Welcome to the Biology and Essentials of Composting

Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council

Composting is a biological process that requires food (organic materials), water and air. This brochure provides an overview of the biology and essentials of composting under the following headings:

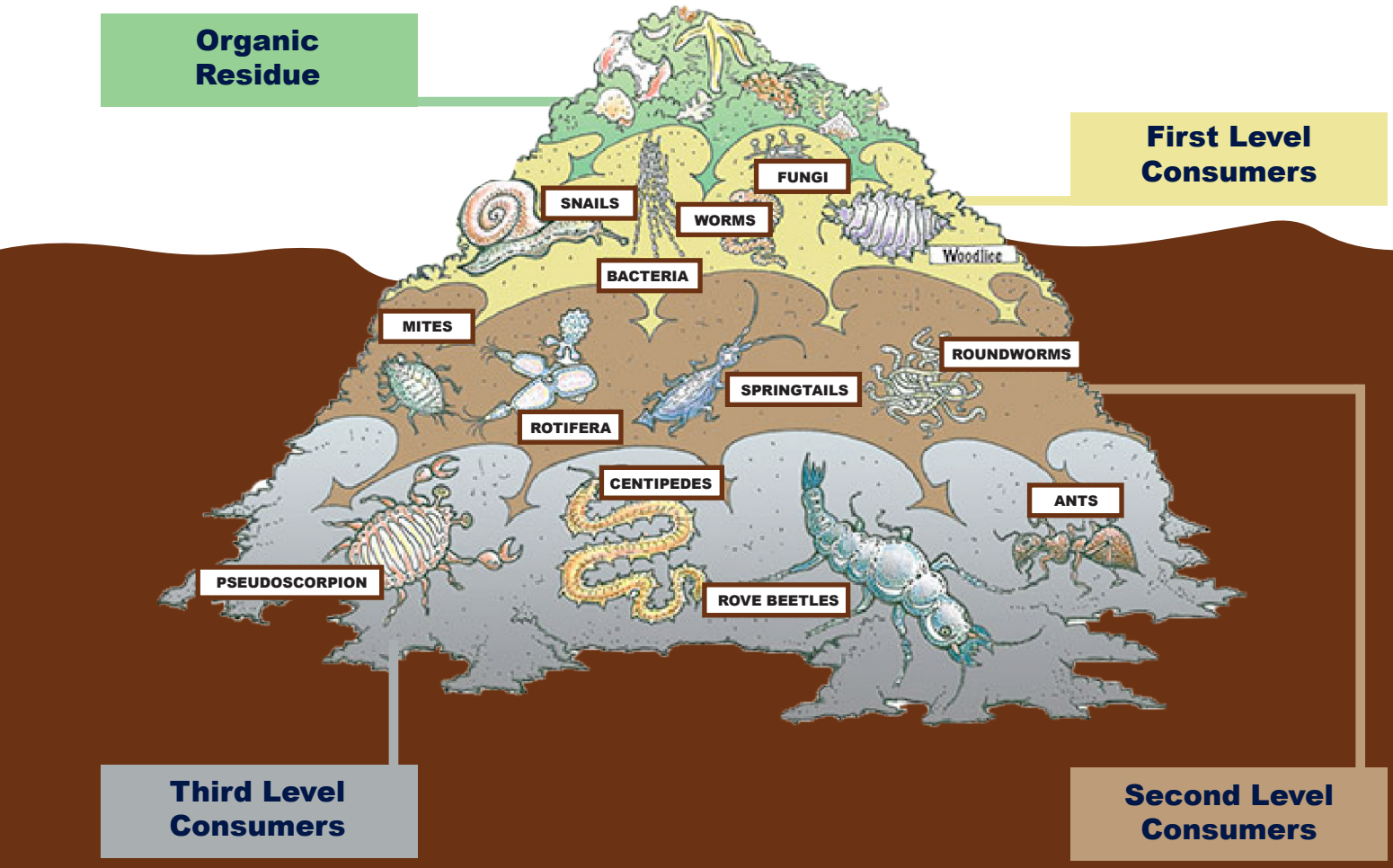
- *What is Compost and Composting?*
- *The Biology of Composting*
- *The Composting Essentials*

What Is Compost and Composting?

Composting, which harnesses the natural biological process of decomposition, turns landscape & garden materials and plant derived food scraps into a dark, crumbly and earthy smelling material. The compost produced has a pleasant earthy smell, is rich in nutrients and full of life. When used in your garden and on your plants, compost feeds the ecosystem of life in the soil and slowly releases nutrients that plants can easily absorb. Using compost is the foundation of maintaining healthy soil for stimulating plant growth and creating a beautiful garden or landscape.

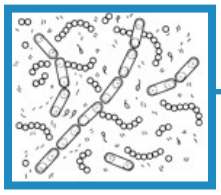
The Biology of Composting... How Does It Work?

- Composting involves a wide variety of organisms which are naturally present in our environment. The compost pile is really a teeming microbial farm.
- In the beginning of the composting process, bacteria are the first to start breaking down plant tissue – they are the most numerous and effective decomposers.
- Other composting organisms, including protozoa, fungi, moulds, worms and other small insects, also take part later on in the composting process.
- No one organism, or group of organisms, are responsible for composting on their own. It is a succession of creatures that makes it all happen. The life cycle of the compost pile shows the various critters involved.

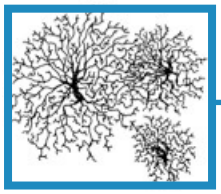


The different composters - who's doing what

So, there are three main levels of consumers involved in the composting process. Some of the key composters involved are described in a little more detail here.



Bacteria are single celled organisms and are the powerhouse of the composting pile. They are the first to colonise the pile, are the fastest and most efficient decomposers, and are responsible for the generation of the heat associated with composting. Other primary decomposers, feeding directly on decaying materials include: actinomycetes, fungi, red worms, woodlice, slugs and snails.

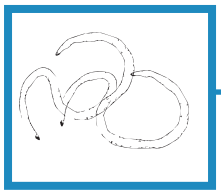


Actinomycetes produce greyish growths throughout compost and give the pile a pleasing earthy smell. They thrive on woody materials and survive in a wide range of conditions.

Wood Lice feed on woody materials and durable leaf tissue, and are often mistaken as pests.

Red Worms or Tiger Worms with white or yellow rings (as opposed to larger earthworms or nightcrawlers that live in the soil) play an important part in breaking down materials and stabilising finished compost. Worm castings are rich in readily available nutrients and hormones that stimulate plant growth.

include nematodes, mites, springtails, and centipedes.



Nematodes, or roundworms, are the most abundant invertebrates in the soil. Though there are many forms of nematodes, most are beneficial. They prey on bacteria, protozoa, fungal spores and each other.

Mould Mites, also called fermentation mites, feed on yeasts in fermenting materials. They can become pests in the wine and cheese making processes, but they are not pests in the compost pile.

Springtails feed principally on fungi, although they also eat nematodes and small bits of partially decayed materials.

Centipedes and millipedes are frequently found in compost piles. Centipedes prey on almost any organism near their size and smaller while millipedes are herbivorous, eating decaying matter.

Composting Essentials

Composting and the organisms involved, like all other life forms, need food, air and water to survive and thrive. The five essential ingredients for successful composting are:

1. Nutrients: Green & Brown Materials
2. Particle Size & Surface Area
3. Moisture
4. Aeration
5. Size of Pile

1. Nutrients: Green and Brown Materials

Composting organisms thrive on a balanced diet of nitrogen-rich “green” and high-carbon “brown” materials. The “greens” provide protein needed for growth and reproduction while the “browns” supply energy. Fresh green grass clippings are high in nitrogen; dead brown leaves are high in carbon. Separately, these materials may not compost well on their own: grass cuttings tend to compress, turn gooey and smell bad; while leaves by themselves break down very slowly. Mixing them together though is a perfect composting mix. Just like baking a cake, it is important to always balance “green” wet materials with drier “brown” materials. Try half and half to start with and adjust as needed.

For example, if you want to compost food scraps, you will need to balance them with a dry (brown) carbon source, such as hedge prunings, straw, hay, saw dust, wood shavings or autumn leaves. Composting food on its own or with grass cuttings will not work very well either and can lead to a smelly, gooey mess.

Remember that variety is the spice of the compost pile’s life! So mix it up and add as much variety as you can.

2. Particle Size and Surface Area

When it comes to composting, the smaller the particle, the faster it will break down. This is because decomposers work from the surface inward so to speed up composting:

- Chop woody stalks with a shovel
- Use secateurs to cut materials into 10-20cm pieces as you garden
- Run over leaves or weeds with a lawn mower, or
- Put woody trimmings through a shredder.

Chopping things up helps make a better mix of materials when forming a pile. It also makes it easier to turn piles later on for faster composting. Ideally, you want a mix of fine and coarse materials, from grass clippings to chopped-up bush trimmings, in your pile.

3. Moisture

All life requires moisture to sustain itself and composting is no different. It is important to remember that the main composting organisms live in the film of moisture that surrounds each particle. Too little moisture and the composting organisms die off or go dormant. Too much moisture, and the pile can drown allowing anaerobic bacteria, which thrive in the absence of air, to take over and potentially create foul odours. Ideally, the surface of each particle should be moist enough to support the decomposition process which starts on the surface of the materials and works inward from there.

Maintaining the proper moisture level is easy. Here's how:

- At the start, materials should be sprayed with water so you can clearly see a visible sheen of moisture on them.
- Spray and mix dry trimmings on the ground before they are added to the pile or bin.
- If piles dry out, spray them with water when they are turned.
- Keep compost piles in the shade so they do not dry out.
- Always cover open piles with plastic or plywood. In most countries, this is to keep moisture in, but in Ireland, this is to keep the pile from getting too wet from all of the rain.

So remember, the pile should be moist but not soaking wet and should feel like a wrung out sponge.

4. Aeration

Just as with water, all composting organisms need oxygen to survive and thrive. To promote good aeration and therefore good composting: Create a pile with lots of tiny air pockets: by adding stems, stalks, chips and other rigid materials, the pile will hold oxygen better. This also helps promote passive air flow through the pile. With a good blend of materials and adequate moisture, the heat produced from composting rises drawing air into the pile.

(4. Aeration)

- Build the pile on a few inches of coarse materials: a layer of stalks, wood chips, or broken branches at the bottom will raise the pile slightly above the ground and help air to flow underneath and up though the compost. This also improves drainage from the pile if it gets too wet.
- Don't build the pile too big: Air penetrates from the surface, sometime up to a metre into the compost pile. Larger piles can become compacted and this will squeeze out the air pockets from the pile. So smaller piles will get more air than larger ones.
- Turn the pile: this helps to fluff up and aerate materials. For larger piles, it restores the air spaces needed for the pile to "breathe" again. Depending on your energy level and your need for finished compost, piles can be turned, weekly, monthly, annually or not at all.
- If the pile gets soggy: turn it and add in coarse stalks, sawdust, dry leaves or straw and/or bush & tree trimmings.

5. Size of Pile

While the size of the pile will be determined by the amount of material you have to compost and the system you chose to use, the ideal size is about one cubic metre. A pile of this size can be made with materials accumulated over time (cool piles) or made all at once (hot piles). When a large pile is made all at once and all of the optimal conditions for composting are met – the proper balance of nutrients, air and water – the breakdown of materials is so rapid, that the pile generates heat and can get as hot as 70°C. Piles of one cubic metre in size and larger also have an ability to hold heat better due to their self insulating qualities. Smaller piles aren't as good at holding heat and tend to dry out quickly, though bins with solid sides and a lid help keep smaller piles warmer and moister. But remember, with larger piles they may require a little more work with turning periodically to introduce air into the middle.

Additives

While compost additives ("activators," "accelerators," "starters", etc.) are often recommended for on-site composting, none of these ingredients are essential for composting. Such compost "activators" often contain nitrogen fertiliser, dried enzymes, microbes and/or other nutrients, which help "kick-start" or speed up decomposition. The main point is that there are plenty of composting organisms already present on the materials and they are ready to start working when the conditions are right.