REAL school gardens

Compost Compilations

Presented By

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Metamorphosis: Nature Transforming Lives Transforming Nature

Compost Compilations!

Changes in Nature

Ah, the cycle of life. Witness the beauty of decay and rot in a compost bin. We will begin with a quick overview of the process of composting and a few tips to get started and maintain an active compost bin. Then we'll observe and record quantitative and qualitative data about our compost from characteristics such as size and smell to composition and temperature. After recording our data we will take it back to the classroom to come up with appropriate ways to display and analyze our data for studying the wonderful world of decomposition and sharing the progress with our schools. Not to be ignored will be a discussion on the benefits of composting and how to take the process home!

What is this rotting mess?

Composting is just speeding up and intensifying natural processes. In composting, we bring together organic materials to speed up decomposition to use the end result – yummy, beneficial compost.

Why should I compost?

Figure 1 Typical Landfil

Our landfills aren't going to hold everything forever.

1. Think about your annual household waste:
   - ¾ of household waste is organic
   - Volume of yard waste is ~230 pounds PER PERSON!
   - Food waste is ~100 pounds PER PERSON!

   To put it into perspective, a four person family throws away 400 pounds of food waste a year and 920 pounds of yard waste a year! A 5 person family would be throwing away ONE TON of compostable material a year. Translate that to your school. Think about just food waste for 2 meals a day. We'll be generous and assume that 50 pounds of food waste per student is thrown out a year. In a small school of 400 students, that is ONE TON of food waste thrown to the landfills a year – all which could be easily composted and benefiting your school yard and garden!

2. Compost also provides benefits to soil health. Healthy soil needs Nitrogen (N), Phosphorus (P) and Potassium (K). Compost contains all of these nutrients PLUS Boron, Cobalt, Iodine, Iron, Manganese, Molybdenum and Zinc which are often overlooked as beneficial for soil health.
3. When used with soil, compost releases these nutrients as plants need them. When the temperature heats up– microorganisms speed up and compost releases the nutrients faster.
4. Compost increases the water capacity of soil.
5. Compost neutralizes soil toxins and metals and acts as a pH buffer.

Where it gets complicated (The Science of Composting)

Microorganisms, bacteria, fungi and actinomycetes, and macroorganisms make composting work. These are living things and living things need:

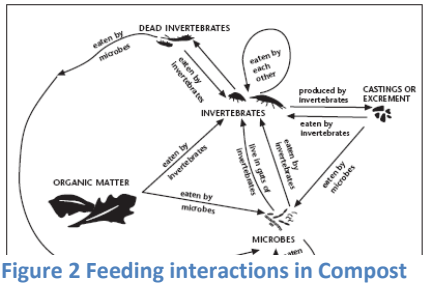


Figure 2 Feeding interactions in Compost

- Energy source (Carbon)
    - Leaves, straw, sawdust, dry and tough fibrous plant materials.
- Protein source (Nitrogen)
    - Manure, grass clippings, green vegetation, blood meal, kelp meal
- Oxygen and Moisture (Water)

3 Types of Bacteria

1. Psychrophiles live at 55°F (or around 13°C) which is the temperature where most refrigeration occurs. At this temperature carbon oxidizes and heat energy is given off which increases the compost temperature and helps to move into the mesophilic zone.
2. Mesophiles live between 70° and 90° F (or 21°-32°C) and create most of the decomposition in a compost bin. This is the temperature at which your compost bin will be most of the time and where much of the work is getting done.
3. Thermophiles live between 100° and 160°F where they stabilize (or 38° and 42°C). A compost bin will not remain at this temperature, but will peak and return to a mesophilic state until new material is added. This is the bacterial killing zone. Any harmful substances remaining in your compost will be killed off when this temperature is reached.

Fungi & Actinomycetes

- Cool temperature fungi break down cellulose and lignin
- Actinomycetes (½ breeds of fungi and bacteria) appear at medium temperatures and have a cobwebby look.

Macroorganisms

Earthworms ingest and digest organic material (including microorganisms) and leave castings behind that provide nutrients that plants usually wouldn't get.

Ratio Recipe

Carbon to Nitrogen (C:N) ratio of 30:1
Average C:N ratios from *Letting it Rot* by Stu Campbell

Compostable Material	Average C:N
Alder/Ash leaves	25
Grass clippings	25
Legumes	15
Manure (w/ bedding)	23
Manure	15
Oak Leaves	50
Pine needles	60-100
Sawdust	150-500
Straw, cornstalk, corn cobs	50-100
Vegetable trimmings	25

So what do I put in this mess? (Compostable materials)

The greater the variety the better! But remember, *to be composted materials must be biodegradable and contain things that are usable and available to microorganisms.*

Common compost materials

1. Ashes *(wood only)* potash a fine sprinkling over 18" or so
2. Shaved feathers contain Nitrogen
3. Garbage – all organic kitchen refuse

    a. Except grease, oil and animal fat! Meat scrapings will attract animals and flies. Dishwater often contains grease.
4. Grass clippings
    a. Dry first
    b. Mix with dry, absorbent materials
    c. Put them into layer – cake pile in thin layers
5. Ground stone and shells – very fine particles
6. Hay or Straw – should be weathered first
7. Hedge trimmings – chopped or shredded
8. Hops – spent (from brewery waste) may retain a bit of moisture
9. Leaves – chop and mix to speed up decomposition
10. Leather waste (dust) contains Nitrogen and Phosphorus
11. Newspaper – shredded
    a. Carcinogenic carbon black ink is rendered inert by high temperatures
    b. Colored ink is mostly vegetable dyes, no longer heavy metal ink
12. Peat Moss – adds no nutrients, but adds bulk
13. Pine needles – break down slowly but are a good texturizer
14. Sawdust – thin sprinkles
15. Seaweed (Kelp) adds potassium
16. Sod – adds topsoil and organic matter and is a good insulator (place on top of pile, roots up, grass down)
17. Weeds – thermophilic temperatures kill most weed seeds and also if subjected to digestive system of earthworm they will not survive. If you add weeds, add manure or like substance to ensure sufficient heating.

Stubborn Materials

Corncobs, apple pomace, citrus rinds, cotton stalks, sugarcane leaves, palm fronds, walnut, pecan and almond shells (peanut hulls are excellent though!)

Materials to avoid

1. Coal/charcoal
2. Colored paper with heavy metal dyes
3. Diseased plants
4. Non-biodegradable items (synthetic materials)
5. Pet litter
6. Sludge (human waste)
7. Toxic chemicals

Speed it up!

Composting is a slow process, unless intervention is provided.
Aeration is necessary to speed up decomposition.

- Put in ventilation stalks to allow air to move through
- Lift and fluff with a pitch fork or compost aerator to expose material to Oxygen

Moisture is also a key indicator of how quickly your compost bin will work

- Moisture ratio of 40-60% (consistency of a well wrung wet sponge)
- Moisten as you build and add material
- Moisten as you aerate

- Use rainwater! Rainwater picks up lots of oxygen, minerals, microorganism as it falls and adds those beneficial items to your compost automatically.

Keep it moving by turning your compost

- To remain in a thermophilic state your compost bin needs to be turned every 3-4 days
- Turn the pile whenever the temperature drops below 100° F

Ground, chop and chip your material before you put it into your pile.

Activators

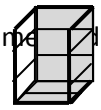
1. Complete compost
2. Manure
3. Meal (but look out for pesticide residue found on many types of meal)
4. Natural activators
    a. Alfalfa meal, blood meal, bone meal, compost, cotton seed meal, fish meal, hoof meal, manure, soil
5. Artificial activators
    a. 10-15-10 fertilizer – 1 cup for every 10 square feet
6. Bacterial activators

Composting methods

There are *many* methods to composting. A few that are most commonly used are:

- Heap method - a 5'x3' pile out in the open. You'll need at least two piles.
- Indore Process (not *indoor*) invented by Sir Albert Howard uses sandwich like layers of green/wet – dry/withered and requires you to keep an accurate moisture content, optimum pile size and good aeration.
- University of California Method will give you compost in just 14 days. Use all chopped or shredded material with a thorough blending of C:N and turn your material often.
- Ogden 3 pile system requires that you move a completed compost pile and start a new one. The idea is that you should have compost at 3 different stages at all times; beginning, middle, end.

Compost Systems



- Wooden box made using pallets. Create ½ of a cube to contain your compost. It is recommended to use 4 pallets per box, using one as a floor piece to allow for aeration.
- Circular or 5 panel wire bins
- 3 bin system made from wood and wire
- Commercial plastic bins made from a steel drum or garbage can
- Composting tumblers

Some small scale systems are:

- Indoor worm composting using a 1'x2'x3' wood box filled with shredded newspaper, manure and leaf mold. Temperature of this system stays between 50° and 84°F. For every ground up pound of garbage you "feed" your system, add 2 pounds of red or composting worms.
- Bag composting uses a 32 gallon trash bag where you toss in food scraps, leaves, grass clippings, garden soil or compost and alfalfa meal to activate. Shake the bag to mix and add water if too dry or dry leaves if too moist. Once the bag is full, spread and start over – but HOLD YOUR NOSE! Fluff the bag to get a lot of oxygen in and mix in some soil and let it dry before mixing into your garden.

My compost is [NPK] complete, now what?

Is it really finished? Complete compost will be free of pathogens and used seeds. It will contain an adequate supply of major nutrients. It will appear crumbly, dark in color and smell sweet and earthy (it truly smells incredible). The temperature should drop from 150°F to the outside temperature. Finally, it should contain 25-30% organic matter.

Uses for compost

- Spread your finished compost over whole growing area in fall or a month before spring planting.
- Spread finished compost over plantings
- Compost tea
    - 1 part compost with 5 parts water. Stir and let sit for several days.

Too much compost?

- Adding too much compost can make your soil too carbonaceous. Check soil pH to check for affect. An excessive amount of added compost can also repel water. Your soil should contain 5-10% organic matter.

What about my class?

There are a number of applications to your class for composting. Aside from the science of the Nitrogen cycle and the environmental aspects of composting, a compost bin provides many opportunities for data collection, monitoring and analysis.

- pH – average garden soils range between 4.7 and 7.0
    - Adding lime will raise your pH
- Nitrogen
- Phosphorus
- Potassium
- Temperature
    - Hot compost – kills seeds, pathogens destroyed quickly
    - Cold compost – earthworms not harmed, less turning, better at preventing damping off disease of seedlings.
- Pathogens are killed off at about 140°F
- Insects are a good sign! Except symphylans (resemble centipedes) and maggots and flies are a nuisance
- Weeds – pull them before they get too big and turn their roots toward the sun

Trouble Shooting Chart

From *Let it Rot* by Stu Campbell and *Composting in the Classroom* by Nancy Trautmann and Marianne Krasny

Problem	Possible Cause	Solution
Unpleasant odor from pile	Not enough oxygen due to compaction	Aerate
	Not enough oxygen due to overwatering	Add carbon materials to soak up excess water; improve aeration
	If odor of ammonia, too much nitrogen	Add carbon materials and aerate
Pile not heating up	Lack of nitrogen	Mix in a nitrogen source. If you can't mix the materials easily, try making holes in the pile and pouring in the nitrogen materials
	Not enough moisssssssssssss" ASSSSSSSwz"?sture	Stick a garden hose down into the pile in several locations and water; or poke holes into the pile with a rod and pour water down the holes using a watering can.
	Pile needs to be turned	Use a pitchfork to bring materials from

		the outside of the pile to the center
	Compost may be finished.	
Compost is damp and warm only in the center	Pile is too small	Gather more materials and rebuild a larger pile
Pile is attracting animals	Meat and other animal products have been included	Keep meat and other animal products out of the pile; enclose in a ¼ inch hardware cloth
	Food scraps are not well covered	Cover all food with brown materials such as leaves, woodchips or finished compost

References

Cambell, Stu. *Let it Rot: The Gardener's Guide to Composting.* North Adams, MA: Storey Publishing, 1998.

Trautmann, Nancy M. and Marianne E. Krasny. *Composting in the Classroom: Scientific Inquiry for High School Students*. 1997 <http://cwmi.css.cornell.edu/compostingintheclassroom.pdf>

What changes are taking place in a compost bin?

Tools available:
Thermometer Hand lens Meter Stick Pitchfork Soil test kit

What data will we collect?	Is it qualitative or quantitative?
1._____	_____
2._____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____

Data collection:

Taking it to my school

What changes need to be made to this activity to make it relevant to my students?

Helpful hints to remember!

Great idea! Teachers love to share!

Idea	*Who came up with it and how can I find them?*
1. _____	_____
2_____	_____
3_____	_____
4_____	_____
5_____	_____

Additional resources

Basic Composting: All the Skills and Tools You Need to Get Started by Erich Ebeling
Composting: A Practical Step by Step Guide by Penguin