Composting 101: The Real Dirt – a presentation by Stephen Brueggerhoff; © 2012
This slide show is developed to explain the process of decomposition, how to build a compost pile, compost pile maintenance, different styles of compost bins, & resources for further exploration.
Composting mimics a natural process that can transform your kitchen & garden waste into a valuable resource for your garden. Young or old, composting is an activity that anyone can do.
There are many reasons each of us may compost:

1. Resource conservation – add nutrients to soil, prevent soil erosion, cut down on water usage, reduce pollution, reduce landfill waste!!

2. Limited space – live in an apartment, town home, small lot footprint, etc.

3. Personal – we make a difference; exercise; save money!!
Definitions:

1. **Compost** - from Latin *compositus* (to put together). Late 14 cen., from M.Fr. *composte* "mixture of leaves, manure, etc., for fertilizing land".

2. **Humus** - the organic constituent of soil, usually formed by the decomposition of plants & leaves

3. **Microinvertebrates** – fungi, bacteria (listed below), actinomycetes, etc.
   a. Psychrophiles; b. Mesophile; c. Thermophile

4. **Macroinvertebrates** – worms, insects, etc.

5. **Aerobic** – with oxygen

6. **Anaerobic** – without oxygen

Let’s review a few terms you may read about in your research.

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2. **Humus** - the organic constituent of soil, usually formed by the decomposition of plants & leaves

3. **Microinvertebrates** – fungi, actinomycetes, & bacteria, etc. The primary class of species that aid in decomposition
   a. Psychrophiles – bacteria that decompose organic matter in cooler temps; 50-F to 70-F
   b. Mesophile – primary decomposing bacteria in a compost pile; 50-F to 110-F
   c. Thermophile – heat tolerant decomposing bacteria; 110-F to 160-F

4. **Macroinvertebrates** – worms, insects, etc.

5. **Aerobic** – with oxygen

6. **Anaerobic** – without oxygen
How Do You Know When You Do It Right?


We use an aerobic process when we compost at home. Living organisms (e.g. decomposers) use oxygen & water to feed on organic matter. These organisms develop cell protoplasm from the nitrogen, some of the carbon, phosphorus, & other nutrients present in decaying organic matter. Much more carbon than nitrogen is used in the process of decomposition. Carbon molecules combine with oxygen molecules, & app. two-thirds carbon is respired as CO₂ while the other third combines w/ nitrogen in living cells. If the amount of carbon over nitrogen being decomposed is greater, biological activity diminishes & several cycles of feeding organisms are required to decompose most of the carbon. When the ratio of carbon to nitrogen is low enough, nitrogen is released as ammonia. This imbalance can result in ‘rotten’ or sulfurous smells. Turning your compost pile regularly w/ a pitchfork provides air spaces in the pile for oxygen, aiding in decomposition & reducing the foul odor.
Pit composting is another example of aerobic composting. Note the tube with holes inserted in the middle to provide oxygen to the decomposing organic matter. Aerobic composting can be accomplished in pits, bins, or piles if there is adequate oxygen present.
A great deal of energy is created in the oxidation of carbon to CO$_2$, resulting as heat. Organic material has the potential to raise over 170-F temperature during decomposition. Microbes, specifically bacteria, are the workhorses of the compost pile. Psychrophilic bacteria work in the lowest temps (most active at 55° F - 70° F). Most commonly present: Mesophilic bacteria (50° to 115° F). When temp’s exceed 120° F, thermophilic organisms thrive (115° to 160° F), replacing mesophilic bacteria in the decomposing material. Oxidation at thermophilic temperatures takes place more rapidly than at mesophilic temperature.

If temp’s exceeds 162-F to 172-F, could kill off decomposing organisms. One advantage to generating higher temp’s is that the heat destroys pathogenic bacteria & weed seeds.
Ah, Composting Critters!

There are also critters present in a compost pile: Macroinvertebrates – decomposing & predator insects.

‘Rolly-Pollies’, or Pillbugs – present in temp’s at mesophilic range. They feed on woody materials not decomposed by others.

Millipedes - have multiple body segments, each having two pairs of leg segments (the front few segments w/ one leg pair per segment). Millipedes feed on dead plant matter.

Centipedes - multi-segmented, w/ each segment having one pair of legs. Centipedes feed on other insects.

Spiders – eat other insects, help control garden pests.

Earthworms – eat organic matter; mostly fungi, bacteria & protozoa.

Nematodes – micro-organisms & worms, bacterial & fungal feeding. Additional macro-invertebrates present - Springtails, flies, mites, etc.
We are looking for organic material that has a balanced carbon to nitrogen ratio (e.g. C:N ratio) to add to the compost pile. Generally speaking, we are looking for organic material ranging between 25:1 and 30:1 for more active decomposition.
Table: examples of organic materials & their C:N ratio’s. If carbon ratio is more than 30:1, heat production drops & decomposition slows. This is why a pile of only leaves or wood chips can look like they have not decomposed over a long time.
What to Avoid?

X Ashes & charcoal
X Dairy products (odors, insects)
X Fats, grease, & oils
X Invasive weeds (seeds)
X Meat, fish & poultry (no bones)
X Non-organics (plastic, metal, glass)
X Pet feces (pathogens)
X Treated wood (preservatives/toxins)
X Waxed or glossy paper
These are tips for building your compost pile from the ‘ground’ up:

1. Select dry, semi-shady spot of bare soil near water source
2. Adequate space: 3’ x 3’
3. Layer of 6-inches of browns; add 3-inch layer of greens
4. ALWAYS water between layers
5. 3 parts browns to 1 part greens. Sprinkle thin layer of soil or finished compost

Building Your Compost Pile

Note: Compost decomposes fastest, internal temp’s between 120-F & 160-F

1. Select dry, semi-shady spot of bare soil near water source – will be challenging keeping your pile w/ adequate moisture in higher temp’s of Central Texas, & semi-shady location is best. ‘Dry’ area meaning not on saturated, anaerobic soils. Remember that organic matter will release moisture/water as it decomposes. The area underneath a finished compost pile will be rich in nutrients & will be ready to create a pocket garden.

2. The ideal size for the compost structure is 3 ft. X 3 ft. X 3 ft. If the bin is higher or wider than 3 feet, aeration becomes a problem & the composting process occurs more slowly.

3. Approximately 6-inches layer of twigs/stems cut into 4 to 6-inch segments will be ideal for aeration at the bottom of your pile. Place ~3-inch layer of mixed, shredded greens on top of the pile.

4. Water your pile in between layers to the approximate dampness of a wrung out sponge.

5. Continue to add 1 part greens to 3 parts browns as you build your pile; remember to water between layers. Sprinkle thin layer of soil or finished compost on your new pile, which contain active microbes that will help begin the process of decomposition.
One can use a compost ‘activator’ to begin the process of decomposition. These organic materials contribute a high nitrogen source, microorganisms, or both to the compost pile, & provides a quick boost to the decomposition process. Remember: you will NOT need to continue to add these ‘activators’ once you establish a balanced compost pile. Also, more is not better so always follow directions for use on the packaging label. Please remember to ONLY use organically certified materials; more info at USDA website: http://www.ams.usda.gov/AMSv1.0/nop.

Composted poultry manure – there has been documented evidence (article at: http://orange.ces.ncsu.edu/files/library/68/Herbicide%20Carryover.pdf) of herbicide persistence found in cattle & horse manure (e.g. Aminopyralid, clopyralid, fluroxypyr, picloram, & triclopyr are in a class of herbicides known as pyridine carboxylic acids). While not all range pastures have applications of this class of herbicides, caution is recommended when using cattle/horse manures in the composting process. Remember to find out & know the source of the manure. Composted poultry manure might be a better alternative as an activator.
Maintenance:

1. Woody material (e.g. browns) – cut from 4 to 6-inches in length. Kitchen/veggie/garden scraps – always shred & cut into small pieces. Example: a 6-inch wide cabbage leaf has a large surface area & will decompose more rapidly if cut into smaller sizes.

2. Turning your compost pile increases internal pore space, allowing more oxygen into the pile.

3. Keep ratio of 3 parts browns to 1 part greens as you add; may be more efficient to bring a larger collection of veggie scraps to your pile.

4. If your compost pile is drying out too fast between watering, consider covering with plastic tarp. Always remember to check on your pile to make sure it is getting enough oxygen.
Q: What is wrong with this picture? A: Too much woody material, no presence of ‘greens’, imbalance of the carbon to nitrogen ratio.
To remedy: Add a proper ratio of 3 parts browns to 1 part greens (more balanced carbon to nitrogen ratio), adequate moisture & oxygen, & if necessary, cover to retain moisture. Note: the white material on top of the pile is the presence of fungal mycelia (thread-like, branching parts of a fungus that is decomposing the organic matter).
Tools: gloves, pruners, pitchfork for turning the pile, & compost thermometer. A compost thermometer helps you to keep an eye on the temperature of the pile to make sure the decomposers are doing their jobs.
The Right Compost Bin For You

3-bin turning unit: http://www.artfulparent.com/2009/05/the-best-compost-bin-ever.html; by Jean Van't Hul

You can find many plans for making your own compost bins through an internet search. One such source of plans for making 3-bin turning unit: http://www.uaex.edu/Other_Areas/publications/PDF/FSA-6033.pdf; from URL: http://extension.missouri.edu/p/G6957
Consider building your compost bin from materials you may have around the house, or materials you can get for free (with permission) from businesses or neighbors. Example: wooden shipping palettes, that may otherwise be placed in a landfill.

From: http://400things.blogspot.com/2011/05/diy-compost-bin.html
Garbage Can Compost Bin: image source - supermomnocape.wordpress.com

Make sure structures you use to make your compost bin have not been used to store or contain toxic chemicals. Regardless of the type of structure you choose, make certain it is well-ventilated for good air circulation throughout the composting process.

As organic matter decomposes, it will release moisture/water. You may wish to insert drain holes at the bottom of a static unit, & place your bin in an appropriate location regarding drainage.
http://www.thehomespunjournal.com/2012/03/09/diy-compost-tumbler. Note: this compost bin is made from a food-grade barrel.
Some home owner’s associations may require the use of commercial products for your compost bin. Each type of commercial product has its challenges: adequate internal space to easily turn the compost (see the product ‘Composter’); organic matter may not completely tumble/rotate inside the container (see the product ‘Tumbler’); too much organic matter may build up in the composter (see the product ‘Green Cone’); & cost. Consider building your own compost bin/mechanism to save on cash, to recycle materials & to continue to be an environmental citizen.
Viola! The Finished Product!

Image: normanack, 2008
Aerated compost tea mechanism: image source - http://www.gardensecrets.org/2012/02/14/compost-tea-anyone-part-2/; photo by: bucklava

Consider that finished compost in it’s solid form will add nutrients & microorganisms to your garden over time as it decomposes, also improving soil structure and tilth.

Compost tea is a nutrient rich liquid derived from ‘steeping’ finished compost in water. Aerated compost tea is a source of nitrogen, potassium & other nutrients for your garden & landscape.

While occasional addition of any fertilizer to your garden in liquid form is a ‘quick fix’ & will temporarily aid in combatting nutrient deficiencies expressed by your plants, always remember to use products such as compost tea only as warranted. If your plants look a little stressed, diseased, or chewed upon, always investigate the cause of the malady before applying a ‘remedy’. Regardless, every day use, or every time you water use, of any liquid fertilizer is not a sustainable practice (e.g. will help temporarily with possible nutrient deficiencies, but not practical for sustained, every day long term use).
There are many books available on home composting; visit your local library to find out more! Some books to consider:

The complete compost gardening guide by Barbara Pleasant

Mini farming: self sufficiency on a ¼ acre by Brett L. Markham

Let it rot!: the gardener’s guide to composting by Stu Campbell

Rodale organic gardening basics: Vol. 8, compost

Composting: decomposition by Buffy Silverman

Kidsgardening: a kid’s guide to messing around in the dirt by Kevin Rafferty and Kim G. Rafferty

Compost Critters by Bianca Lavies
Always use reliable online sources for accurate information:

**City of Austin:** [www.austintexas.gov/composting](http://www.austintexas.gov/composting)

**How to build a compost bin:** [extension.missouri.edu/p/G6957](http://extension.missouri.edu/p/G6957)

**3-bin turning compost bin:**
[http://www.uaex.edu/Other_Areas/publications/PDF/FSA-6033.pdf](http://www.uaex.edu/Other_Areas/publications/PDF/FSA-6033.pdf) (Uof Arkansas Cooperative Extension Service)

**Junior Master Gardener:** [www.jmgkids.us](http://www.jmgkids.us)

**Don’t Bag It TM: Compost it:** [aggie-horticulture.tamu.edu/publications/landscape/compost](http://aggie-horticulture.tamu.edu/publications/landscape/compost)

**Environmental Protection Agency:** [www.epa.gov/compost](http://www.epa.gov/compost)

**Dr. Linda Chalker-Scott:** [www.puyallup.wsu.edu/~linda%20chalker-scott/horticultural%20myths_files/index.html](http://www.puyallup.wsu.edu/~linda%20chalker-scott/horticultural%20myths_files/index.html) (Washington State University)

**Rodale Institute:** [http://www.rodaleinstitute.org](http://www.rodaleinstitute.org)
Rodale Institute: http://www.rodaleinstitute.org
Stephen Brueggerhoff has a Bachelor of Science in Horticulture from Sam Houston State University and a Masters of Forest Resources from the University of Washington. With over 15 years of experience, Stephen has supported the environmental community as lecturer, instructor, administrative organizer and collaborative partner. Stephen serves on the board of the Native Plant Society of Texas, is an active member of Unity Park Community Garden in Round Rock, Texas, and participates with many several professional development and community service organizations.