



# COMPOSTING 101

## Why Compost?

Fertilizers feed plants, Compost feeds the soil.

Compost recycles garbage into nutrients and a symbiotic food web to feed the soil ecosystem. Backyard composting speeds up the natural process of decomposition by providing optimum conditions so that organic matter can break down more quickly.

## How does decomposition happen?

### Microorganisms

Bacteria, fungi, and actinomycetes

*Chemical Decomposers*- change the chemistry of organic waste.



### Macroorganisms

Mites, centipedes, sow bugs, snails, millipedes, springtails, spiders, slugs, beetles, ants, flies, nematodes, flatworms, rotifers, and earthworms.

*Physical Decomposers* - masticate organic matter into smaller pieces.

## Aerobic Bacteria:

>90% of decomposition. A Home Composter's job is to create ideal conditions for aerobic bacteria.

- Psychrophilic, Mesophilic Bacteria, Thermophilic Bacteria
- Millions per gram of soil
- Use Carbon for energy and respiration through oxidation

Other Microorganisms:

- Actinomycetes :
  - Filamentous bacteria (looks like a fungus) that breaks down lignin, starches, proteins, and cellulose during the cooling process.
- Fungi:
  - Finish off lignin and cellulose

### Key factors:

C:N  
Oxygen  
Temperature  
Moisture

## Key factors in Compost Happiness...

### Carbon to Nitrogen Ratio (C:N)

If you get the C:N right, the other stuff often takes care of itself.

#### Optimal C:N Ratio = 25-30:1

**Carbon:** energy, building cell walls, burned up and respired as carbon dioxide (CO<sub>2</sub>).

**Nitrogen:** used in many lifecycle functions

Generally, organisms respire about two-thirds of the carbon they consume as CO<sub>2</sub>, while the other third is combined with nitrogen in the living cells.

- Too much Carbon (>30:1) slows heat production and decomposition (pile of woodchips).
- Too much Nitrogen raises pH to toxic levels, too wet, anaerobic.

What has more Carbon and what has Nitrogen?

MATERIAL	C:N RATIO
Corn stalks	50-100:1
Fruit waste	35:1
Grass clippings	12-25:1
Hay, green	25:1
Leaves, ash, black elder and elm	21-28:1
Leaves, pine	60-100:1
Leaves, other	30-80:1
Manure, horse and cow	20-25:1
Paper	170-200:1
Sawdust	200-500:1
Seaweed	19:1
Straw	40-100:2
Vegetable waste	12-25:1
Weeds	25:1
Wood chips	500-700:1

**Green** = Nitrogen Rich "Greens"

**Yellow** = Carbon Rich "Browns"

RULE OF THUMB: ¼ to ½ Green materials, and the rest Browns.

## Oxygen:

*Aerobic Bacteria need to breath.*

- Oxygen must be greater than 5%
- Oxidize Carbon to CO<sub>2</sub>, while converting Carbon and Nitrogen to Biomass.

### **Anaerobic Imposters**

- Produce a lot of useless organic acids, amines (ammonia-like substances), hydrogen sulfides
- Smelly, contain unavailable nitrogen and, in some cases, are toxic to plants

To monitor oxygen, create aeration: increase porosity with frequent turning, add coarse material.

RULE OF THUMB: Again, Keep 50-75% Browns and Mix.
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## Moisture:

All decomposers (Macro and micro) need water.

- Optimal: 40-60%
- Most microorganism activity occurs in thin water film on the surface of organic matter.
- If it's too dry, add nitrogen rich sources, turn, and water slowly.
- If it's too wet, add carbon sources and turn.

RULE OF THUMB: 1:3 Greens:Browns (sounding familiar?). Keep it damp, like a wrung-out sponge.
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## Temperature Cycle:

Check your compost temperature regularly with a compost thermometer, or stick a metal pole in the pile, pull it out and feel the end.

90-140 F is the "Rapid decomposition zone"

Psychrophilic Bacteria: 55-70 F

- Decompose slowly, raise temperature to 70F

Mesophilic Bacteria: 70-100 F

- Decompose Rapidly
- >100F move to outside of the pile

Thermophilic Bacteria: 113-160 F

- Stabilizes @130-160 F for 3 to 5 days to use up materials
- >140 F Kill pathogens and weed seeds

- >160 TURN! May create sterile compost and kill good disease fighting properties

Actinomycetes and Fungi:

- Actinomycetes are a bacteria that looks like a fungus that further breaks down lignin, starches, proteins, and cellulose during the cooling process.
- Fungi also finish off lignin and cellulose after the heat has subsided (70-75 F).

**Larger piles** retain heat and moisture: at least 3x3x3', or 4x4x4' if it's windy.

Some people cover their piles with a tarp or two in the winter to prolong heat retention.

RULE OF THUMB: Hot to the touch means it's working, turn it when it cools down again.

## Particle Size

Small sizes increase surface area and more opportunity for microbial activity. Having a diversity of sizes creates **porosity**, which creates air spaces.

Chopping tricks:

- Mow leaves with a mower
- Shred leaves with weed whipper in a garbage can
- Chop kitchen scraps with a knife

RULE OF THUMB: Small and Diverse - About like a silver dollar

## The Compost Food Web:

"Mites and springtails eat fungi. Tiny feather-winged beetles feed on fungal spores. Nematodes ingest bacteria. Protozoa and rotifers present in water films feed on bacteria and plant particles. Predaceous mites and pseudoscorpions prey upon nematodes, fly larvae, other mites and collembolans. Free-living flatworms ingest gastropods, earthworms, nematodes and rotifers. Third-level consumers such as centipedes, rove beetles, ground beetles, and ants prey on second-level consumers." -- Soil ecologist Dr. Daniel L. Dindal

## Macroorganisms Index:



**Ants** - Bring fungi and other organisms into their nests. Make compost richer in phosphorus and potassium by moving minerals around as they work.



**Millipedes** - Help break down plant material by eating soft decaying vegetation.

**Centipedes** - Third-level consumers, feed on soil invertebrates, especially insects and spiders.



**Sow bugs** - Feed on rotting woody materials and other decaying vegetation. Pill bugs look similar to sow bugs, but roll up in a ball when disturbed.



**Springtails** - Springtails are small insects distinguished by their ability to jump when disturbed. Principally fungi feeders, although they also eat molds and chew on decomposing plants.



**Flies** - Flies are two-wing insects that feed on almost any kind of organic material. They also act as airborne carriers of bacteria, depositing it wherever they land. Control their numbers by keeping a layer of dry leaves or grass clippings on top of the pile. Also, bury food scraps at least eight to twelve inches deep into the pile. Thermophilic temperatures kill fly larvae. Mites help to keep fly larvae reduced in numbers.



**Beetles** - Rove beetles, ground beetles, and feather-winged beetles. The feather-winged beetle feeds on fungal spores. Immature grubs feed on decaying vegetables. Adult rove and ground beetles prey on snails, slugs, and other small animals.



**Snails and slugs** - Feed primarily on living plant material, but they will also attack plant debris. Look for them in finished

compost before using it, as they could do damage to your garden if they move in.



**Spiders** - Third-level consumers that feed on insects and small invertebrates. They can be very helpful for controlling garden pests.



**Earthworms** - Earthworms are the most important of the large physical decomposers in a compost pile. They ingest organic matter and digest it with the help of tiny stones in their gizzards. Their intestinal juices are rich in hormones, enzymes, and other fermenting substances that continue the breakdown process. The worms leave dark, fertile castings behind. A worm can produce its weight in castings each day. These castings are rich in plant nutrients such as nitrogen, calcium, magnesium, and phosphorus that might otherwise be unavailable to plants. Earthworms thrive on compost and contribute greatly to its quality. The presence of earthworms in either compost or soil is evidence of good microbial activity.