

# *Composting for Soil Improvement (in small places)*

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Associate Professor*

*Composting in small places  
October 24, 2017*

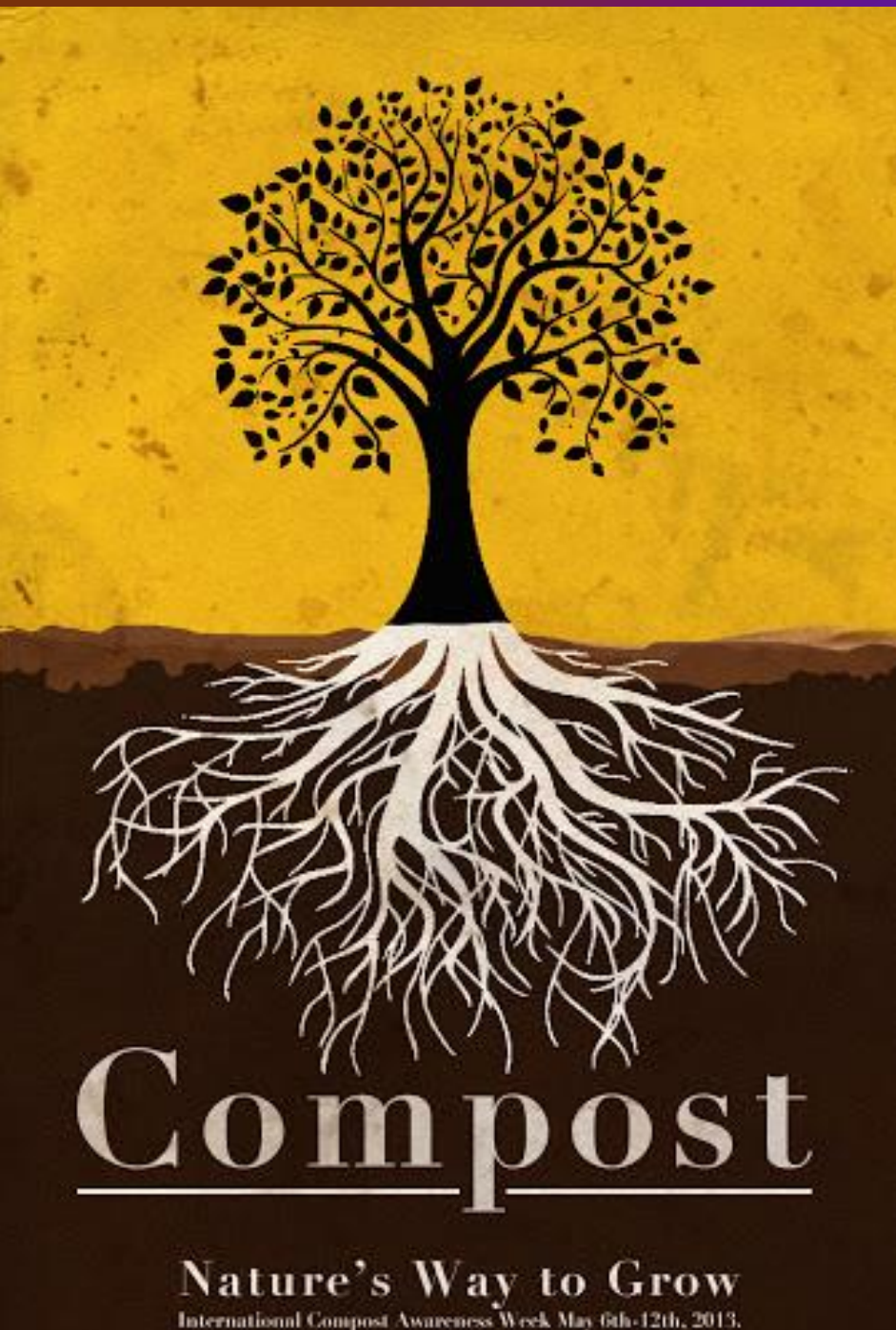


# *PRE CLASS QUESTIONS*

1. It is important to turn compost (choose the correct answer):
  1. At least twice a day
  2. Once a day
  3. Once every few days
  4. Only if it smells bad
2. (True or false) Compost tea is the effluent that drains out of a compost bin, pile or tumbler


# QUESTIONS, CONT.

3. Insects appear in compost (choose one):
  1. If it is not well maintained
  2. But they can be controlled with diatomaceous earth
  3. So the compost should be sprayed with insecticide to keep them from spoiling it
  4. If temperatures are too high
4. (True/false) If compost smells bad, it should be discarded and started over



Compost is proof  
that there is life after death



Peadoodles 

©2010 Lisa Slavid

Recycle me  
fool!



Peadoodles

Yo mama -  
compost  
this!



©2010 lisa slavid

trash talking

**W  
h  
y  
  
b  
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h  
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r  
?**



We  
do  
have  
the  
garb  
age!

***LOCAL DESERT SOILS  
TEND TO BE  
INFERTILE &  
TOO WET OR TOO DRY***



# WHY COMPOST?

- Local soils – low fertility and poor structure
- To be productive, nitrogen and other mineral levels must be raised.
- Unless plant residues are returned to the soil, N fertilizers do not improve soil fertility, quality or health
- Chemical fertilizers can leach into groundwater,  $\Rightarrow$  *nitrate pollution*.

# COMPOST



- organic materials – e.g. leaves or other landscape waste & lawn clippings, fruit and vegetable scraps – are degraded by microorganisms
- added into the soil to improve structure, fertility, drainage and water holding capacity





# AMERICAN WASTE

- More than  $\frac{1}{2}$  → landfilled
- 15% is incinerated
- Less than  $\frac{1}{3}$  is recycled or composted

10/24/2017 10/24/2017



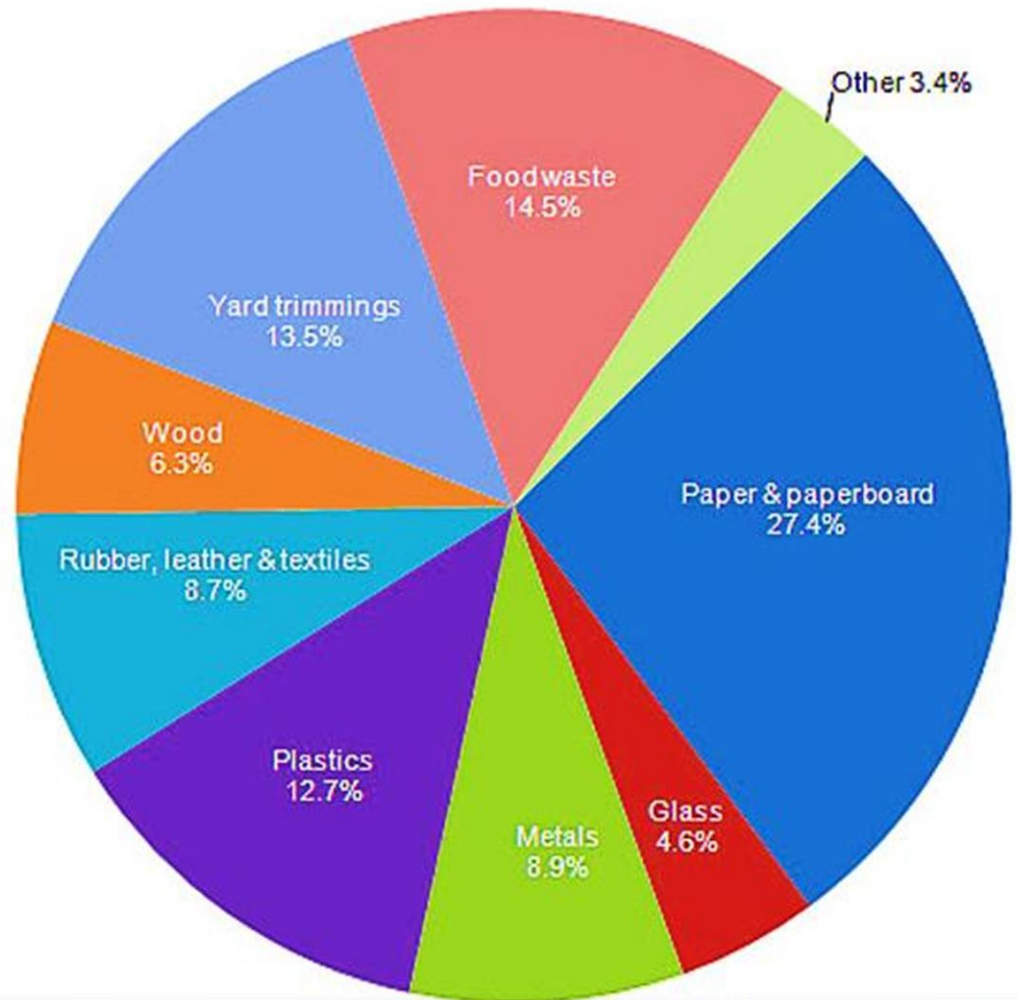
# OUR GARBAGE 1960 - 2013



10/24/2017

*US MUNICIPAL  
SOLID WASTE  
~62% GREEN*

Figure 5. Total MSW Generation (by material), 2012  
251 Million Tons (before recycling)



# COMPOSTING — THE CIVIC GOOD

- Currently
  - 62% of American landfill is *green waste* which produces methane gas (a greenhouse gas, 26x more potent than CO<sub>2</sub>) and ammonia leachate
- Composting could
  - Reduce municipal solid waste
  - Reduce methane emissions

# 2016

## January

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## February

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

## March

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

## April

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## May

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

## June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

[www.123FreeVectors.com](http://www.123FreeVectors.com)

## July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

## August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

## September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## October

Sun	Mon	Tue	Wed	Thu	Fri	Sat
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9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

## November

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

## December

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

[www.123FreeVectors.com](http://www.123FreeVectors.com)

# ***MOST HAPPENS***

# thing, stuff

edite the



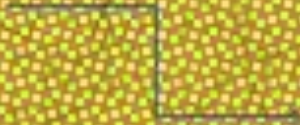
# *DECOMPOSITION TOWERS*

# Compost:



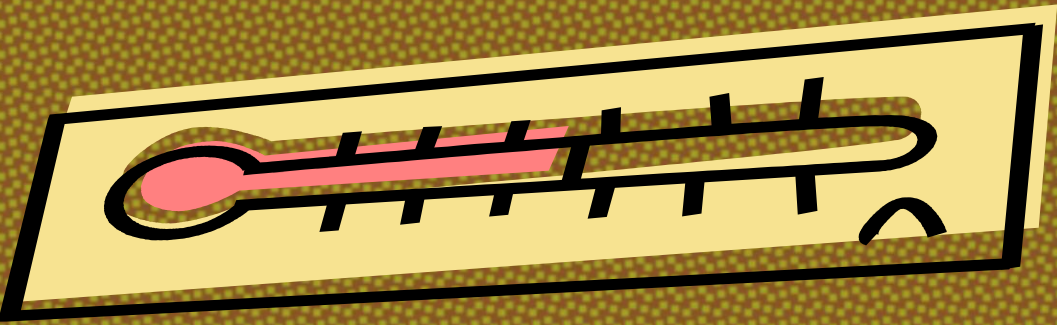
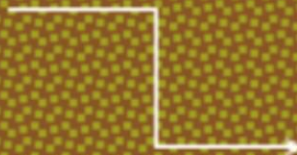
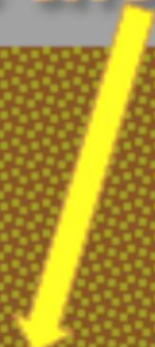
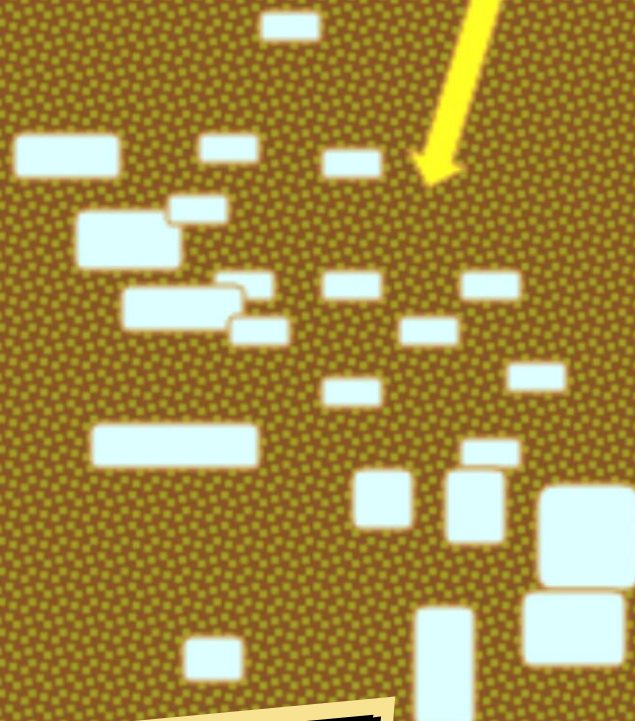
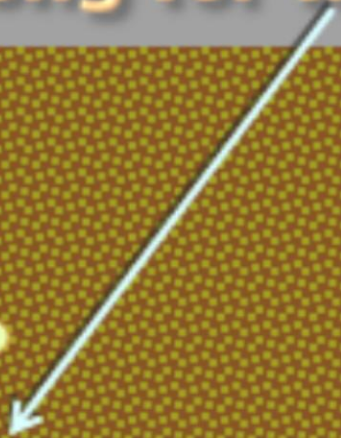
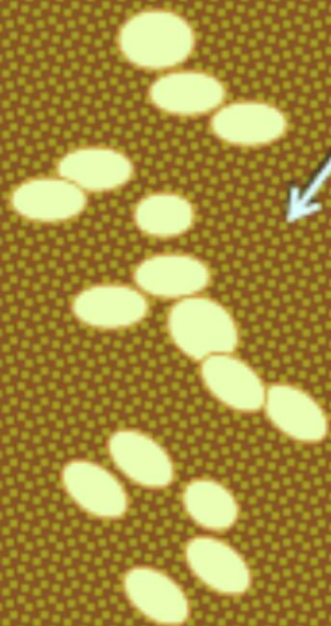
- Decreases greenhouse gases
- waste  $\Rightarrow$  valuable soil amendment
- Reduces/prevents erosion
- Recycles nutrients back to soil
- Retains soil moisture – save water
- Reduces haulage costs of green waste
- Promotes plant growth
- Suppresses plant disease

# How long for this to decompose that?





How long for these to decompose those?

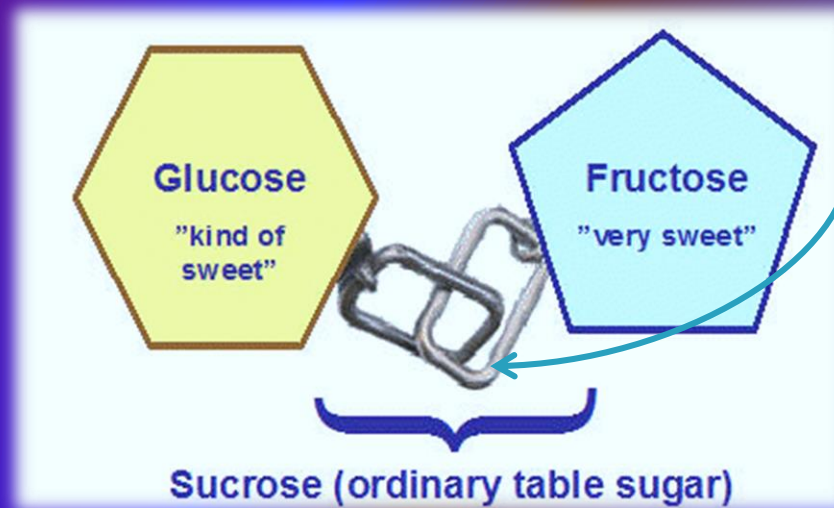


**In other words,  
for decomposition**

**The smaller the  
starting material, the  
faster the breakdown**

# AS THINGS BREAK DOWN

- Starch and sugar are broken down to smaller compounds
- The breakdown releases energy



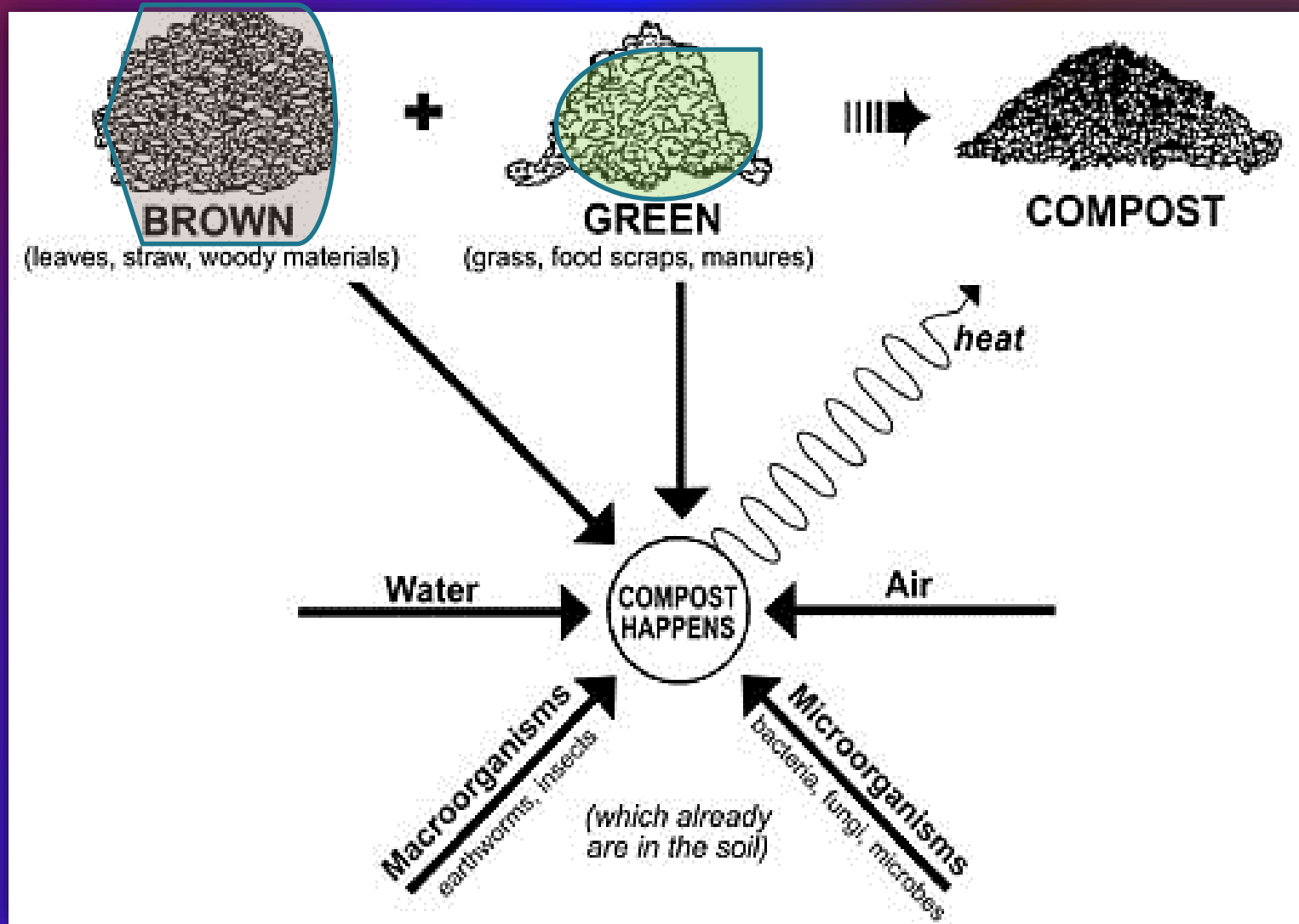
# *ENERGY (HEAT) IN BONDS*

Average bond energies, kcal/mole

C-H	98
O-H	110
C-C	80
C-O	78
H-H	103
C-N	65
O=O	116 (2 x 58)
C=O	187* (2 x 93.5)
C=C	145 (2 x 72.5)

(\* as found in CO<sub>2</sub>)

# COMPOST HAPPENS



# ***BEFORE COMPOSTING, CONSIDER...***

1. How much space you have
2. How much biodegradable material
3. How much compost will you need
4. How much labor can you reasonably perform

# *TYPES OF COMPOSTING*

- Pile            hot            Aerobic
- Tumblers    hot            “
- Bins            hot            “
- Worm            cold            “
- Trench        cold            Anaerobic

# *HOT OR COLD?*

- Hot composting relies on microbes breaking down starting materials and generating heat
- The heat promotes population of microbes, increasing rate of composting
- Temperatures may reach 160°
- Cold composting depends less on heat-producing microorganisms





# COMPOST COMPONENTS

- **Brown**--symbolizes the *carbon* portions: paper, dried leaves, and wood (shredded)
- **Green**--symbolizes the *nitrogen* portions; such as grass clippings, leaves, tea bags and *coffee grounds*

# ***THE FEEDSTOCK CONTAINS WATER***

Material	Moisture (wet basis)
Peaches	80%
Lettuce	87%
Dry dog food	10%
Newspaper	5%

C

Sawdust 100–500:1

Very high carbon!

Paper 150–200:1

Bark 100–130:1

Wheat straw 80:1

Oat straw 74:1

Corn stalks 60:1

Leaves 40–80:1

Fruit wastes 35:1

Horse manure 25:1

Vegetable wastes 12–20:1

Grass clippings 12–25:1

Apple pomace 21:1

Cow manure 20:1

Coffee grounds 20:1

Alfalfa hay 13:1

Poultry manure, fresh 10:1

Very high nitrogen!

Carbon  
Nitrogen  
ratios

N

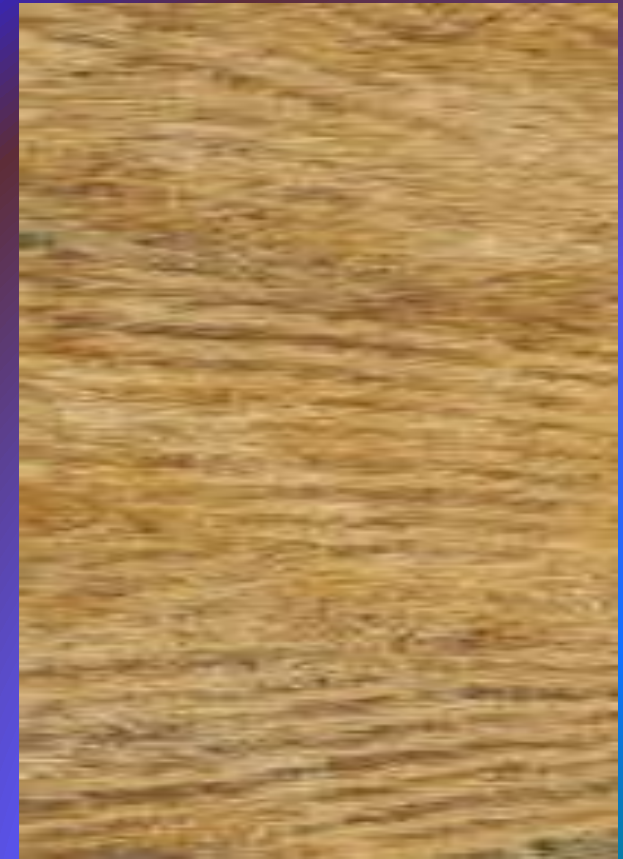
Very high nitrogen!

# A COMPOST PILE - SIMPLE



# *THE BASICS OF BUILDING A COMPOST PILE*

First: Place a layer of coarse material several inches thick on the ground for drainage



Then: Place a layer of high nitrogen material ~3”



# ***DRY MATERIALS***

Place a layer of high carbon material ~6" thick



# *ADD A SMALL AMOUNT OF SOIL*

~ 1"



N



# WATER THOROUGHLY



***TURN  
REPEAT  
LAYERS***

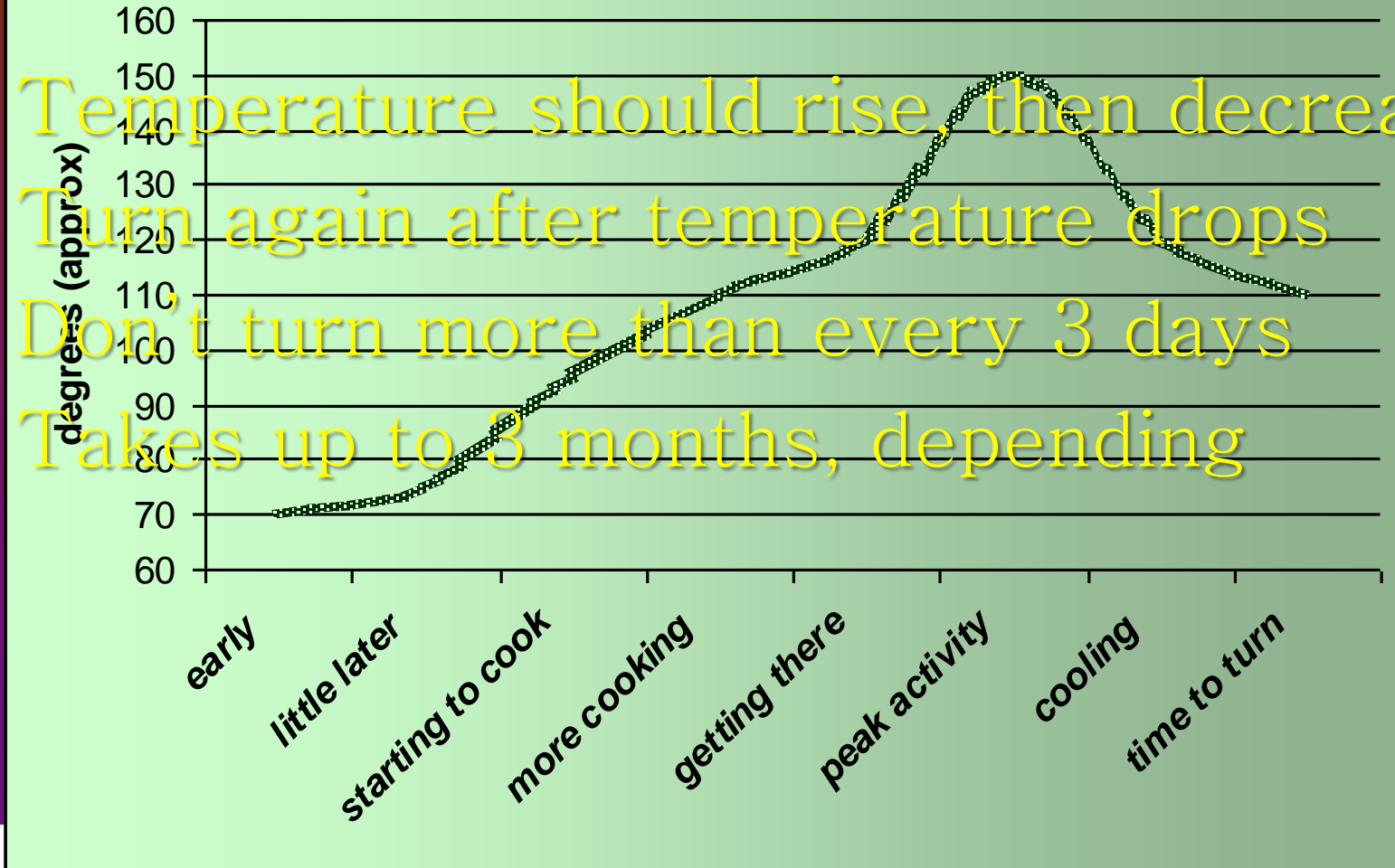


# *THE PILE BECOMES COMPOST*

- Add chopped materials in a rough ratio of 30 parts carbon to 1 part nitrogen
- Moisten thoroughly
- Turn pile to mix ingredients
- Take temperature every few days

# CONTINUED

- Temperature should rise, then decrease
- Turn again after temperature drops
- Don't turn more than every 3 days
- Takes up to 3 months, depending



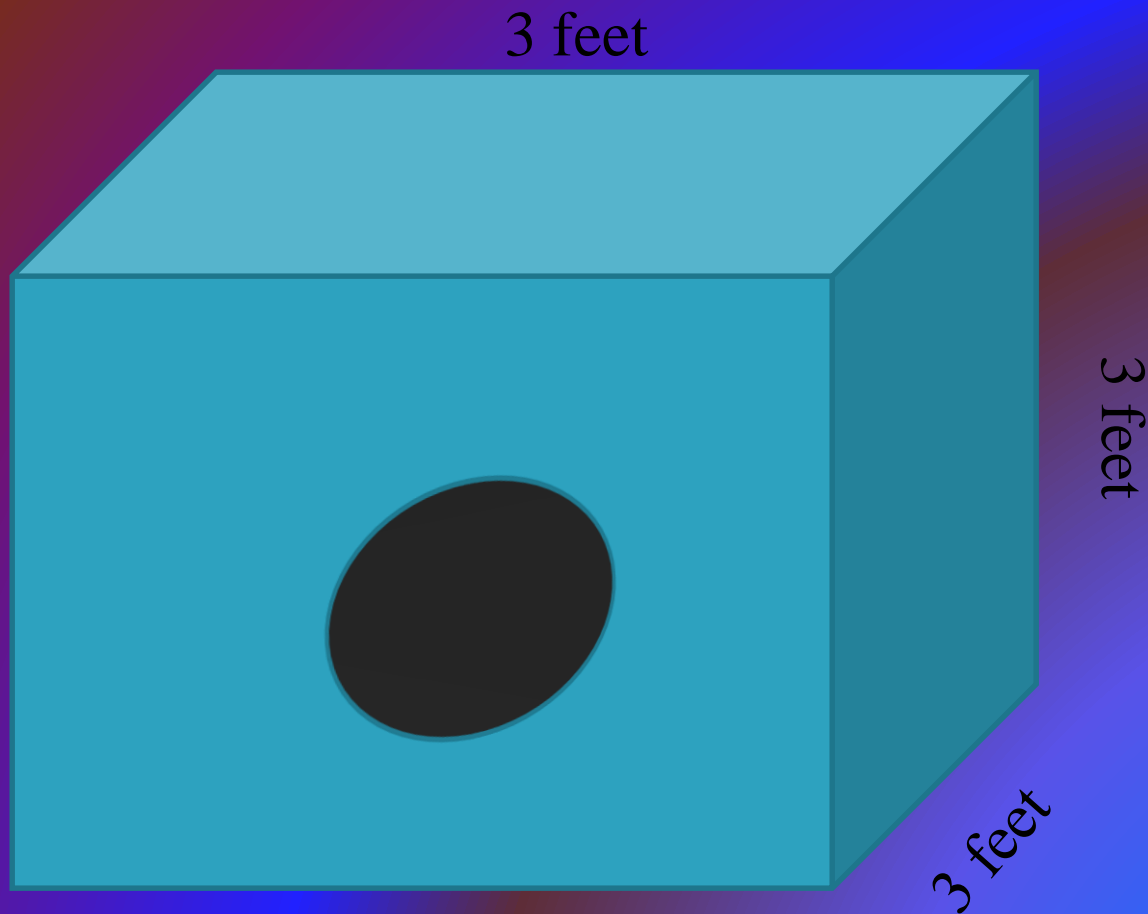
# DEPENDING ON WHAT?

- Feedstock: high in N/C?
  - High N → higher temperature
  - Faster, but may go anaerobic
  - High C → lower temperature
  - Slower
- Outdoor temperature
- Watering regime



10/2

N



*A 3x3x3' cube is a comfortable size.  
Center is where hottest composting  
occurs*

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# *TEMPERATURE RISES!*



20150312\_082134.mp4

**BREAK**





# *GETTING ENOUGH FEEDSTOCK*

Sometimes it is easier to accumulate raw materials and bring a larger quantity to the composter

# *HOLDING THE “FEEDSTOCK”*



# COMPOSTABLE BAGS



# *BUILDING YOUR COMPOST*

Demo

# TURN THE PILE - OR NOT?

- Pile can be turned regularly using a garden fork or a special auger
  - Or
- Pile can be constructed, mixed once and left to degrade slowly
  - Or
- Pile can be constructed in layers (lasagna) and left to degrade very slowly



# *ADDING SOIL?*

- Plant disease organisms may be present in soil
- These almost always live only on plant tissue
- There's no living plant tissue in compost
- Temperatures in compost cooking process kill disease organisms.

# ***HOWEVER...***

- Plants that are infected with disease, or that are infested with insects, should not be composted
- Why ask for trouble?

# *OTHER MICROBE SOURCES*

- Commercial products are available
- Bacterial spores
- Increasing population of microorganisms increases rate of composting



# *BINS*



# *BINS VARY WILDLY*



- Enclosed
- Use fork or auger for turning
- May have door for easy removal of finished compost

**1<sup>st</sup> bin** Fill with raw materials  
Allow to compost  
Turn as with pile

**2<sup>nd</sup> bin** When first is filled, start second  
Allow to compost  
Turn first bin also

**3<sup>rd</sup> bin** Either holds materials **or** gets filled after second  
Allow to compost, turning first & second

3x3x3

3x3x3

3x3x3

## **3 – BIN SYSTEM**

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# TUMBLERS



# TUMBLERS

- Have the simplicity of a pile
- Compost is enclosed
- Easy to turn
- MAY BE TOO EASY
  - Turning too often prevents mix from reaching good composting temperatures



# *MAGIC?* *(DON'T BELIEVE EVERYTHING)*

Easy as 1, 2, 3! (HAH!)

1. Just load it.
2. Give it a few spins, then give it a few spins every day for 2 weeks.
3. In just 14 days take out your finished compost.

# *WANT TO SEE MAGIC?*

- <https://www.youtube.com/watch?v=aBzriA2UANg>

# *TUMBLER COMPOSTING*

Similar to pile composting:

- Add chopped materials in a general ratio of 30 to 1 (C/N) ratio
- Moisten thoroughly
- Turn tumbler to mix ingredients
- Take temperature every few days
- Temperature should rise, then decrease
- Turn again after temperatures drop
- Don't turn more than every 3 days



# *DIFFERENT METHODS*

Electric heat &  
regular agitation  
NOT exactly  
composting

[http://www.naturemill.com/video\\_histChan.html](http://www.naturemill.com/video_histChan.html)

# *VISIT*

- Compost area
- Mulch area

# *COOL COMPOSTING*

# WORMS



# COMPOST WORMS

- Red wigglers (*Eisania foetida*)
- Hungrier and tolerate higher temperatures than 'nightcrawlers'
- Degrade materials rapidly
- Worms eat raw materials
- May eat their own weight daily

# *WORMS, CONT.*

- Foodstuff ground in gizzard
- Microorganisms in worms themselves and in degrading materials also involved
- Little heat generated
- Compost = worm castings

<http://urbanext.illinois.edu/worms/anatomy/anatomy6.html>

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# Health SURVEY

1. Do you consume at least 5 servings of fruit and vegetables each day?

Always

Sometimes

Never

2. How many times per week do you exercise?

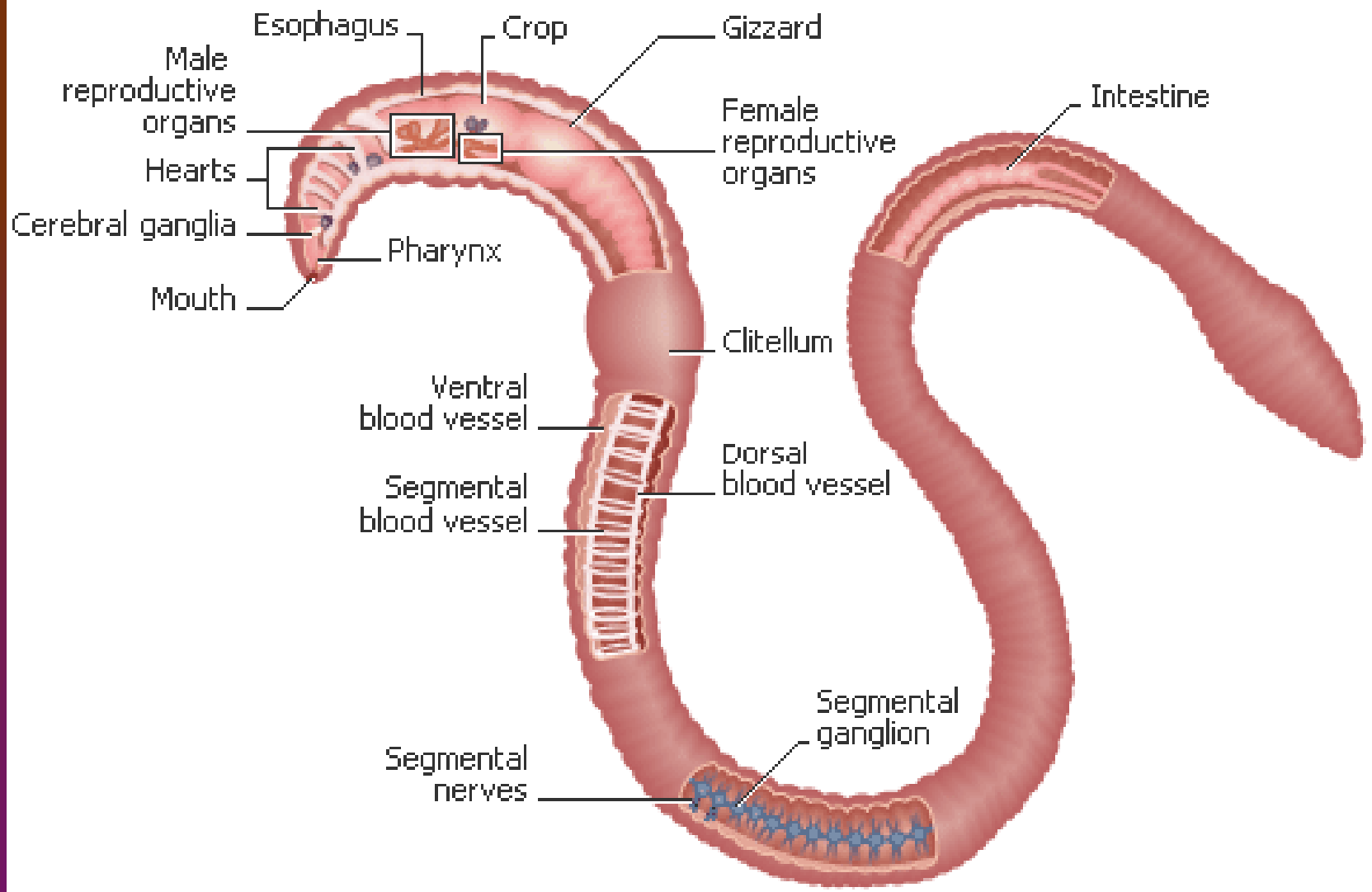
5 or more

2-4 times

1 or less

WORM BIN comics







# MANAGING WORMS

- Starting materials must be moist
- Higher N than other methods
- C/N ratio not important
- Must be protected from heat and cold
- Must not get dry!
- Many, many worms in 1 pound!

# *OUTDOOR WORM BINS MUST BE SHELTERED*

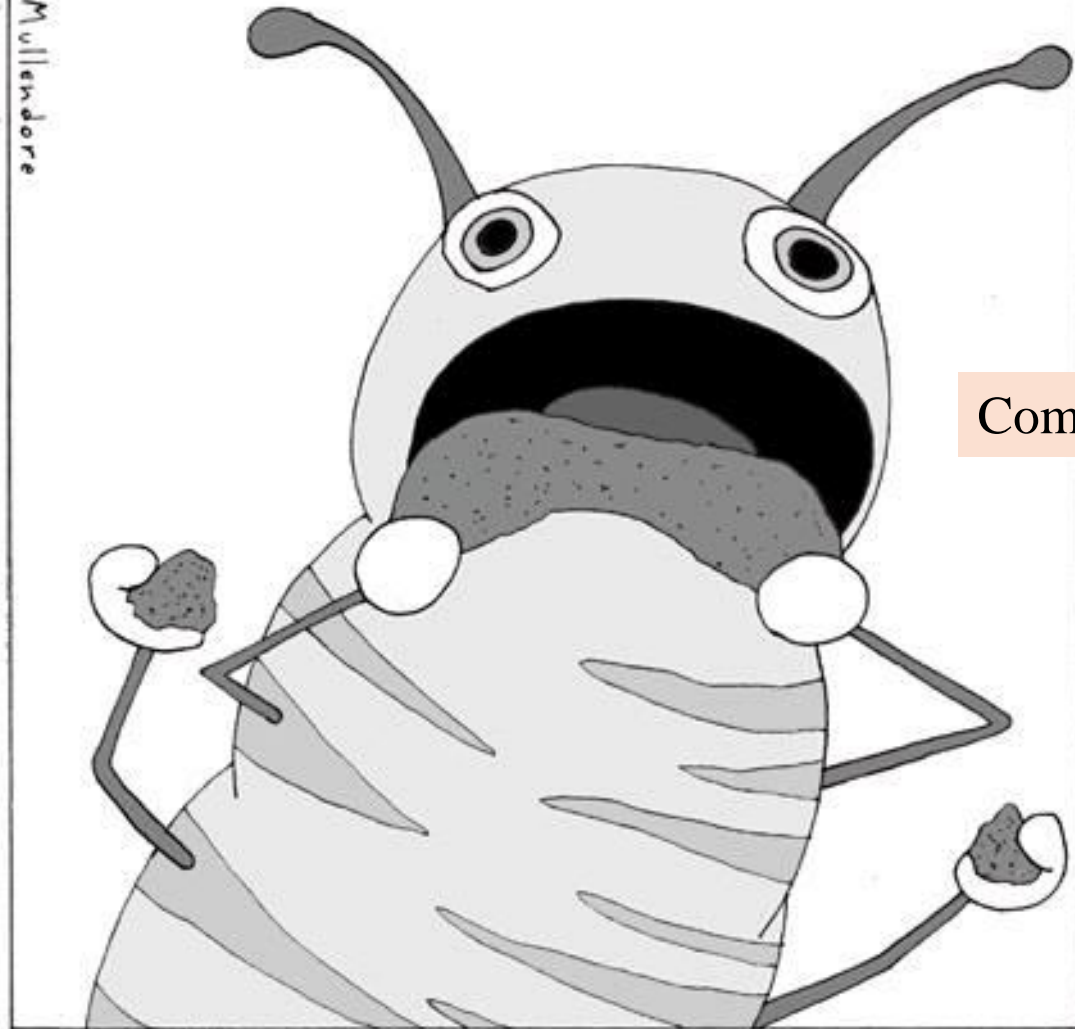


Under cover

09.24.2010



Mullendore



Compost worm

Though normally a very mellow caterpillar,  
Theo had recently discovered coffee grounds  
in the compost pile.

# *BUILD YOUR OWN WORM BIN*



# *ANAEROBIC*

# *BOKASHI*

## Demo

# TRENCH

## SIMPLEST METHOD

- ▣ Slower
- ▣ Anaerobic microbes do work
  - Bury starter material near new garden
  - Add small amount of fertilizer
  - C/N ratio not critical
  - Will smell bad if opened before complete





# *ALTERNATE ANAEROBIC (RODALE)*

- Use a 30 or 40 gallon plastic garbage bag.
- Fill with organic materials & nitrogen fertilizer.
- Shake well to mix materials.
- Add about 1 quart of water
- Close the bag tightly.
- Store outdoors (shade) in summer and in a heated garage during winter.
- No turning or additional water.
- Compost should be finished in 6 – 12 months.

# *PET WASTE CONTAINER PROS & CONS*

# *WHICH IS BEST FOR YOUR SITUATION?*

1. How much space available?
2. How much biodegradable material is available?
3. How much compost will be needed?
4. How much labor can you reasonably perform?

# *WHICH BIN OR TUMBLER?*

- How will your choice look in the spot you have selected?
- Do you have the ability to turn your choice?
- Do you have enough feedstock to make the cost of your choice worthwhile?

# DON'T COMPOST THESE!!!

- Plant with severe disease or insect infestations
- Noxious or succulent weeds
- Grasses that spread by rhizomes

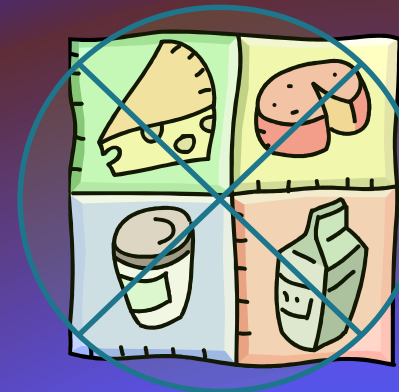


- Dog and cat manure
- Meat or fish leftovers



Bones

- Butter
- Cheese
- Lard
- Grease
- Mayonnaise
- Milk
- Peanut butter
- Oils
- Salad dressing
- Sour cream
- Whole eggs



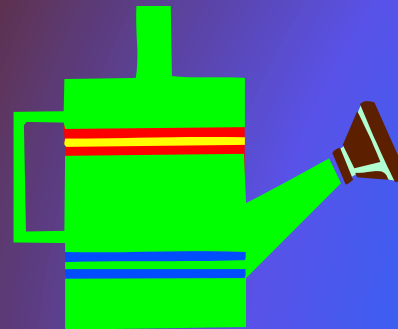
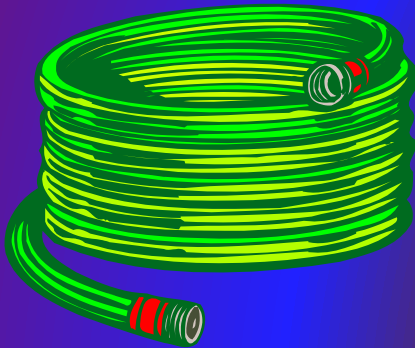
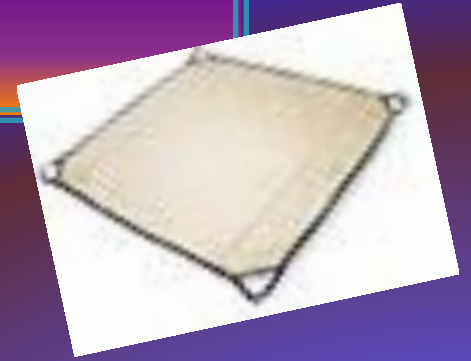
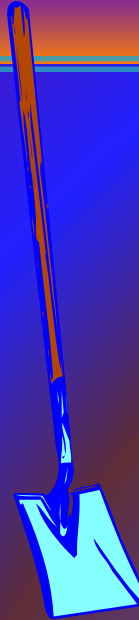
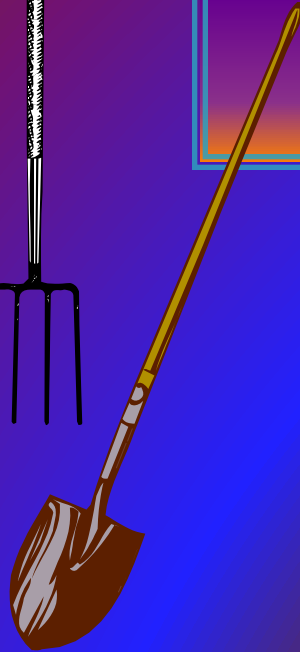
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Palms are OK but

They take forever to break down!



# TOOLS



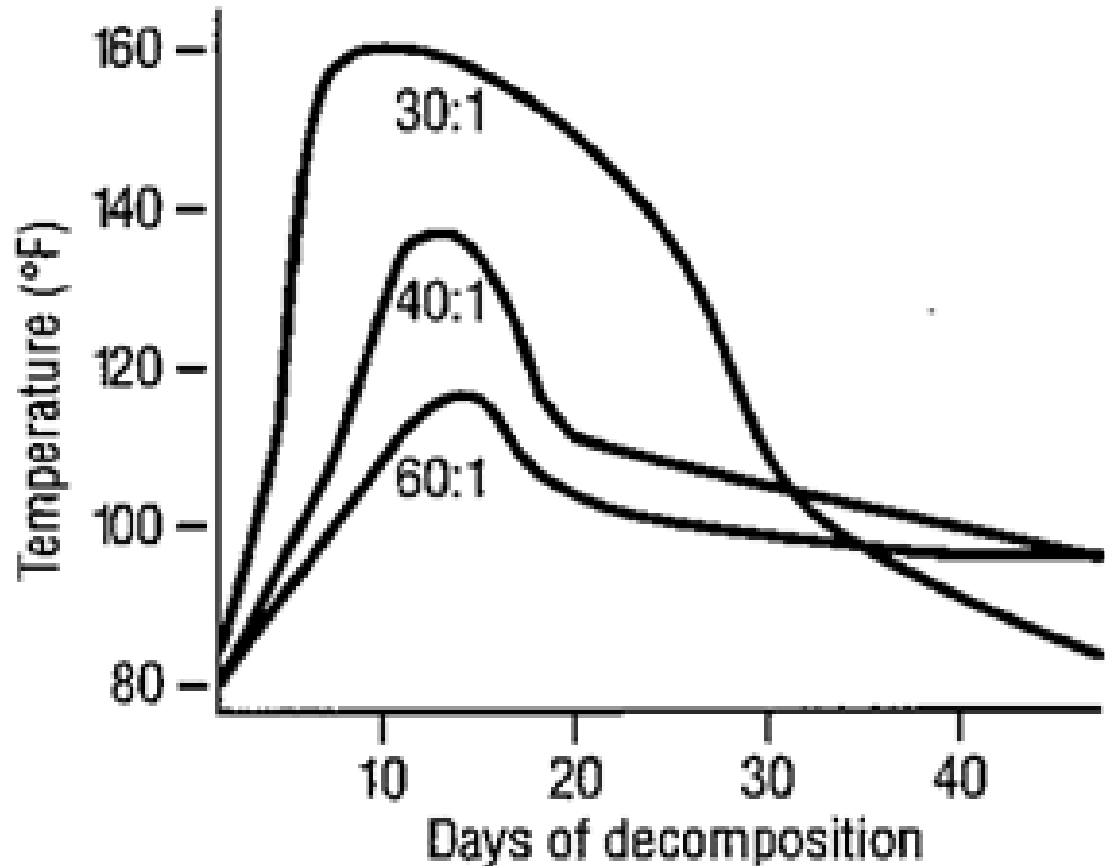
# *HOW MUCH TIME?*

Preparation – Between 5 and 20 minutes per week for a small system; for a landscape this will vary with the amount of material being composted and the number of people attending to the process (turning, etc.)



# SPEED OF COMPOSTING

## Carbon:Nitrogen Ratio Effects on Composting



[http://whatcom.wsu.edu/ag/compost/fundamentals/needs\\_carbon\\_nitrogen.htm](http://whatcom.wsu.edu/ag/compost/fundamentals/needs_carbon_nitrogen.htm)

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# *COMPOST IS COMPLETED*

in anywhere from a few weeks to a few months, depending:

- Composition and preparation of raw materials
- Turning regime

# *HINTS FOR SUCCESS*

- Include oxygen in the mixture to support aerobic organisms that break down the materials (STIR)
- Don't stir too often, or it won't get hot enough to compost.
- These materials should be mixed on a regular basis
- Aeration will cut down odors

# *PROBLEMS TO CONFRONT*

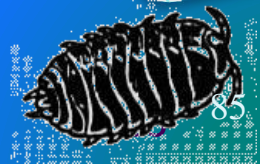
- Dry Air
  - Always keep lightly moistened
- Hot
  - Place in a shady space if possible
    - Always have a cover
- Insects
- Odors
- Not Composting



# ***INSECTS, ETC.***



- ▣ Bugs happen. They benefit compost & help expedite process by breaking down starting material
- ▣ No pesticides! Can kill bugs and worms
- ▣ Decrease flies and other insects in compost by freezing starting material before putting it in the composter
- ▣ Put DE on top to control roaches



# *DIATOMACEOUS EARTH (DE)*

- Fossilized remains of diatoms
- Ground to a powder
- Used as a filter
- Used as a mechanical insecticide



# Preventing odors

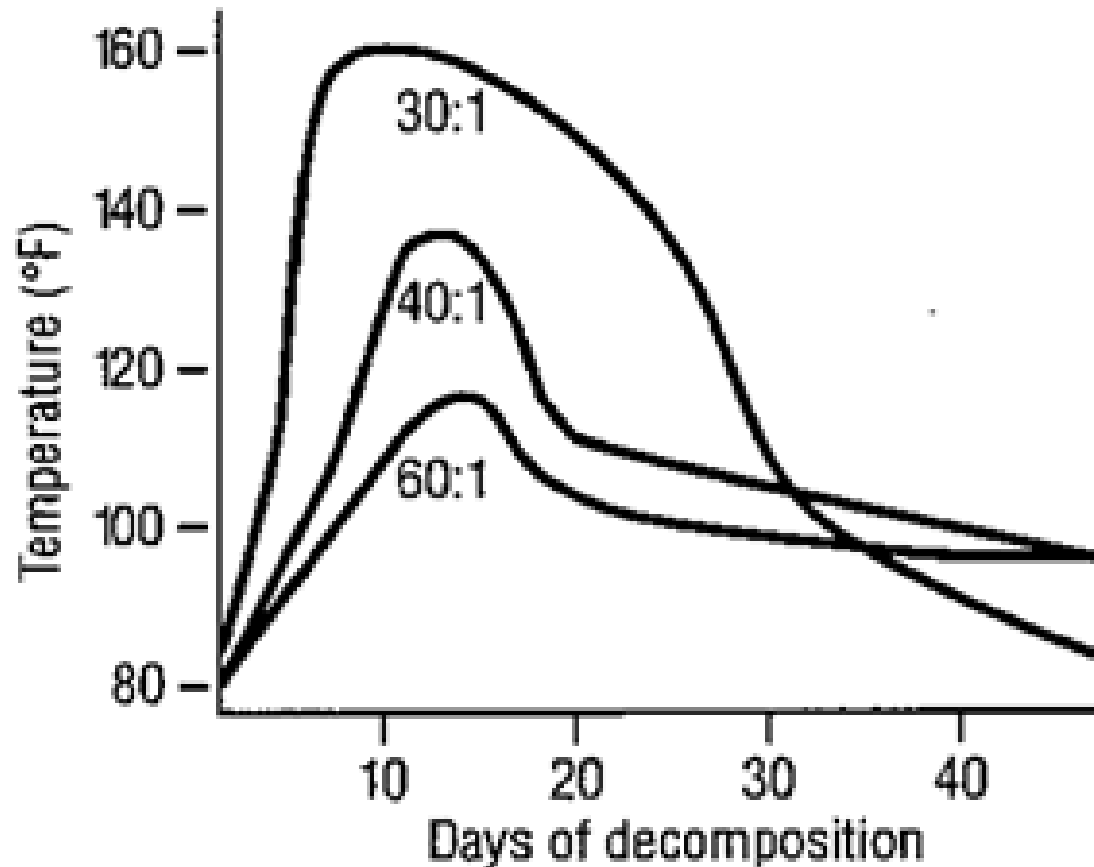
- ▣ Compost should smell like fresh soil
- ▣ Foul smells may be due to
  - Anaerobic conditions – stir to add oxygen
  - Too much green or large green clumps – add some browns and stir well
- ▣ Always make top layer of compost brown

# *NOT COMPOSTING???*

- Turned too often, heat doesn't generate
- Not turned often enough, process is very slow
- Too much carbon, no food for microbes
- Pile too small, microbes can't get established



## Carbon:Nitrogen Ratio Effects on Composting



[http://whatcom.wsu.edu/ag/compost/fundamentals/needs\\_carbon\\_nitrogen.htm](http://whatcom.wsu.edu/ag/compost/fundamentals/needs_carbon_nitrogen.htm)

# *HYGIENE*

- Compost is rarely a disease risk
- To reduce these remote risks:
  - Wear gloves when handling
  - Wash your hands after handling
  - Cover any cuts on hands or arms
  - Don't sniff compost deeply, especially if
    - your immune system is suppressed (HIV/AIDS, chemo/radiation, organ transplant anti-rejection drugs)
    - You have asthma, emphysema, etc.

# *IT'S FINISHED WHEN IT:*

- *has no chunks of undecomposed matter*
- *is dark*
- *does not feel “slick”*
- *Holds together when pressed in the hand*

# *USING COMPOST*

- Incorporate about 1 – 3 inches of compost into top soil.
- Mix thoroughly.
- Plant as usual
  
- Or place it on top of soil and allow it to work its way into the soil.
- Or – make a slurry and apply

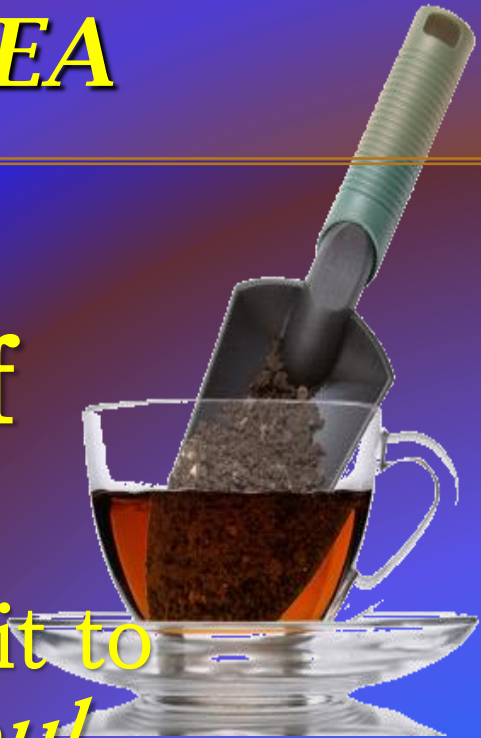
# *SLURRY METHOD*

- When applying to existing landscape
- Mix a handful in a bucket of water
- Stir, pour around plants
- Wash off mulch



# COMPOST TEA

- An aerated brew of compost in water
- Insufficient air will cause it to go anaerobic and smell *foul*
- ~ one part compost to five parts water



# *COMPOST TEA (CONT.)*

*IS A SOURCE OF PLANT NUTRIENTS .  
CAN BE APPLIED TO SOIL OR  
(DILUTE) TO FOLIAGE.  
BUT MAY BE MORE IMPORTANT AS A  
DISEASE CONTROLLER*

# *PROPERTIES VARY WITH*

1. Starting materials
2. Length of brewing time
3. Level of aeration and stirring



# *MANY SYSTEMS, BUT BASICALLY*

- Stir/aerate
- Allow to settle
- Dilute to a tea color
- Use tea as desired



# APPLYING COMPOST TEA



# COMPOST TEA IS NOT

- The liquid that develops at the bottom of a composter
- That is stinky!
- That is effluent, and can be used if diluted beyond the stink



# *SUMMARY - COMPOST IS*

- A terrific source of plant nutrients
- A source of many beneficial microorganisms
- A plant disease controller, both as compost and tea
- An important way to lower the amount of organic garbage going to the landfill.

# *POST CLASS QUESTIONS*

1. It is important to turn compost (choose the correct answer):
  1. At least twice a day
  2. Once a day
  3. Once every few days
  4. Only if it smells bad
2. (True or false) Compost tea is the effluent that drains out of a compost bin, pile or tumbler

# QUESTIONS, CONT.

3. Insects appear in compost (choose one):
  1. If it is not well maintained
  2. But they can be controlled with diatomaceous earth
  3. So the compost should be sprayed with insecticide to keep them from spoiling it
  4. If temperatures are too high
4. (True/false) If compost smells bad, it should be discarded and started over

# *ANSWERS*

1. 3
2. False
3. 2
4. False

# *LEE HAYS ON COMPOSTING*

- If I should die before I wake,  
All my bones and sinew take;  
Put me in the compost pile,  
And decompose me for a while.
- Wind, water, rain will have their way,  
Returning me to common clay!  
All that I am will feed the trees,  
and little fishes in the seas.
- On radishes and corn you munch--  
You might be having me for lunch!  
And then excrete me with a grin--  
Chortling, "There goes Lee again!!"

[compost.css.cornell.edu/yourself.html](http://compost.css.cornell.edu/yourself.html)

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# *RESOURCES*

<http://www.epa.gov/epawaste/conserve/rrr/composting/benefits.htm>

[http://www.caes.uga.edu/publications/pubDetail.cfm?pk\\_id=6288](http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=6288)

<http://green.wikia.com/wiki/Compost> looks at the various cost savings from composting unexpected materials.