COMPOSTING

for Your Farm or Garden

Presented by Heather Caveny

What is composting?

Composting is the decomposition of organic material through the generation of heat by microorganisms

- food scraps
- leaves, lawn/garden waste
- plant matter
- sawdust
- cardboard, paper
- animal manures
- coffee grounds
- seaweed, algae, seafood wastes
- ….

Benefits of compost

- improves soil health & fertility
- helps regenerate poor soils
- increases the nutrient content of soils
- promotes higher yields of crops
- brings & feeds diverse life in soils
- makes soil easier to work
- increases soil porosity & moisture retention
- suppresses plant diseases & pests
- can reduce the need for fertilizers & pesticides
- encourages healthy root systems
- can prevent & manage soil erosion problems (less compaction)
- reduces water demands of plants & trees

OTHER Benefits of composting

- makes onsite use of home/garden/farm waste that has to be dealt with some way
- decreases waste going into the landfill
- can reduce money spent on soil amendments, fertilizers, pesticides, etc.
- can become a revenue stream - removing others' waste (manure, animal bedding, yard waste, coffee grounds, old produce,...), selling compost (requires a permit and testing)

What to do with your compost?

- Seedling/potting mix (~1 part compost to 3 parts soil)
- Add to garden beds/rows before planting
- Add to soil with transplants
- Apply to lawns, shrubs, trees
- Use as mulch

What's the best fit for you?

- HOW MUCH and WHAT TYPES of organic material do you have available regularly?
- How much space do you have?
- How much time? effort? money?

Methods of Composting

- Microbial composting
  - piles, bins, windrows
- Vermicomposting
  - bin(s), continuous flow, windrows
- Black soldier fly larvae (BSFL)
  - bin(s)
- Hügelkultur
  - ground space
- Anaerobic digestion


MICROBIAL
COMPOSTING

What Do I Need?

- Organic materials - Browns and Greens
- Microorganisms (bacteria and fungi)
- Earthworms and insects
- Moisture
- Air

Meet Your Decomposers

Two kinds of biological decomposition take place in a compost pile:

Chemical and **Physical**

Microorganisms chemically break down organic matter

Larger soil invertebrates break down pile material physically

Invertebrates of the Compost

Tertiary Consumers

(organisms that eat secondary consumers)

centipedes, predatory mites, rove beetles, fomicid ants, carabid beetles

Secondary Consumers

(organisms that eat primary consumers)

springtails, some types of mites, feather-winged beetles, nematodes, protozoa, rotifera, soil flatworms

Primary Consumers

(organisms that eat organic residues)

bacteria, fungi, actinomycetes, nematodes, some types of mites, snails, slugs, earthworms, millipedes, sowbugs, whiteworms

Organic Residues

leaves, grass clippings, other plant debris, food scraps, fecal matter and animal bodies including those of soil invertebrates

Browns (carbon) and Greens (nitrogen)

- Browns are sugar-rich and provide energy to microorganisms to break down organics
  - Dried leaves, newspaper, straw, sawdust, napkins and other paper products, twigs, aged manure
- Greens provide protein to microorganisms through nitrogen
  - Grass clippings, food scraps, yard trimmings, green plant debris, coffee grounds, fresh manure

What can be composted?

- Leaves, grass clippings, twigs
- Vegetables & fruits
- Coffee grounds, filters
- Tea bags, leaves
- Paper napkins, cereal boxes
- Sawdust, pencil shavings
- Pizza boxes, paper egg cartons
- Bamboo skewers, toothpicks
- Old herbs, spices
- Loofahs
- Paper bags, wine corks, newspapers
- Houseplant leaves
- Paper rolls (towel, toilet, gift wrap)
- Nut shells (not walnut)
- Cotton balls and swabs, dryer lint
- Hair, fur, nail clippings
- Cotton, wool clothing
- Vacuum contents
- Straw, hay
- Manure from rabbits, cows, horses, sheep or chickens

What should NOT be composted?

- **Meat, bones, fish, milk products, eggs, oils** (produce odors, attract animals)
- **Pet feces** (can contain pathogens)
- **Plant material recently treated with herbicides/pesticides** (most do not persist in the environment)
- **Pressure-treated lumber** (has toxic chemicals)
- **Diseased plants and leaves (**may spread disease IF PILE DOES NOT GET HOT ENOUGH)
- **Charcoal ash or coal** (ash contains sulfur and iron that can be harmful to plants; coal likely won't compost)
- **Wood ash** (too alkaline; can stop composting process; MAYBE add in the beginning and small amounts later
- **Lime** (can cause smelly ammonia gas releases & and reduce nitrogen levels)
- **Pine needles** (waxy coating resists decay)

Composting Weeds

- Be careful with weeds that have gone to seed
- Persistent weeds may not get killed by composting
- Pile should reach 145°F for several hours
- Weeds with invasive roots can cause havoc
  - Dock weed, Alligator weed, Bermuda grass

Balancing Browns and Greens

- Microbes thrive best at **C:N ratio of 20:1 – 30:1**
  - For every 20-30 parts carbon, add 1 part nitrogen
- Ratio of carbon to nitrogen is chemical, not based on volume
  - You don’t need 30 times more brown than green

Some common C:N ratios

Carbon Sources (est.)

- Bark 100-130:1
- Cardboard 200-500:1
- Leaves 40-80:1
- Newspaper 150-200:1
- Peanut shells 35:1
- Peat moss 30-65:1
- Pine needles 250:1
- Sawdust 100-230:1
- Straw 50-100:1
- Wood chips 200-700:1

Nitrogen Sources (est.)

- Alfalfa 13:1
- Clover 23:1
- Coffee grounds 20:1
- Food scraps 15-25:1
- Garden debris 20-60:1
- Grass clippings 15-25:1
- Hay 25:1
- Manure, cow 20:1
- Manure, hog 5-7:1
- Manure, poultry 5-10:1
- Meal, blood or bone 3-4:1

Determining the C:N ratio

- Add materials to pile in equal amounts
- Add up carbon for all materials and divide by number of materials added
- Example: food scraps + leaves + grass

15:1 + 60:1 + 15:1 = 90:1

90 divided by 3 = 30

C:N = 30:1

Do Maple Leaves Compost Quickly?

- Maple leaves have C:N ratio near 30:1
- Most leaves are fairly high in carbon
- With the right moisture and frequent turning, maple leaves can break down in just a few weeks time.

What About Oak Leaves?

- Oak leaves have a C:N ratio of ~60:1
- Also have high levels of tannins which are resistant to decay
- Mixing oak leaves with high nitrogen materials will accelerate their decomposition

Keep It Simple:

BROWNS : GREENS

2 : 1

Is Surface Area Important?

- Since decomposition is a microbiological process, it occurs in thin films on the surface of particles
- A large particle has less total surface area than the same particle chopped into small pieces
- If particles are too big, the process will take longer
- A 1-inch wood chip will decompose much slower than grains of sawdust
- Shred fallen leaves by mowing them before raking

How Much Moisture Does Compost Need?

- Microorganisms require water to work
- Decomposition process will slow down if too little or too much moisture
- 40-60% moisture is needed in pile
- Pile should feel like a wrung-out sponge
- If too moist, pile will stagnate and produce unpleasant odors
  - Add dry leaves, paper or sawdust to absorb excess

How Much Air Does Compost Need?

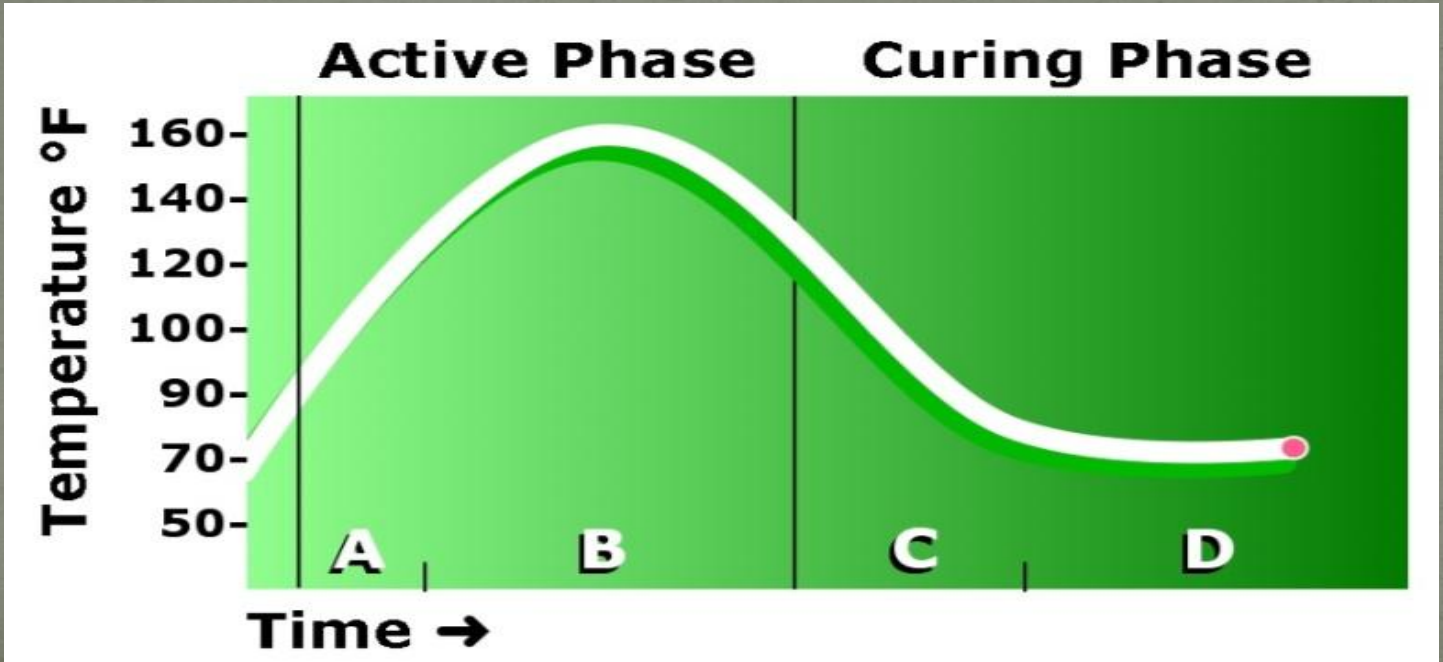
- Your pile needs ventilation throughout
- Aerobic piles produce little or no odor
- Turning with pitchfork or shovel or poking it with aerating device will keep air flowing
- Anaerobic (no air) piles smell bad, compost slowly, and produce dense, wet, smelly compost

Phases of Chemical Decomposition

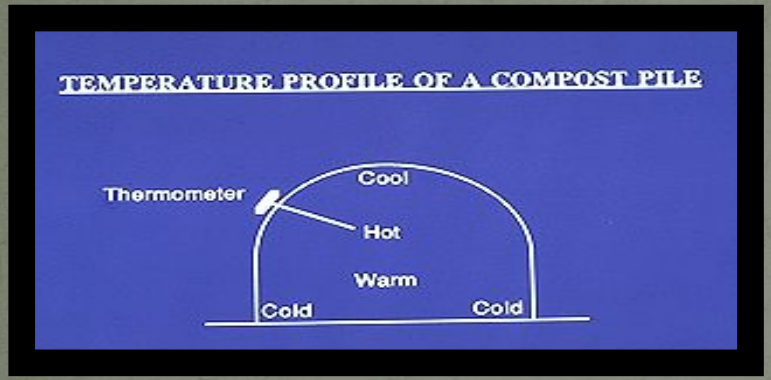
2.Thermophilic (106 - 252℉)

1. Mesophilic (68 - 113℉)

3. Mesophilic



How Hot Should It Get?



>131°F
PATHOGENS

>145°F
WEED SEEDS

<160°F
DECOMPOSERS

- Heat will be given off as organisms feed on wastes
- Ideal temperatures: between 90°F and 150°F
- Ideal time: 3 days at the above temperature
  - The hotter the pile, the less time it takes to kill pathogens and weed seeds
  - 158°F at 1 hour kills most weed seeds

How Long Does It Take To Make Compost?

- One year if you leave the pile alone
- Several months if you aerate the pile weekly
- Several weeks if you are diligent
  - Turn pile on second day
  - Then fourth day
  - Then every three days until batch is finished

How Do I Build A Compost Pile?

- Build it higher than 3 feet but less than 5 feet
- To make a batch:
  - 4 inches tangled branches on bottom
  - 4-5 inches Browns
  - 2-3 inches Greens
  - Alternate layers
  - Throw in a handful of soil as you layer to introduce more microorganisms
  - Top with 4-5 inches Browns

When's My Compost Ready?

- Cannot recognize original materials
- Can be screened through ½ inch screen
- Pile temperature is <10 degrees warmer than ambient
- Color is dark brown or black
- Smells earthy

When pile no longer heats, cover with fabric weed barrier and let it cure for 6-12 weeks, misting and poking.

- results in a more chemically stable end product
- fresh compost can "burn" plants through phytotoxicity
- fresh compost can rob soil of nitrogen as the process finishes

Do I Need A Permit?

- Tier 1 - All compost produced from materials on your land; not distributed to public
- Tier 2 - Importing < 1 cubic yard (~1000 lbs) per week of nitrogenous material; not distributed to public
- Tier 3 - Importing 1 cubic yard or more per week of nitrogenous material OR distributing compost to the public


VERMICOMPOSTING

Pros

- Smaller space required
- Higher nutrients / activity than microbial compost
- Higher value product than microbial compost
- Can also grow worms to sell for fishing or composting

…and Cons

- May not be able to compost large quantities
- Not ideal for woody materials

What do you need?

- A worm bin
  - Untreated
  - Opaque
  - Air holes!

What do you need?

- Or flow-through containers

What do you need?

- Or windrows

What do you need?

- Bedding
  - Nontoxic
  - Moist

What do you need?

- Worms (epigeic – live in surface litter)
  - Red wigglers
  - European nightcrawlers

What do you need?

- Food
  - Fruit/veggie scraps
  - Coffee grounds
  - Crushed eggshells
  - Animal manures
  - Animal bedding
  - Corrugated cardboard
- Do NOT add:
  - Meat/dairy
  - Oils/fats
  - Citrus/acidic fruits
  - Onions/garlic
  - Salty/seasoned food scraps

Maintenance

- Avoid extreme temperatures (59 – 77°F is ideal)
- Need moisture
- Feed regularly, but don’t over-feed
- Chop food scraps into small pieces for faster composting, or pre-compost
- Bury food scraps
- Hands off!

How do you harvest?

- Sideways migration
  - Feed only on one side of bin for several weeks
  - Worms move towards the food
- Light separation
  - Dump worm bin contents on a tarp with bright light
  - Harvest from the top, worms move away from light
- Vertical separation
  - Start with a vertical stacked bin OR
  - Add another bin on top of original (with holes in bottom so worms can migrate up to the food)

What to do with your vermicompost?

- Use immediately or store it:
  - Soil amendment for garden or potted plants
  - Kickstart transplants
- Make compost tea:
  - Stir vermicompost into de-chlorinated water, OR add unsulfured molasses and air stone
  - Use immediately
  - Spray directly on plants or water soil around them

BLACK SOLDIER FLY LARVAE (BSFL)

Pros

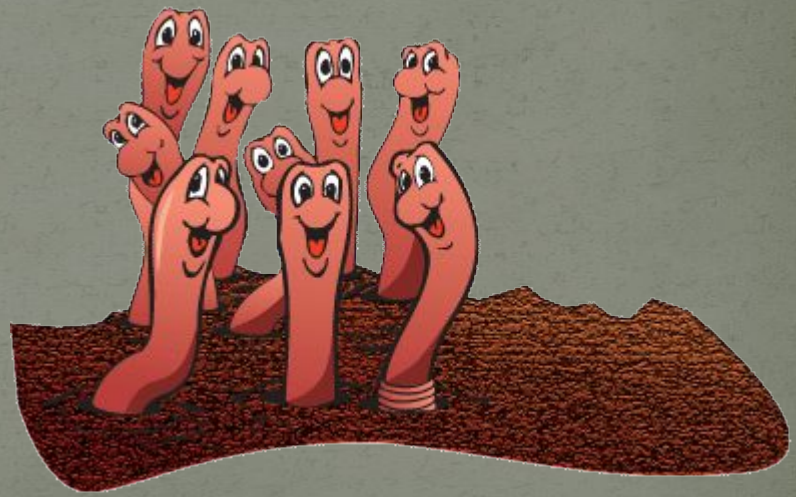
- can process foods that worms can’t
- native to southeast
- outcompete house flies
- larvae are 40% protein, 30% fat

…and Cons

- inactive during winter
- need wild population to re-populate

BSFL bins

Worms and BSFL – great composting partners!

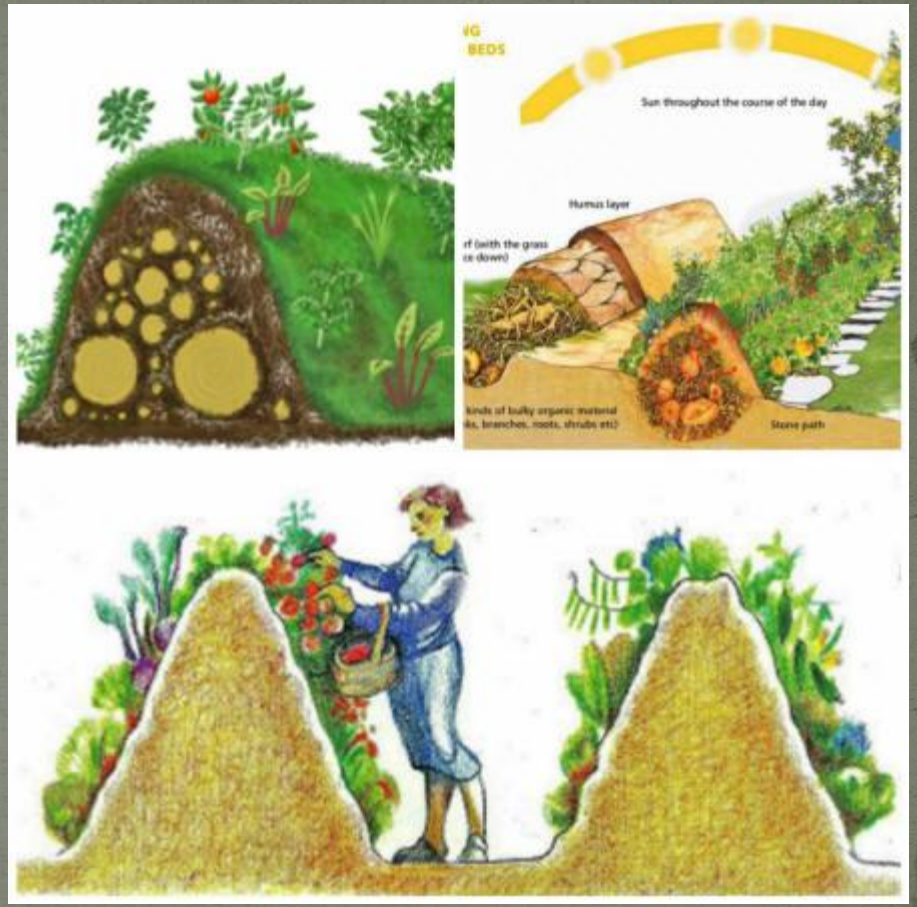


Hügelkultur

Permaculture setup using rotting logs and branches as foundation for a hill of sod/soil/compost

- Builds healthy soil ecosystem
- Slowly releases nutrients over time
- Holds plenty of water

Rotting logs become porous and soft, retaining moisture, encouraging beneficial soil diversity, giving off warmth and nitrogen

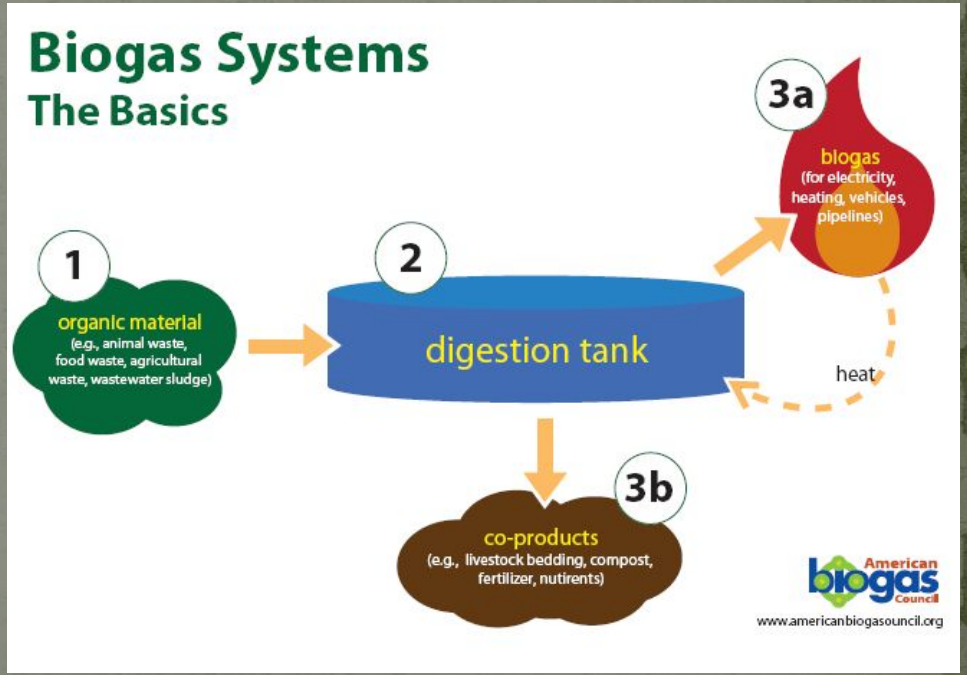


http://www.bibliotecapleyades.net/ciencia/ciencia_futurebeyond55.htm

Anaerobic Digestion

Microorganisms break down organic waste in the ABSENCE of oxygen

- Instead of heat, an acidic environment kills pathogens EVENTUALLY
- Can pasteurize or aerobically compost solid digestate
- Fresh digestate may be too acidic to use immediately



Resources

- **https://www.bae.ncsu.edu/topic/composting/**
  - Rhonda Sherman, NC Extension
- **http://portal.ncdenr.org/web/deao/recycling/composting**
  - Jorge Montezuma, NCDEQ
- **https://attra.ncat.org**
  - publications
- **http://carolinacompost.com**
  - NC Compost Council