring or early summer** before planting
 - Turn soil to a depth of 5-10 inches
 - Add 4 inches of compost
 - Turn in compost
 - Through **growing season** add a sprinkle of compost mixed with soil as a topdress
 - **Fall** apply a couple inches of unfinished compost to be turned in the spring



COMPOST USE

- **As Mulch**

- Early summer
 - 2-6 inch layer of course compost on soil around trees and bushes for mulch
 - Compost from woody materials works best
 - Annuals and perennials
 - Mulched with a material that breaks down quickly
 - Grass clippings and leaves
 - Annuals- Thick layer
 - Perennial- thin layer



COMPOST USE

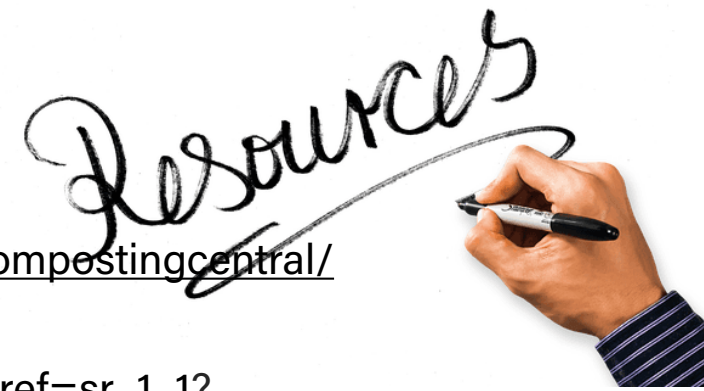
- **Plant Starter Mixes**

- High quality mature compost
 - It is sterilized during composting at high temperatures
- Recipe
 - 1 part mature sifted compost
 - 2 parts soil
 - 1 part sand, perlite, or vermiculite
 - Mix well



ANY QUESTIONS?

- **Brooke Alford**
- **Purdue Extension Marion County**
- **Urban Agriculture & Natural Resource
Extension Educator**
- **bmalford@purdue.edu**
- **206-380-1267 (CELL)**



- **University of Illinois Extension Composting Central:** <https://web.extension.illinois.edu/compostingcentral/>
- **Worms Eat My Garbage: How to setup and maintain a worm composting system:** https://www.amazon.com/Worms-Eat-Garbage-35th-Anniversary/dp/1612129471/ref=sr_1_1?
- **Managing Yard Wastes: Clippings and Compost:** <https://www.extension.purdue.edu/extmedia/ID/ID-182.pdf>
- **Let it rot! : the gardener's guide to composting:** https://www.amazon.com/dp/1580170234/ref=cm_sw_em_r_mt_dp_JW4FFbFBQGD9F
- **Chapter 7 Part 6 Purdue Master Gardener Manual**
- **Seattle Tilth Alliance Wood and Wire 3 Bin Construction Document:** <https://tilthalliance.org/wp-content/uploads/2022/02/3-Bin-Wood-and-Wire.pdf>
- **UK Extension Wood Worm Bin Construction Document:** <https://oldham.ca.uky.edu/files/worm-compost-bins.pdf>
- **Compost Mixture C:N Ratio Calculation Spreadsheet:** <http://compost.css.cornell.edu/download.html>
- **Cornell's Troubleshooting Worm bins:** <http://compost.css.cornell.edu/worms/troubleshoot.html>
- **Composting to Reduce the Waste Stream- A Guide to Small Scale Food and Yard Waste Composting:** <https://ecommons.cornell.edu/handle/1813/44736>

THANK YOU