

Nevada County Master Gardeners

Compost is
the gardener's
best friend!

Are you... busy?
creative? lazy?
green thumb?
black thumb?
a newbie? into worms? hot or cold...
Composting is for everyone

 Nevada County Master Gardeners
ncmg.ucanr.org (530) 273-0919

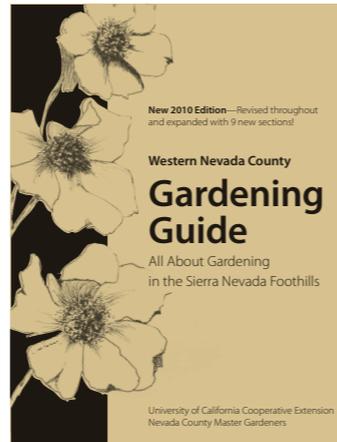
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Nevada Co. Master Gardeners

Non-profit community volunteers trained as educational outreach arm of UC Extension.
We disseminate research-based home gardening information to Nev. Co. residents

In addition to this slide show, please read our comprehensive [8-page color compost handout](#) with hyperlinks downloadable under "Composting Resources" at ncmg.ucanr.org

Written by Nevada County Master Gardeners for Nevada County residents



2010 edition features over 208 pages with illustrations throughout and a comprehensive index

Includes in-depth information on:

- Our local soils, microclimates and average first and last freeze dates
- Dealing with our deer, gophers, invasive plants, short growing season and other challenges
- Composting, mulching, worms, recycling, irrigation
- Growing vegetables, fruit trees/orchards, grapes, berries, native plants and ornamentals in Nevada County
- Raised-bed and container gardening
- Firewise landscaping for the foothills
- Sustainable gardening, integrated pest management and beneficial insects
- Month-by-month gardening and lists of the best plants to choose for landscaping in our county

Nevada County Master Gardeners depend on proceeds from the sale of this publication for over 40% of their annual operating budget.

\$30

when purchased directly from Nevada County Master Gardeners

Available in local nurseries, bookstores and hardware stores or directly from Nevada County Master Gardeners

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Available directly from Master Gardeners or from local merchants

Composting

Bacteria, yeast, fungi break
down organic material

Biological activity causes decomposition of ORGANIC material

Organic: defined as alive or once alive, as in animal, vegetable

Inorganic: generally derived from non-living sources, (rocks or minerals) includes glass, ceramics, and metals (and manmade inorganic material: plastics, etc.)



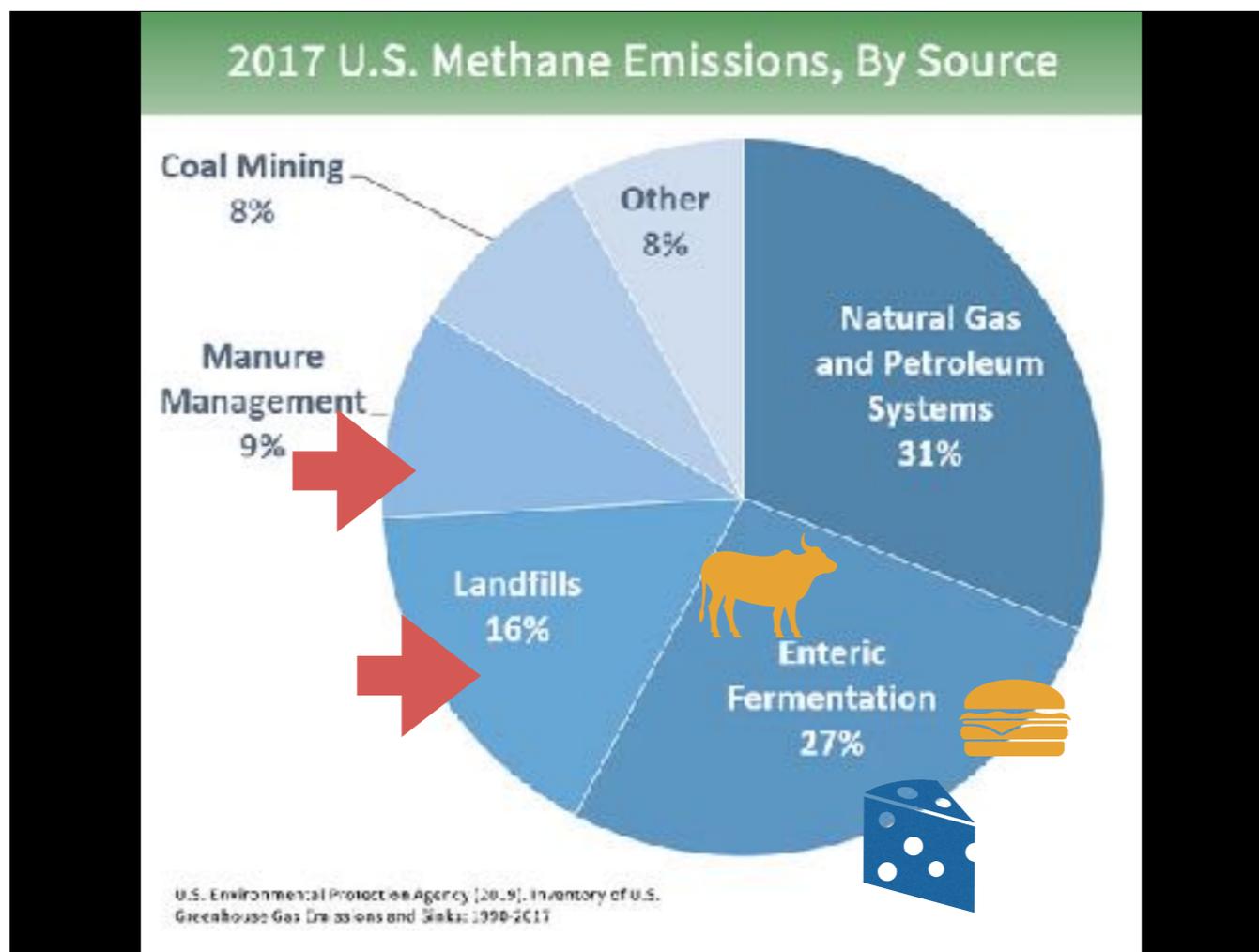
2 categories of composting

Aerobic: bacteria/fungi/insects/worms decompose in presence of **air**, no bad odor, no greenhouse gases, plus benefits the environment. Includes home composting, GreenWaste cart service, worm composting, fallen leaves in nature

Anaerobic: airless wet decomposition without oxygen emits **methane**, a greenhouse gas **28 to 36 times more effective than carbon dioxide at trapping heat in the atmosphere over a 100-year period.**

Natural emissions: swamps.

Humans are causing more than 1/2 of the total methane being emitted

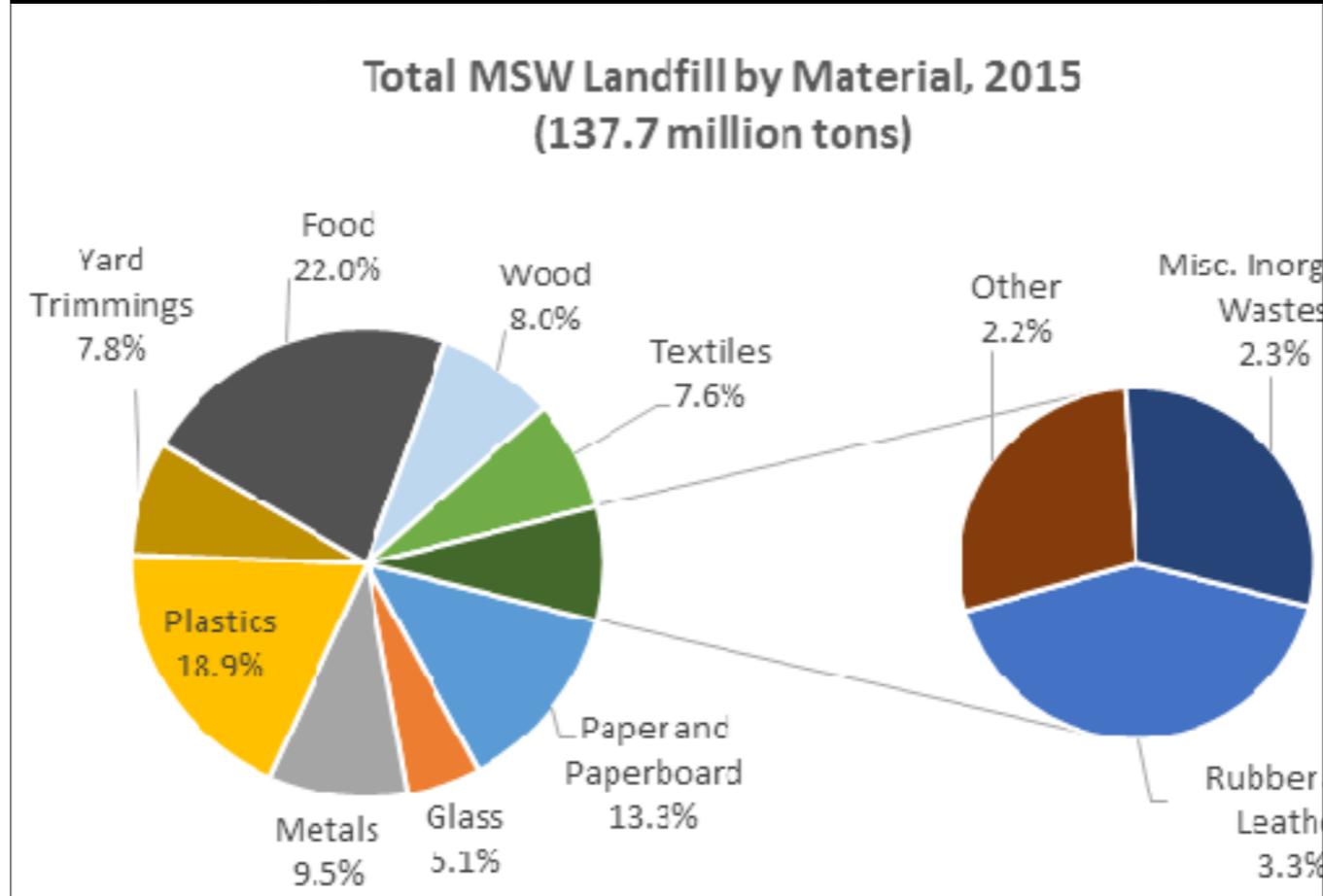


Enteric fermentation (belching) is anaerobic composting in the stomachs of ruminant animals, who are literally belching out methane. Of 27% on the chart, 25% comes from dairy and beef cows.

9% "Manure Management" is from LACK of manure management by allowing manure from farmed animals to compost anaerobically.

Organic material composting anaerobically in landfill: **16% of total methane emissions in this country**

Additional human caused methane: anaerobic composting in sewage treatment and in your septic tank



Compostable organic materials going into landfill and causing methane greenhouse emissions

22% food + 7.8% yard trimmings + 8% wood = 37.8%

7.6% textiles (probably containing organic materials but also plastics)

13.5% paper and paperboard (containing wood products)

ALSO: your toenails, your hair, your pets' hair, your meat bones/waste, dog/cat poop...

Easily recycled and taking up valuable space in landfill

Metals 9.5% + Glass 5.1% + Paper 13.3% = 27.9%

Aerobic



...but petroleum intensive

Why keep compostable materials when there is GreenWaste?

GreenWaste advantages

Keeps compostable materials from taking up valuable landfill space where they emit methane.

Disadvantages

- Energy intensive: large trucks/long distances (Roseville), heavy equipment to process
- Poor quality compost: composted as hot and as fast as possible. Compost they sell may contain persistent herbicides/pesticides. Clopyralid (Stinger, Reclaim, Transline, Confront, Curtail) broadleaf herbicide persists in compost for 1–2 years. Small amounts damage plants in tomato, bean and lettuce families.

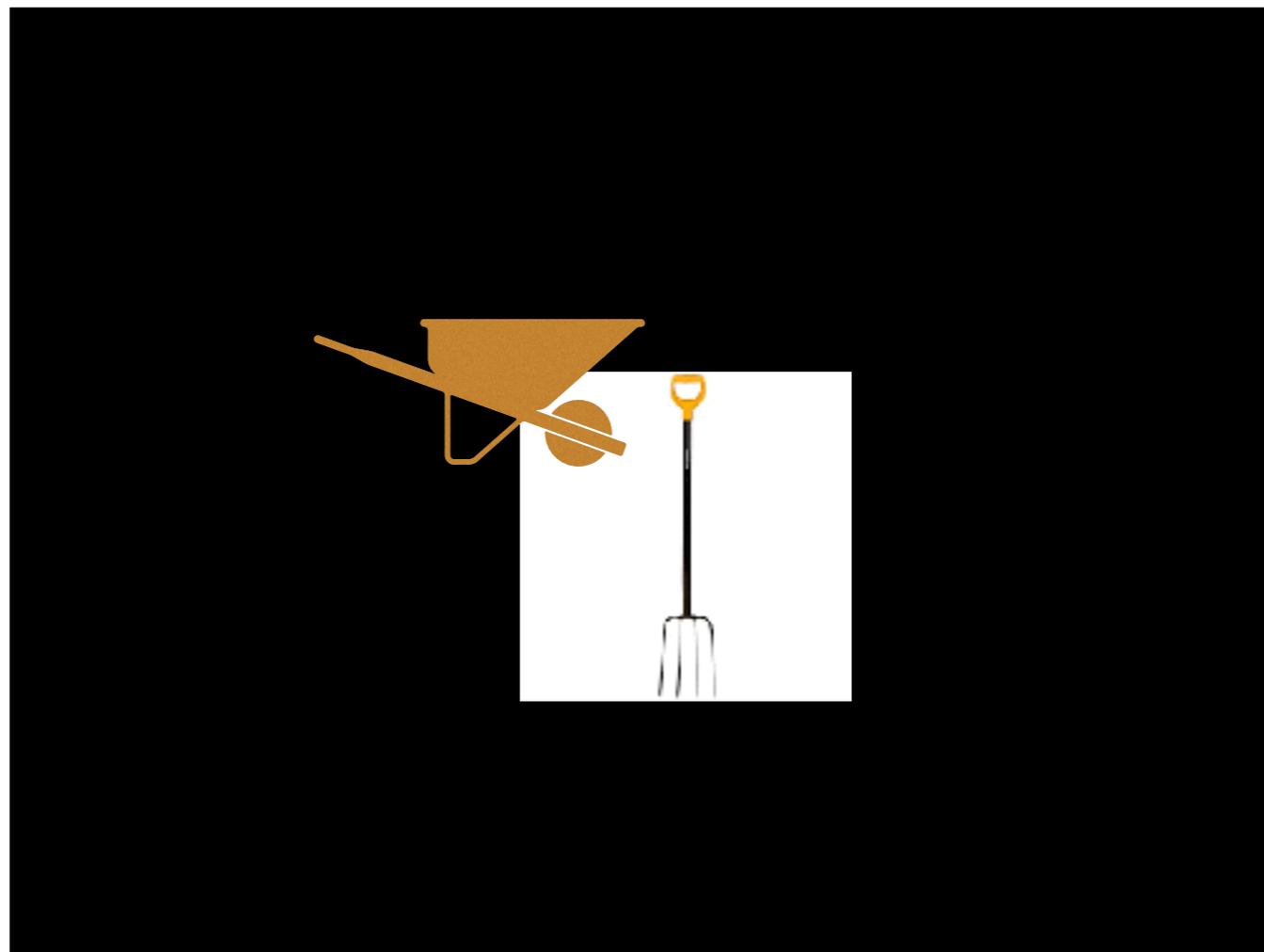


Summary

- In landfill anaerobic composting emits greenhouse gasses.
- GreenWaste, you part with your valuable pine needles, oak leaves, kitchen waste and yard waste, then buy it back in a plastic bag. You don't know what's in it. Not a good idea for growing something you plan to eat.

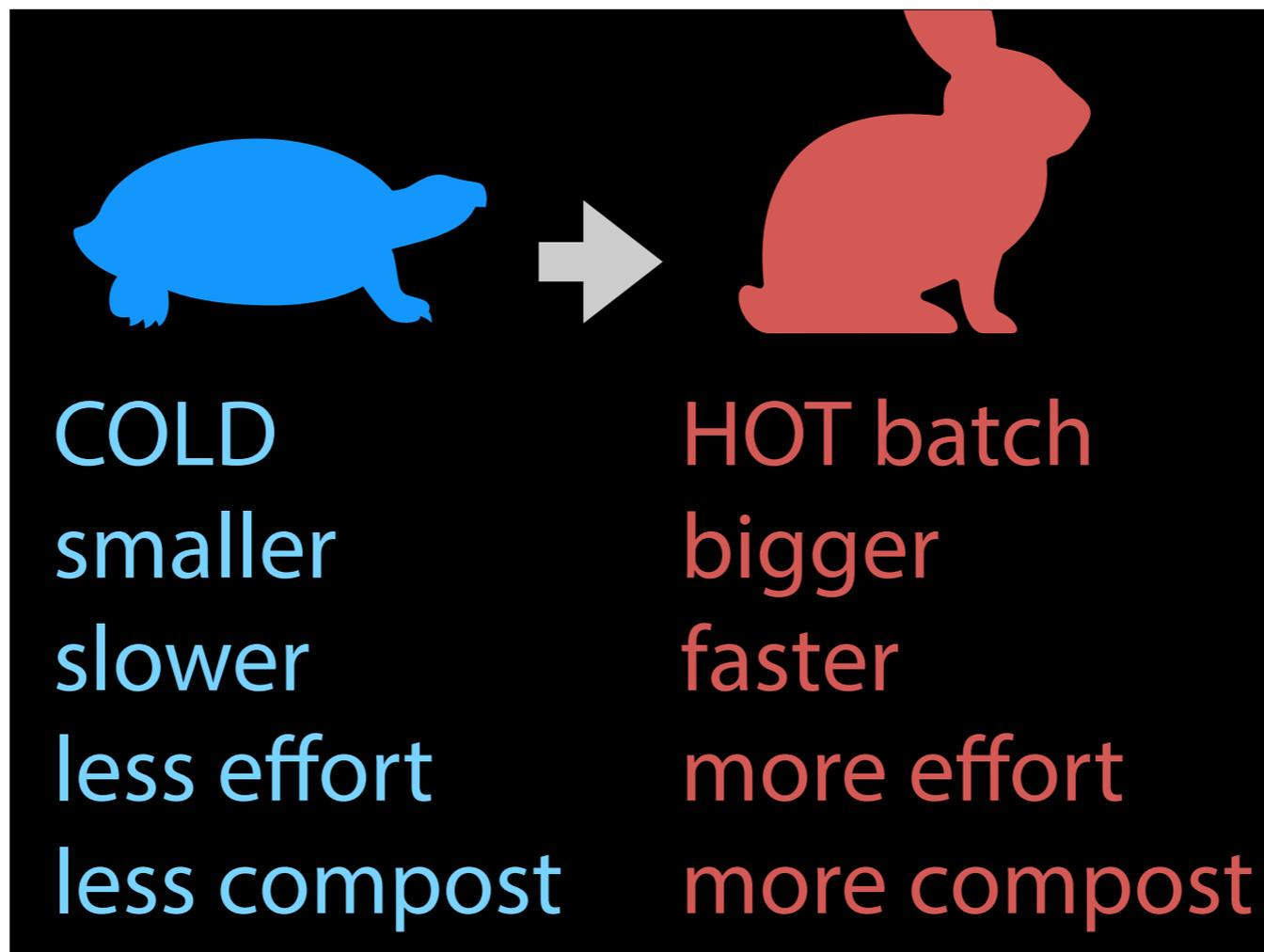
Advantages of home-made

- You know what's in it
- High quality
- Make as much as you like free and onsite
- Environmental benefits



Tools for composting

1. pitchfork, shovel
2. the dream wheelbarrow w/ 2 wheels, costs up to \$300 but you can push it with your little finger and it tips over easily to unload
3. fun but optional: thermometer about \$25, or attach meat thermometer to a string OR **Low-tech thermometer**: a metal spike or piece of rebar that you stab into pile, then feel with your hand



Same recipe and principles apply whether you choose a lazy or more ambitious approach

Compost happens whether less effort/cold more effort/hot.

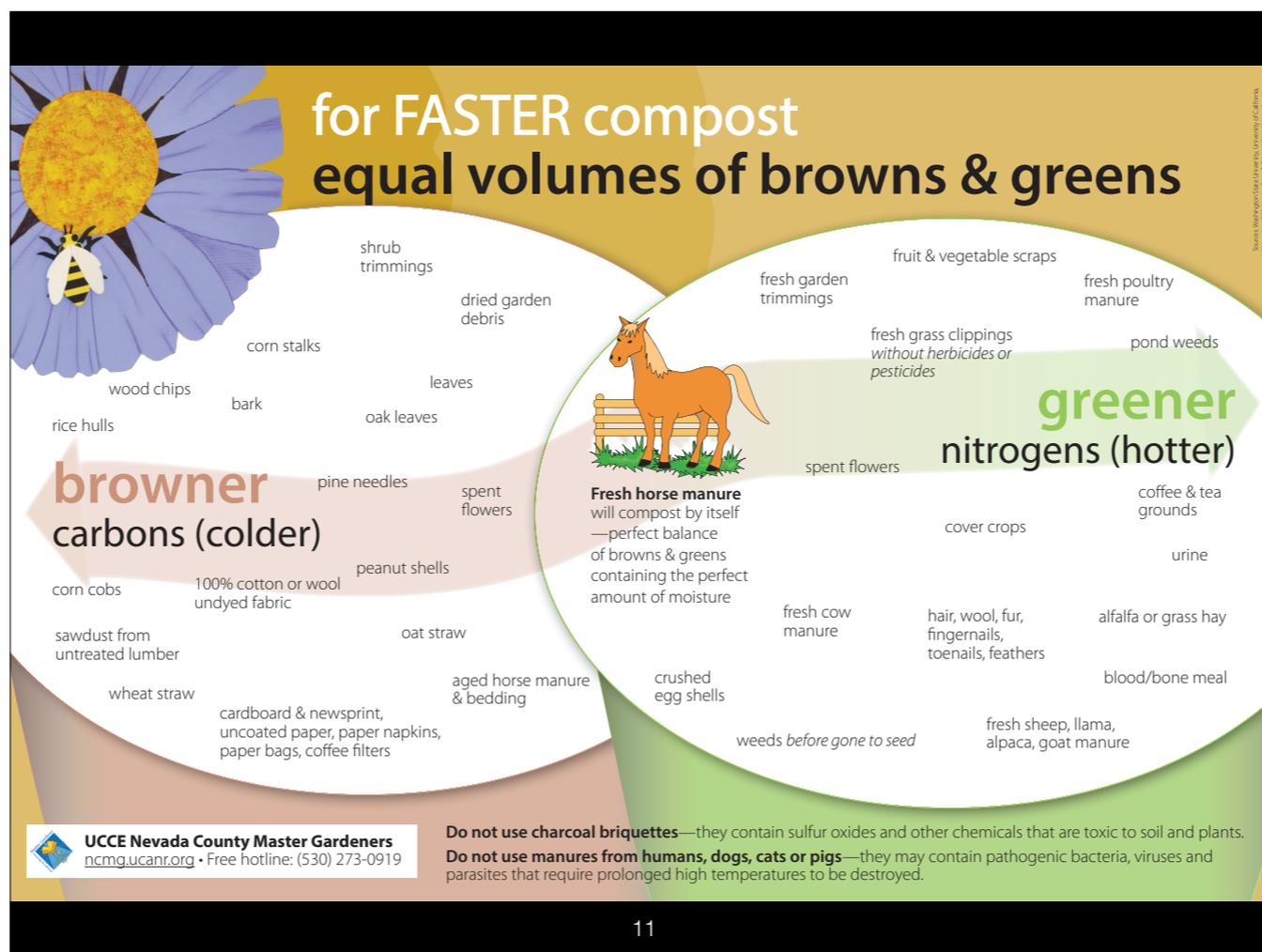
Main difference

Cold (slow): small add-on pile

Hot (faster): larger BATCH pile, minimum size 3x3x3', larger better

How you compost is highly individual and a reflection of how you live your life—from beautiful/tidy to more messy/functional...

Important part is the RECIPE, only 2 ingredients along with water and **air...**



Browns, greens, water, AIR (this chart downloadable from MG website)

browns/carbons trees, woody, stemmy plants

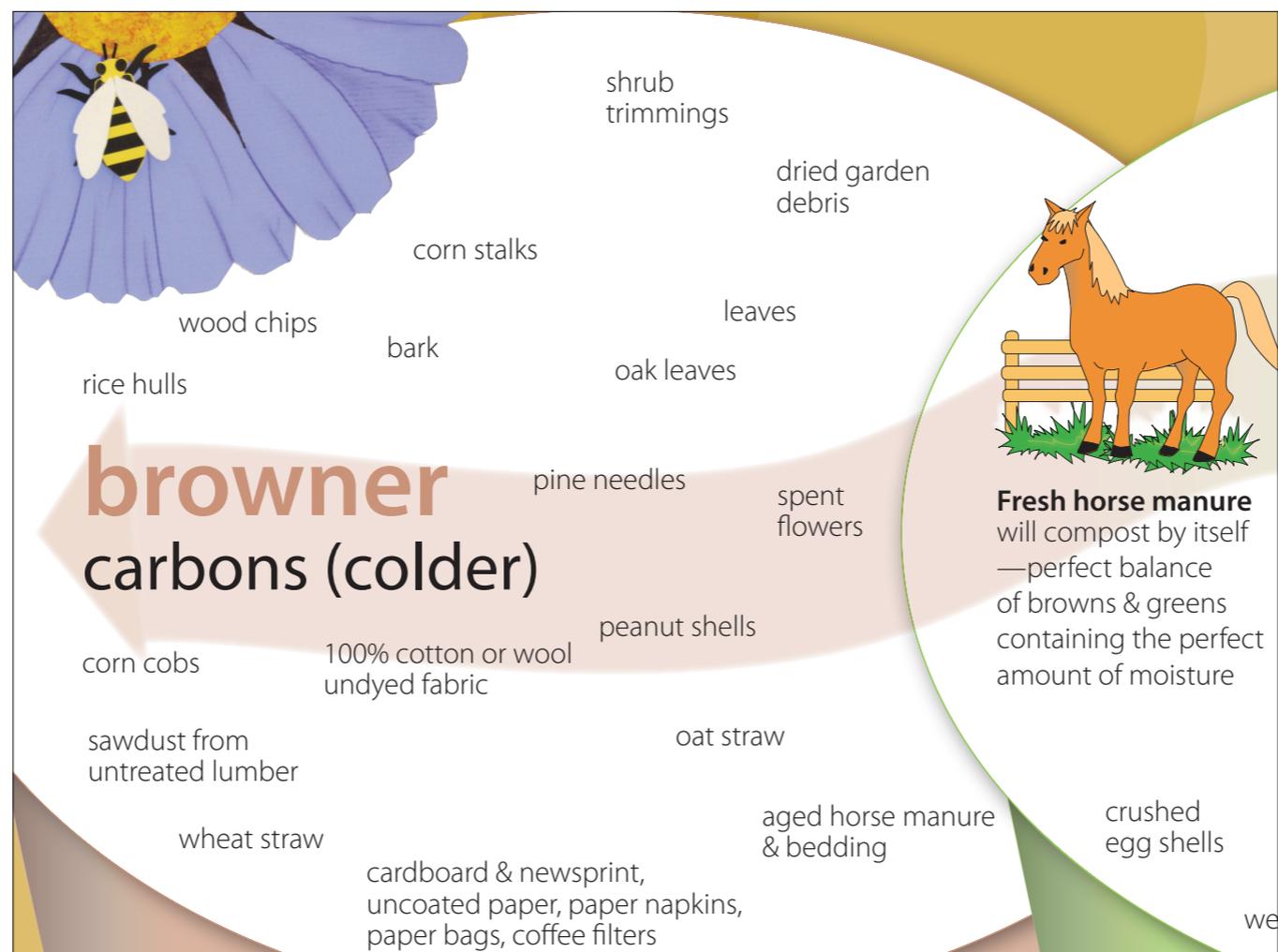
greens/ nitrogens leafy, tender parts of plants

Approximately equal VOLUMES of each layered, can go up to ratio of 2 to 1 greens to browns, If you smell ammonia = too much nitrogen

Equal volumes compost faster, warmer. BIGGER volumes FASTER, hotter

- Browns light in weight: brown leaves will not weigh much but we want roughly equal volumes, not weight (i. e. a few inches of browns, then greens, then browns, etc.)

Same recipe whether SMALL (cold) or LARGE (hot) pile



- On this chart browner to left greener to right: browns/carbons, to the right more extreme greens.
- Fresh horse manure—perfect combination of browns, greens and moisture, So if you have JUST horse manure you don't need anything else.
- Aged manure, the rain **may** have washed it out to the point where you may have to treat it as a brown. Once it has dried out it's harder to get it moist again. FRESH is BEST. But many old piles of dry horse/donkey manure have been to to heat up once moistened.
- If you have ingredients on one side of chart, balance with ingredients on other side (layered in approximately equal volumes).

Get ingredients from
friends
neighbors
coworkers

Tell your friends, neighbors and coworkers **“if you can’t be a composter, be a compost supporter”** by providing you with kitchen waste, manure, lawn and yard trimmings.



- Or ducks/chickens, alpacas/llamas/sheep/goats, pond weed, lawn clippings (make sure no pesticides/herbicides)
- No pig, dog, cat or human manures in your main pile (contains pathogens/viruses/parasites that require prolonged high temperatures to be destroyed)



Grow your own "greens" by growing cover crop, aka "green manure" crop or "biomass"



GREENS

Weeds
before
gone to seed

Weeds are excellent “greens”

Italian Thistle (shown above) or annual weeds not gone to seed or seeds not yet viable

CATTAILS around pond, easy to cut and transport—don't worry if gone to seed—they require really WET soil so won't grow in your garden



Kill first
by
drying out

Yellow Dock (long, thick tap root, eaten by Native Americans) but a weed in the garden (a weed is a plant in the wrong place)

Let the sun dry out and kill thoroughly first before adding blackberries or weeds like this.

Browns



- Ideal particle size for wood chips: 1/4" to 1-1/2" or with injured surface area = more surface area accessible to decomposers.
- Browns easy to stockpile/store all winter until you can score a bunch of greens and make a batch pile. **Most people have browns and can stockpile them.** Or keep on hand to layer on top of greens as you add them incrementally.



Using raw materials directly

We call this composting method "LEAVE IT!"

In Nature: tree drops its leaves or needles, which decompose naturally and eventually turn into compost to **feed the tree!** Top layer creates a protective skin or mulch for the decomposing leaves below, feeds the universe of decomposer organisms in the soil and eventually becomes compost. It protects these organisms from birds, soil from rain/wind erosion/the elements and prevents competing plants from growing.

With LEAVE IT we let Nature feed itself. We abstain from raking.

Leave the leaves all winter!



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FIRE SAFETY: ok to rake during dry months in your firesafe zone—but rake very the top dry layer only, leaving the already decomposing rich material below to feed the trees and plants. Use leaves you rake to mulch bare soil and pathways to prevent water or wind erosion, compaction and to suppress weeds.

In the wet of winter (no fire danger) “Leave it!”



Use the most hard-to-break-down browns on permanent pathways and pathways between vegetable garden beds.

- **Thick hardwood chips**—slow to break down and excellent for pathways
- **Pine needles** have a waxy coating so very slow to break down—better on flat ground or where you won't be slipping as much

Mulch for weed suppression/moisture retention.

General rule: mulch is an insulator so, when soil in your vegetable beds is cold and you want it to warm up with "solar gain" do not mulch. Add mulch in summer to keep soil cool to and keep it from drying out as quickly.



Get creative and use your wood chips or fallen leaves as bedding for chickens or other animals, then later compost the coop or stall waste. At the county fair many cow people were using wood chips as stall bedding.

Or you can stockpile your fallen leaves and wood chips as "browns" for later use in composting. Keep them, they are valuable!



★ let it fly!

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Another version of LEAVE IT! is **grasscycling**. When you mow, take off the bag and let it fly. The clippings will feed your lawn naturally and reduce your need for fertilizers.

If you can't convince neighbors to Grasscycle, maybe you can get them to give the bagged clippings to you to compost. Just make sure they aren't using any herbicides or pesticides you don't want in your compost.

What makes it heat up?



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Heat is caused by a kind of bacteria that is activated when compost pile is a batch of 3 x 3 x 3' minimum. 4 x 4 x 4' better. Or 5 x 5' and as long as you like. SIZE MATTERS. **The bigger the hotter, the smaller the cooler.**

Most commercial bins & tumblers are too small for significant heat.

Containers: you don't need to buy a bin, you can have a pile, wood pallets tied together, contained by insulating straw bales, it can be against a hillside.

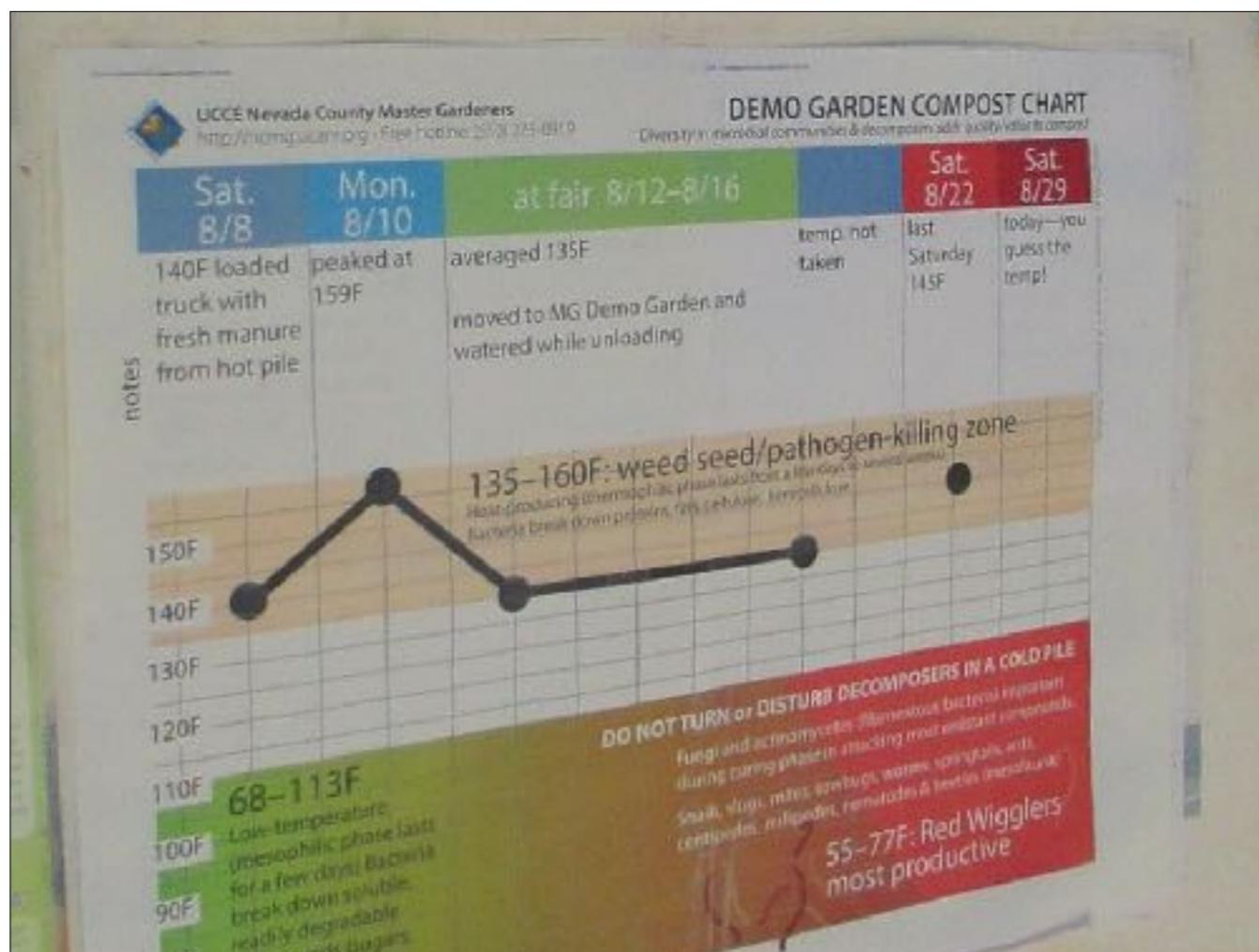


Chart compost temperature as different bacteria, yeast, fungi and insects/worms go to work.

If you have the necessary BATCH SIZE to activate the heat-generating decomposers, just sit back & let these naturally occurring microorganisms go to work. **With a balance of browns/greens, sufficient pile size, moisture and air, after 2-3 days you WILL have heat, there is nothing tricky about it.** Temperature will peak and sustain for a week to weeks, then slowly start to decline. All you have to do is sit back and relax. Blank chart downloadable from MG website.

Heat is by-product of the respiration of thermophilic bacteria 113-160F.

Sustained temp. for 3 days in the range of 135-160F kills most weed seeds and pathogens.



BATCH COMPOSTING TEMPERATURE CHART

Diversity in microbial communities & decomposers adds quality/value to compost

Ideal batch size at least 4' x 4' x 4' or LARGER
ABSOLUTE MINIMUM size 3' x 3' x 3'

date/notes

150F

over 160F: compost quality suffers

Some weeds, including oxalis bulbs, seeds of burr clover, some amaranthus seeds and seeds of cheeseweed, are not killed by the high temperatures in a compost pile.

140F

135–155F: weed seed/pathogen-killing zone

130F

Heat-producing (thermophilic phase lasts from a few days to several weeks)
Bacteria break down proteins, fats, cellulose, hemicellulose.

120F

"Heat" generated in composting is by-product of microbial metabolism.

110F

100F

68–113F

Low-temperature (mesophilic phase lasts for a few days)
Bacteria break down soluble, readily degradable compounds (sugars, starches).

90F

80F

70F

Fungi and actinomycetes (filamentous bacteria) important during curing phase in attacking most resistant compounds.

Snails, slugs, mites, sowbugs, **worms**, springtails, ants, centipedes, millipedes, nematodes & beetles (mesofauna) mechanically break down organic materials into smaller particles.

55–77F: Red Wigglers most productive

Allow 2+ mo. cool down/curing period for highest quality compost.

Sources: University of California, University of Wisconsin

Mesophylic bacteria operate at lower temperatures, 68-113F. Next mesofauna includes slugs, sowbugs, worms (worms like humans are most productive 55-77F). All these work in concert and set the stage for each other. *Teaming with Microbes* is a great book to read more on this.

2 reasons for **hot** composting

1. kill pathogens/weed seeds
2. faster/more compost

2 main reasons for **hot batch composting** over slower, cooler compost

1. Sustained heat of 135-160F for approximately 3 days kills pathogens & weed seeds.
2. Hot composting is faster and a larger scale approach so you produce a lot more compost.

If you want to kill weed seeds and you want a lot more compost, at least one round of hot composting is the way to go.

Turning is optional!

Reasons to turn hot/batch pile: To get the cooler edges to the middle to heat up more, to aerate if too soggy, to add water if too dry. Turning will speed up composting because the heat-generating bacteria are faster than the others. Each time you turn, the pile will heat up less. When it no longer heats up, it is probably “done.”

Turning is not required. It's fine to be lazy (smart) and let the worms/others finish it off slowly. You can let Nature do the work. If you had a large enough batch, your compost pile has had one good round of killing heat—that may be good enough for you.

Turn a cold pile to aerate if too wet, add water if too dry.

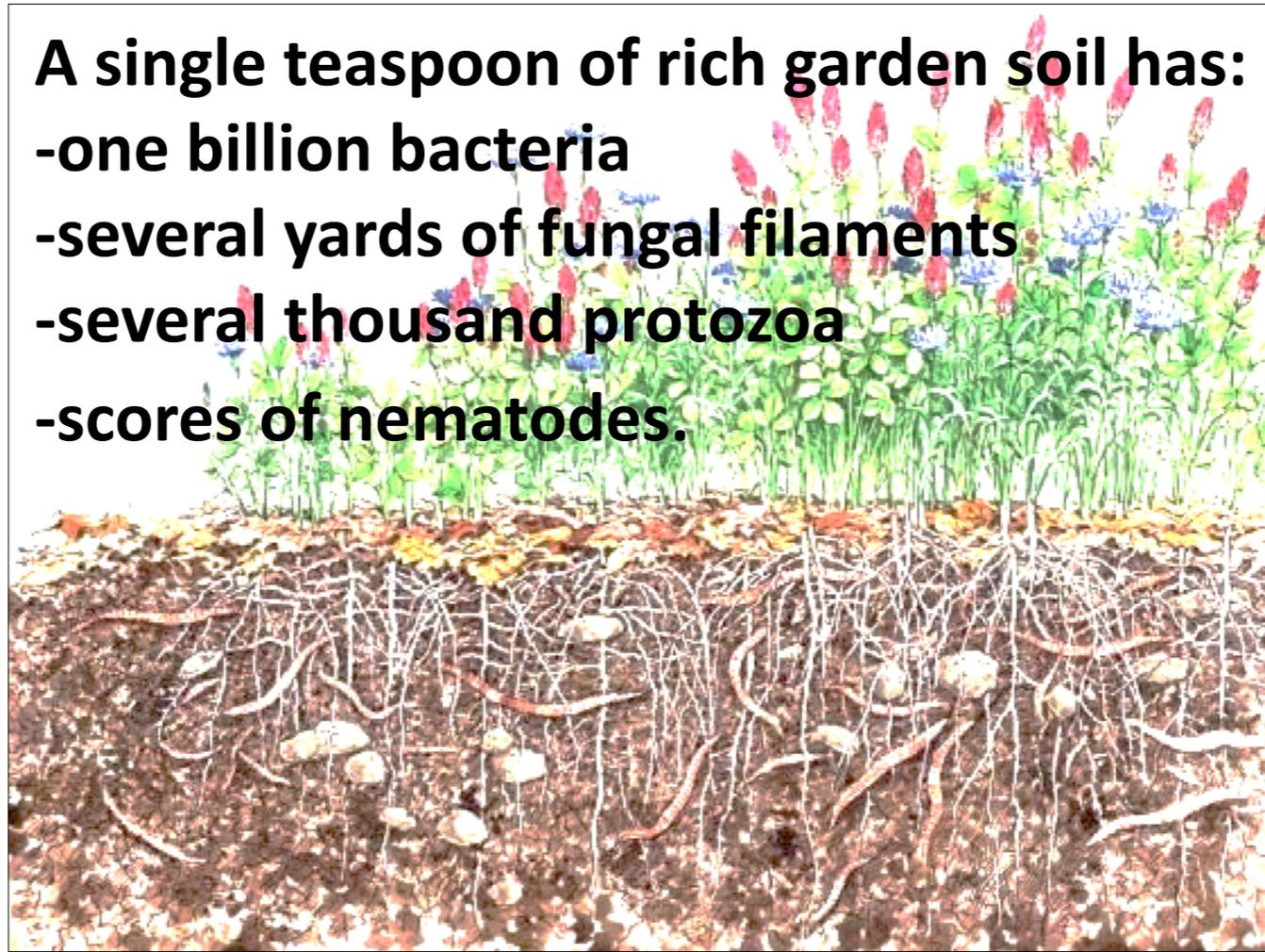
Do not turn a cold pile if you have a lot of worms and decomposer bugs—let them do their work in peace!

In composting, different bacteria/microorganisms predominate at different temperatures, but each contributes value to the compost. The highest quality compost is the kind with the longest cool-down or curing period, **when the low-temp decomposers & worms really go to work.**

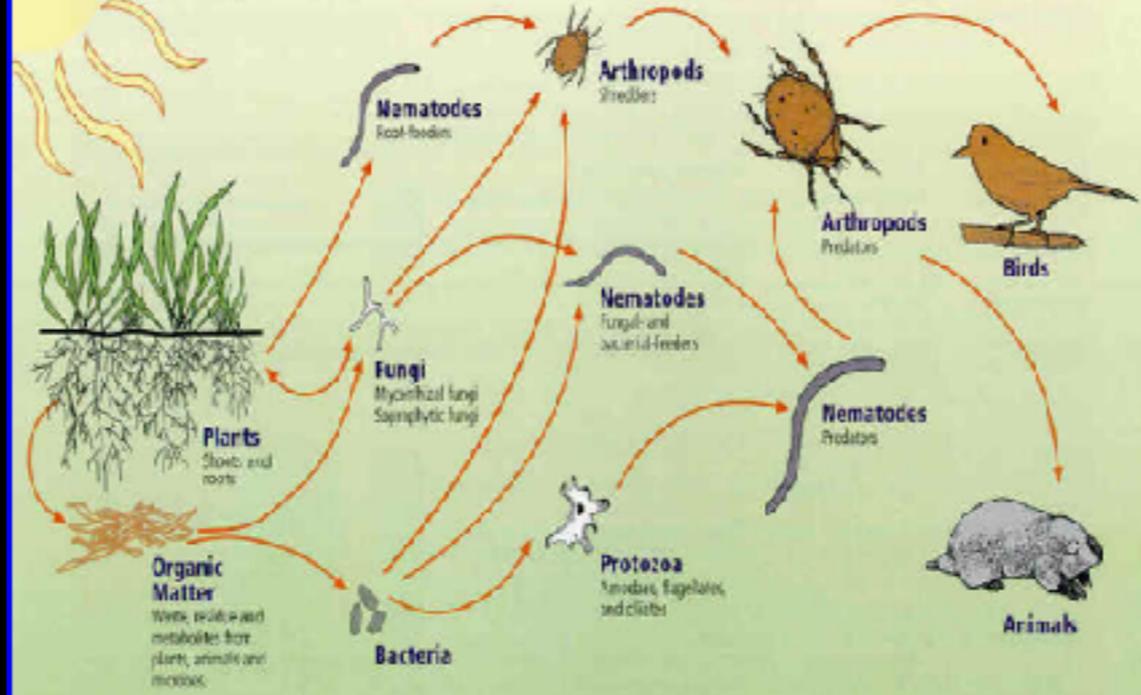
- Bacteria and fungi break down and RETAIN nutrients
- Protozoa eat B&F and release plant-available nutrients
- 80% of a plant's nitrogen needs are supplied by this process

A single teaspoon of rich garden soil has:

- one billion bacteria**
- several yards of fungal filaments**
- several thousand protozoa**
- scores of nematodes.**



The soil food web



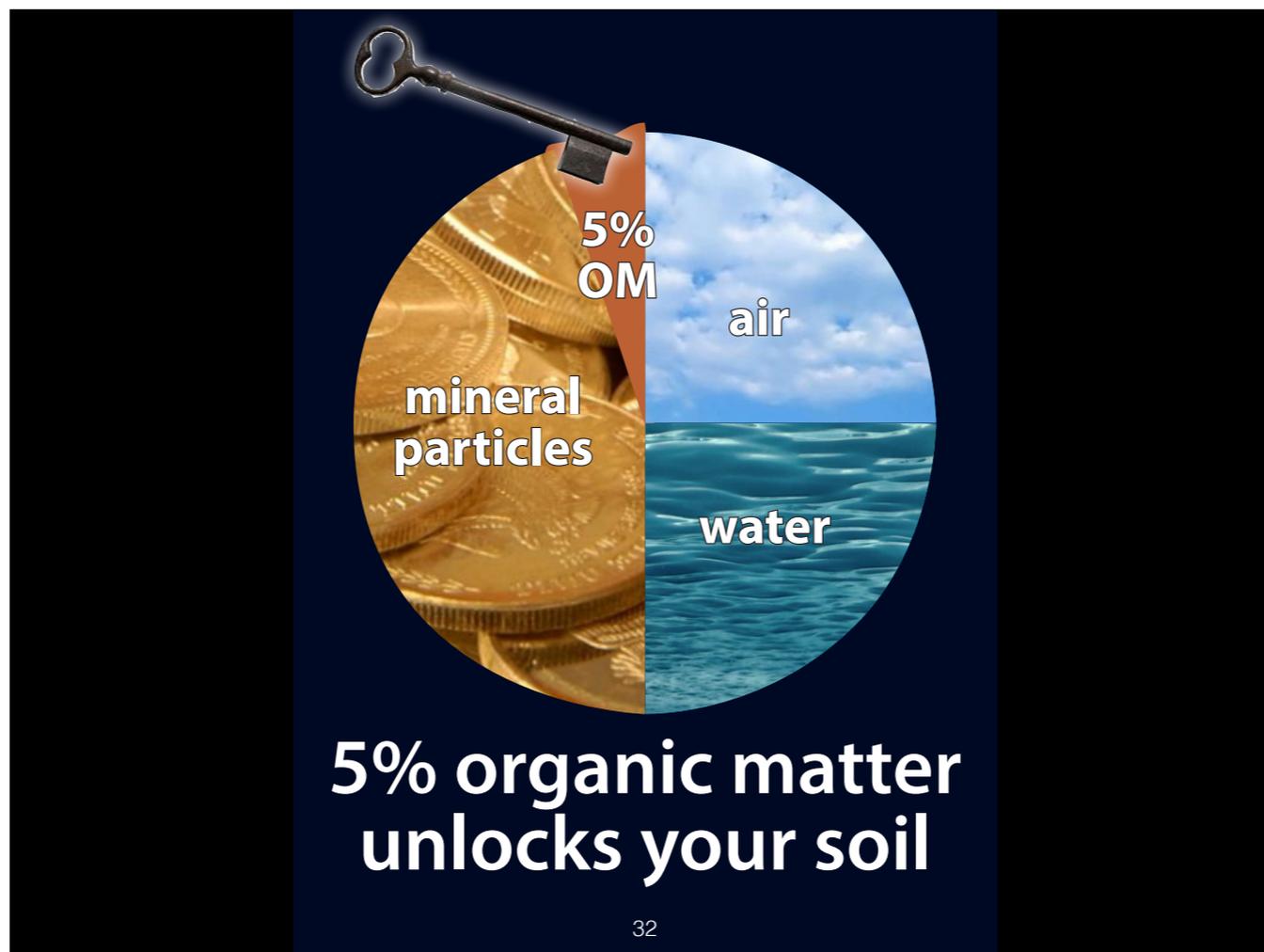
First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, parasites
Root-feeders

Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators



A minimum of 5% organic material/compost UNLOCKS the mineral content of your topsoil, which may otherwise remain unavailable to plants.

top dress 2" compost



- **Add 2" compost or more on top of garden soil each season you plant. Compost gets used up on an ongoing basis.**
- Digging or tilling not necessary, disturbs soil life. Not recommended unless starting out for the 1st year with rock-solid compaction containing no life whatsoever. Use a digging fork to avoid inverting soil layers.
- Topdress 1/4" compost onto lawns or grasses.
- Good compost returns valuable organic matter and nutrients to the soil: **nitrogen, sulfur, calcium, magnesium, potassium and micronutrients.**
- Reduces reliance on synthetic fertilizers which have contaminated our waterways and deplete soil (by not replacing the organic matter in our soil that gets used up by plants).



Building a batch compost pile in MG Demo Garden

We imported small load of fresh horse manure in small truck.

Bottom layer: 6" layer of sticks (from pruning grapevines) for air flow. Air essential to the decomposers.



Tossing in mixture of brown fall leaves and tender weeds not yet gone to seed

Locate your compost pile:

- Close to water source with easy access by vehicles
- Close to where you plan to use the compost (may be different location each time). Can be modular and movable bins made from free materials or against a natural barrier like boulder or hillside, flexibility, space for adding on.
- Compost in place (lasagna gardening)

Cover in summer to prevent it from drying out, in winter to prevent it from getting soggy

If too dense with not enough air, **lazy way to aerate:** stab with rebar to let air in (thermophilic bacteria use up oxygen and need more to continue working)



Layered with manure

We took turns unloading horse manure layers.

This is a no-turn batch pile—in “no turn” make it big enough to heat up thoroughly 135-155F for at least 3 days in the 1st week, then let the temperature decline slowly over weeks, then let the low-temperature decomposers work until compost “done ” (months). As an option when some areas have cooled to about 80F, you can add Red Wigglers (worms) and let it sit for 6 mos. or until the worms have migrated out. Warning: if you use in your garden while still full of worms, it will attract moles (who eat worms). Let them migrate into fresher compost before using castings.

Small pile more work: with smaller pile (3 x 3 x 3') you will need to turn the outside areas to the center to heat up to kill weed seeds/pathogens/ speed up decomposition. However with large pile, you do need to gather a much larger volume of greens and browns at the onset.

Optional insulate with straw bales

Optional: insulate with straw bales so edges heat up more uniformly, otherwise the outer 12" doesn't heat up as much, which is the main reason for turning the pile. A smaller pile will dry out more easily.

Plus straw bales help to contain the pile.

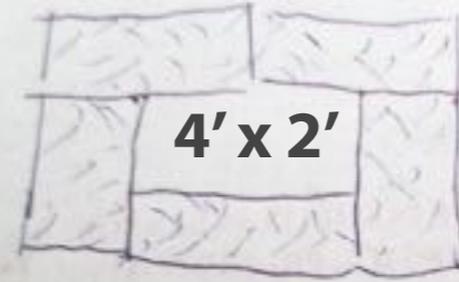


Deluxe version: 7 straw bales for this insulated compost container (at county fair). Movable, eventually biodegrades. About \$12 per bale at feed stores. This is wheat straw, seeds will sprout. Rice straw contains remnants of rice but won't sprout (unless underwater!)

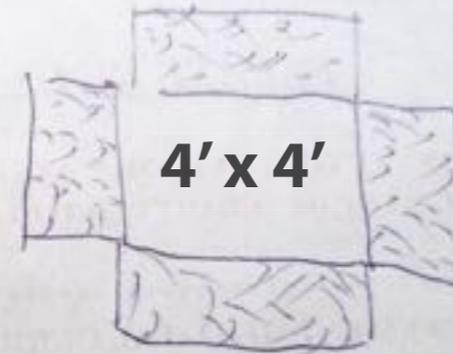


Insulated with bales on sides only, modular movable and compostable!

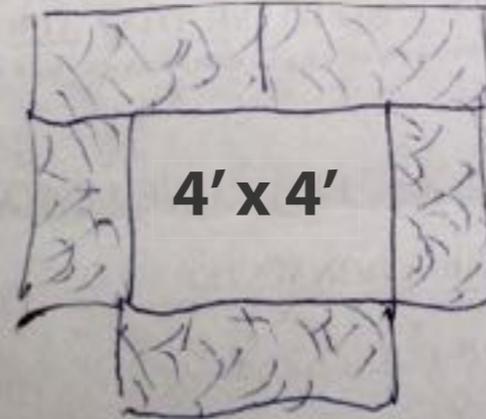
5 bales



4 bales



5 bales



08/13/2018

Other configurations for one-row tall



Troubleshooting

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For people who can't get horse manure or access to a lot of greens, a **cold pile is an easy way to compost**. Collect kitchen waste and add to a bin or place where you pile yard trimmings, old leaves, weeds. Eventually, after a year or 2, bottom decomposes/makes a little compost, **You don't have to turn your cold pile**. If you have the good fortune of worms/bugs or fungi in your pile, do not turn or disturb them

3 things can go wrong. These are all easy to fix!



1. **bugs, yellow jackets, flies/maggots.** The solution: COVER with a thick mulch layer, pine needles/fall leaves, rice straw mulch...
Something that is easy to pull back so you can add more. As in Nature, this top layer will also protect the decomposers as they work. If covering with tarp, use heavier duty and throw out before they start disintegrating. Cover in **summer** to help keep from drying out, in **winter** to prevent too wet/soggy
2. **It stinks.** Too wet—mix in fallen leaves as you go and cover with mulch and UV resistant material to keep rain out



Rodents & critters



Problem #3: Critters, rodent population exploding, attracting rattlesnakes, etc.

Prevention: convert to manure



Turn edible waste into manure first—cooperate with neighbors—feed it to chickens/ducks, fruit tree prunings to donkeys, then use the manure in compost (manure never attracted rodents!) OR look into an indoor worm composting system.



Or bury kitchen waste 12" deep into hottest part of compost.



damp like
a wrung-out
sponge



Keep your pile wet and moist but not dripping wet.

Fort Knox



- Rodent proof tumbler. Most tumblers too small for heat-generating bacteria to work, but we've heard that people eventually get excellent compost.
- Rodents can chew through the commercial bins made of tough plastic—they are rodent resistant but not rodent proof!
- Common problem with small bins or piles: drying out—keep contents damp like a wrung-out sponge

Danger of spontaneous combustion @ 12' tall

[www.soilandmulchproducernews.com/index.php/
frontpage-articles-hidden/160-a-perfect-storm-mulch-
fire-dynamics-and-prevention](http://www.soilandmulchproducernews.com/index.php/frontpage-articles-hidden/160-a-perfect-storm-mulch-fire-dynamics-and-prevention)

Stay extra safe by keeping your pile under 8' tall

Size: One large pile is much more dangerous and able to combust than multiple long narrow "windrows" (4-6' high, 6-8' wide, and as long as you want).

Moisture: A dry pile, or a pile with wet and dry pockets is much more prone to combustion than an evenly moist one.

Oxygen: Turning a pile will release heat and compost faster. An unturned pile can just build heat. Most dangerous is an excessively large static pile.

The more the merrier

Dedicated piles

- Your MAIN pile is for compost you plan to use in an garden for edibles. We are aiming for no pathogens and weed seeds.
- If you want to use “done” compost in seed starting, you can sift your compost. Sifting not necessary unless newly germinated plants need to push their way through.
- Your main pile is just ONE of many compost piles and staging areas you can have. Here are more ways to develop your composting empire!



Pile of branches big or small, same as cold pile

Slow to decompose but meanwhile excellent habitat for wildlife.

Say NO to burn piles: releases greenhouse gases and pollutes air with particulate matter. Particle pollution can also impact the young, the elderly and people with existing conditions such as emphysema, bronchitis and asthma. Particle pollution can also contain other harmful pollutants such as heavy metals.



Weeds-gone-to-seed pile

Keep them prisoner in one place! Most weed seeds aren't viable after 4 years.

The number of surviving seeds of most weed species declines rapidly the first year. But thereafter the rate of weed seed decline slows. Some seeds such as Star Thistle can persist for decades. Best if seeds kept above or below the germination zone in soil/or use under cardboard in sheet mulching. Caution: thistle seeds become airborne and travel by air so you can stuff them under branches or other weeds in the pile.

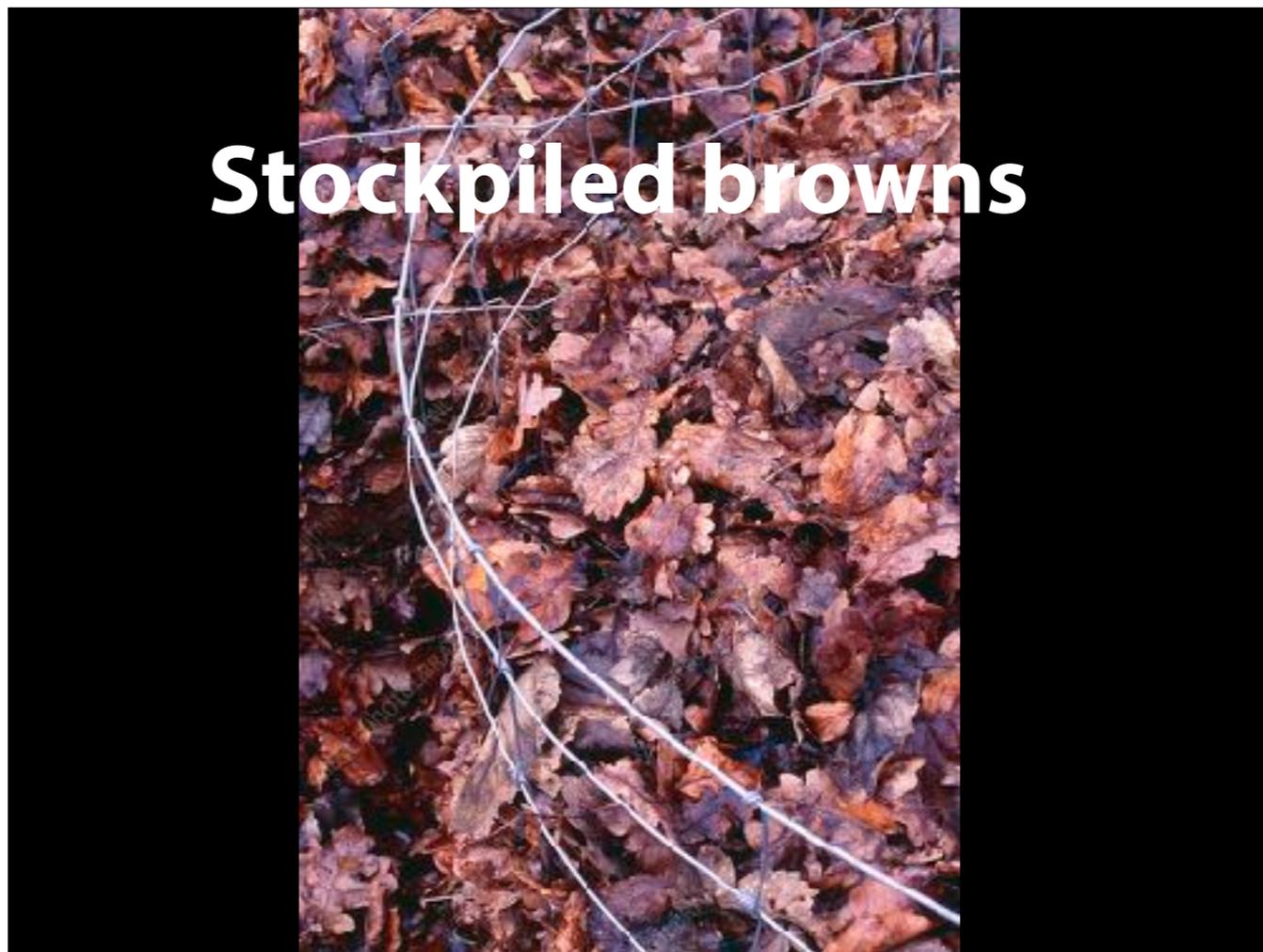


Maximum security bin



Meat, bones, fat, cheese not recommended for your main pile because they attract rodents, which may carry diseases. Find a rodent **proof** container for composting these materials. Rodents chew through hard plastic so rodent “resistant” means nothing. Must be rodent PROOF. Do not attempt this if you might have bears in your area. Do not use resulting compost on edibles.

Stockpiled browns

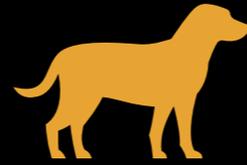


Dedicate an area for stockpiling browns to layer in with greens as greens become available, or to make a batch pile when a large amount of greens become available.

You may also have a dedicated area for neighbors to drop off their materials. Kitchen waste can go into a pair of secure containers (such as 5-gallon buckets with screw-on lids) that you swap out.



Kill blackberries and other persistent weeds by **thoroughly** drying out first before adding to compost pile. Here they are drying out on top of compost pile tarp but you may want to dedicate a special area just for drying out.



“Composting Dog Waste”

instructions at
www.nrcs.usda.gov/

Exclude dog, cat and pig manure from your main pile because of pathogens that can cause diseases. Learn how to compost dog poop safely in a dedicated pile. Do not use resulting compost on edibles.



**“Composting Human Waste
from Denali with Worms”**

article at
www.nps.gov/

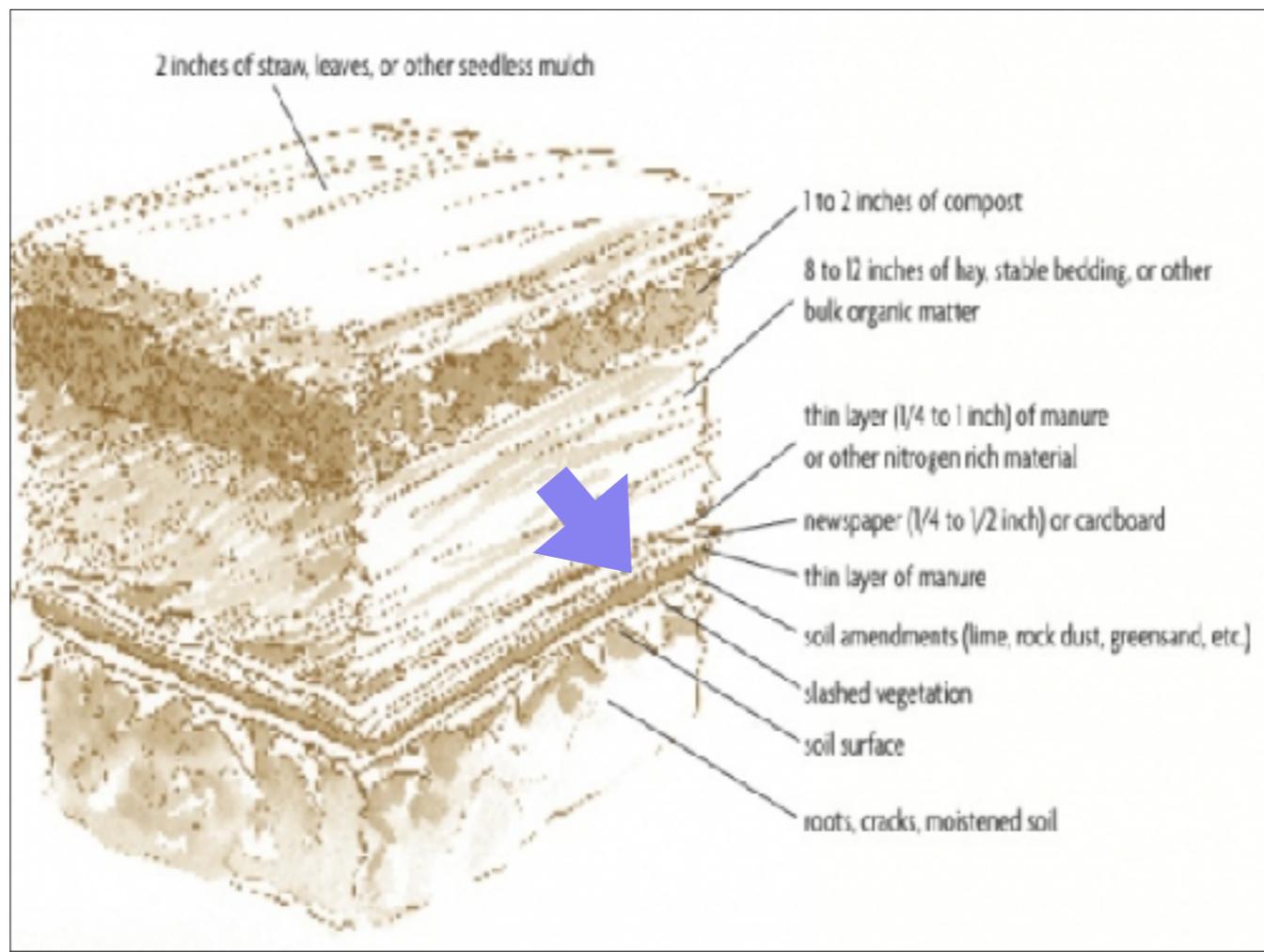
Exclude human manure from your main pile because of pathogens that can cause diseases. We encourage you to learn how to do this safely. Do not use resulting compost on edibles.

Lasagna gardening

AKA sheet mulching

Compost in place, can be used to smother annual weeds

- no-till gardening
- let biology do your work



Use any compost you suspect of containing weed seeds underneath your cardboard or newspaper layer.

Sheet-mulched cover crop



For more information, “search” for information on sheet mulching, lasagna gardening, no-till gardening and cover crop.



Use the heat!

Batch piles generate significant heat. You can bury a coiled hose or container inside the hottest part for a little hot water OR...



Heat a cathouse! This pile keeps outdoor cats warm all winter.

Cats defend the pile against mice/rats which can attract snakes. As the pile expands, move the shelter periodically so it's sitting on top of the hottest area.



bottom heat for germination

Bottom heat to germinate seeds outdoors or propagate plants instead of a greenhouse or bottom heat pad. The bonus is that the plants are already outside so "hardening off" is not needed



Review

- biodiversity = quality
- “leave it”
- same recipe for hot or cold
- size matters
- multiple piles
- compost happens

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Commercial compost has been made fastest way possible—mainly by heat generating bacteria. Because you have the luxury of being a home composter, you can give your compost more time to go through the full cycle from warm to hot to cool-down and allow fungi, worms and other decomposers time to contribute, adding quality and value that money can't buy.

Basic recipe: layer roughly equal volumes greens and browns. Small pieces, sprinkle with water as you compile it to keep the pile damp with ample oxygen. Cover in summer AND in winter. **Size matters:** Any batch minimum 3x3x3' (larger better) will heat up and decompose faster.

Get creative: stockpile browns, a dedicated weed pile, a hot batch pile, smother weeds by sheet mulching and restore large areas without herbicides. Get materials from neighbors.

Remember compost happens. It can happen faster or slower, it can happen without bad odor or be a stinky mess. We want you to be able to make compost easily, efficiently and without creating a fly resort or alienating your neighbors.



Other resources downloadable from
[ncmg.ucanr.org/
Composting_Resources/](http://ncmg.ucanr.org/Composting_Resources/)

- **Compost is the gardener's best friend** 8-page compost handout with hyperlinks
- **Browns/greens chart**
- **Composting temperature chart**
- **Compost vs. fertilizers**—pros and cons
- **Compost videos** of MGs Peggy and Mary making compost piles in the Demo Garden

Recommended websites

- Information on **methane greenhouse gas emissions from landfill** and other sources—from Environmental Protection Agency epa.gov
- **Compost** <http://web.extension.illinois.edu/homecompost/>
- **Cover crops** <http://www.soilandhealth.org/03sov/0302hsted/covercropskansasstate.pdf>
- **“Composting Dog Waste”** search at www.nrcs.usda.gov
- **“Composting Human Waste from Denali with Worms”** search for this article at www.nps.gov UC Vegetable Research and Information Center