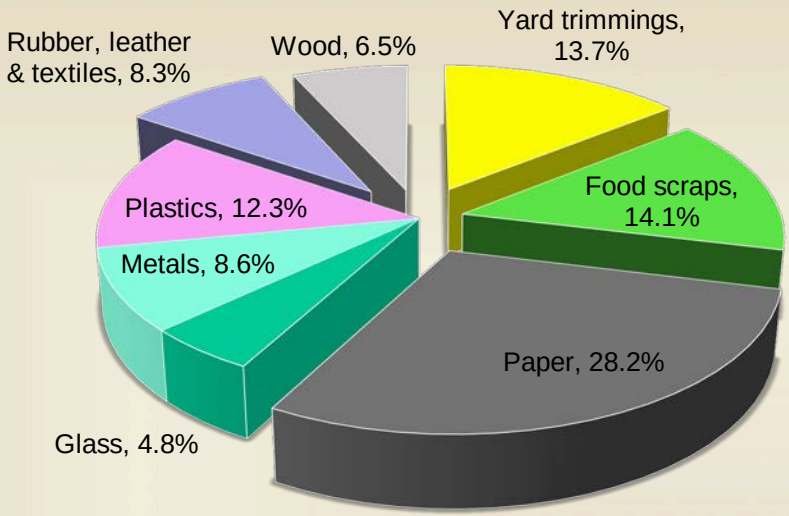
Composting..How it All Works

"…because rinds, limbs, manure, leaves, garden cleanout, etc...are Terrible Things to Waste!!"

Jean Bonhotal
Cornell Waste Management Institute
cwmi.css.cornell.edu

US Waste Stream



Composting can also help solve our society's solid waste disposal problem. *Organic residuals can comprise over 60% of our solid wastes nationwide.

*USEPA Municipal Solid Waste in the US: Facts and Figures 2009.

Composting to Reduce the Waste Stream and…. Make a Great Soil Amendment

REDUCE

REUSE

RECYCLE

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Why Compost?

- **Managing Organic Waste through Composting Reduces Volume**

by 50%

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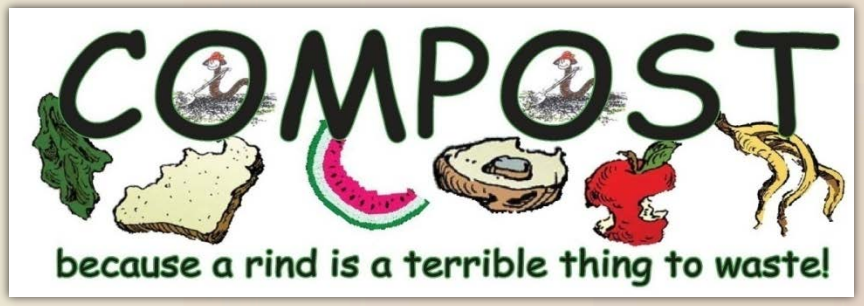
- ❑ It does not burn well
- ❑ Fills up Landfills
- ❑ Convert organics into a soil like product
- ❑ Holds soil moisture during dry seasons
- ❑ Helps to Suppress Plant Disease
- ❑ Improves soil quality

Compost = Healthy Soil = Good Food = Healthy People



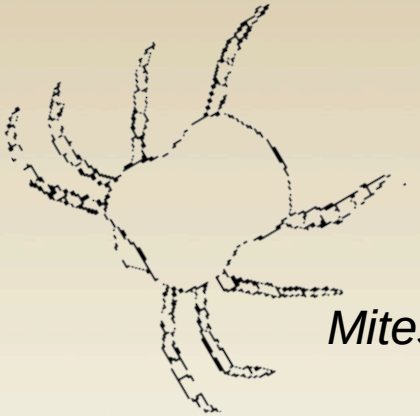
What Makes the Compost Process Work?

Micro and macro organisms are key….

They require

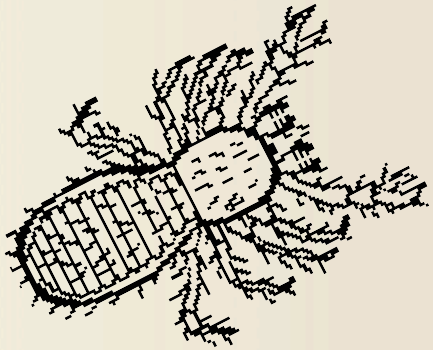
1. **Food**
2. **Shelter**
3. **Moisture**

Springtails

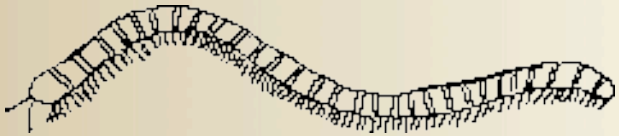


Mites

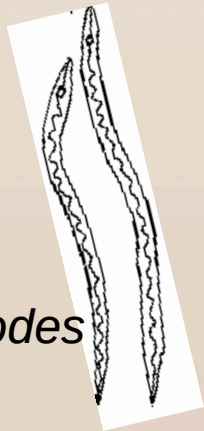
All decomposers are bound together in a complex feeding web. They turn organic wastes into a beneficial soil conditioner.



Spiders



Earthworms



Nematodes

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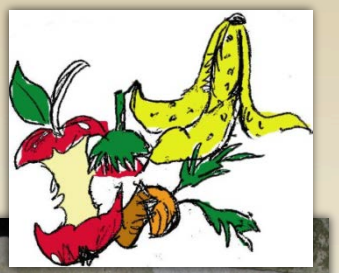
Think About Residuals Available to Compost



- Food waste
- Food processing
- Leaf and yard waste
- Garden residuals
- Manure
- Weeds/lake weeds
- Nut Hulls
- Biosolids
- Silage/Haylage
- Mortality

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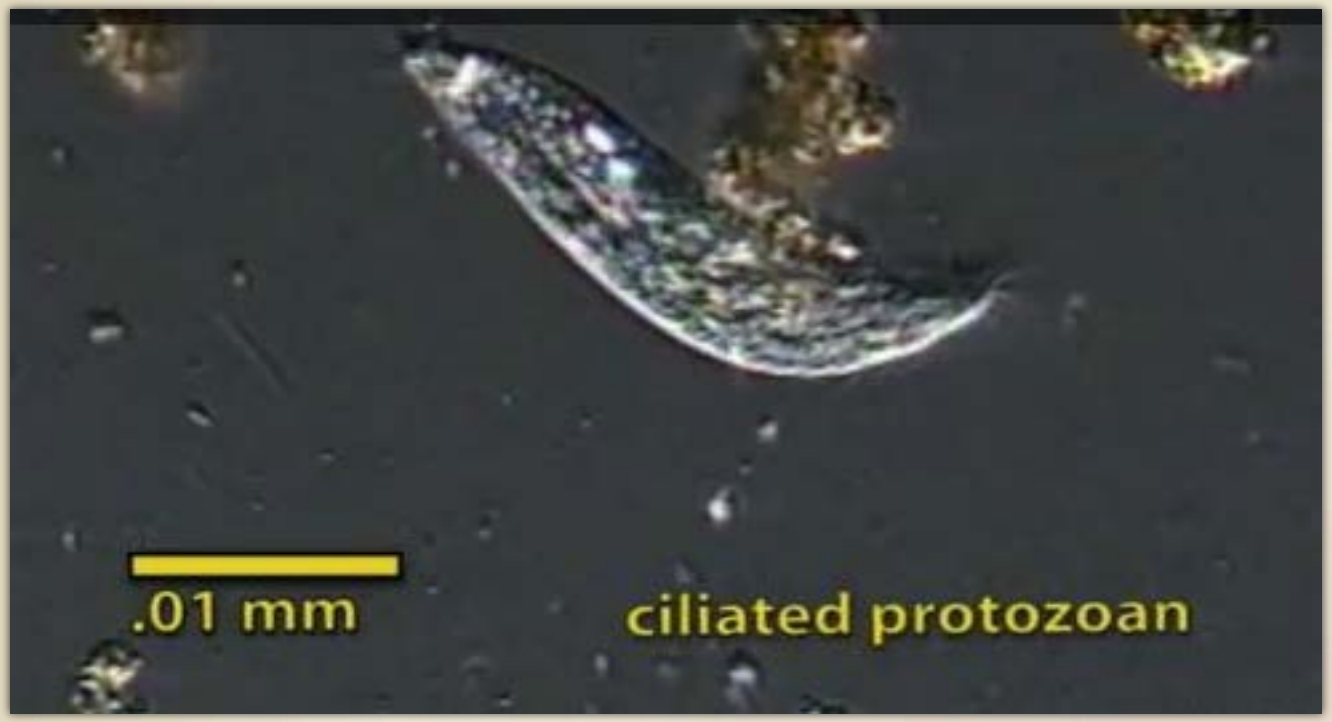
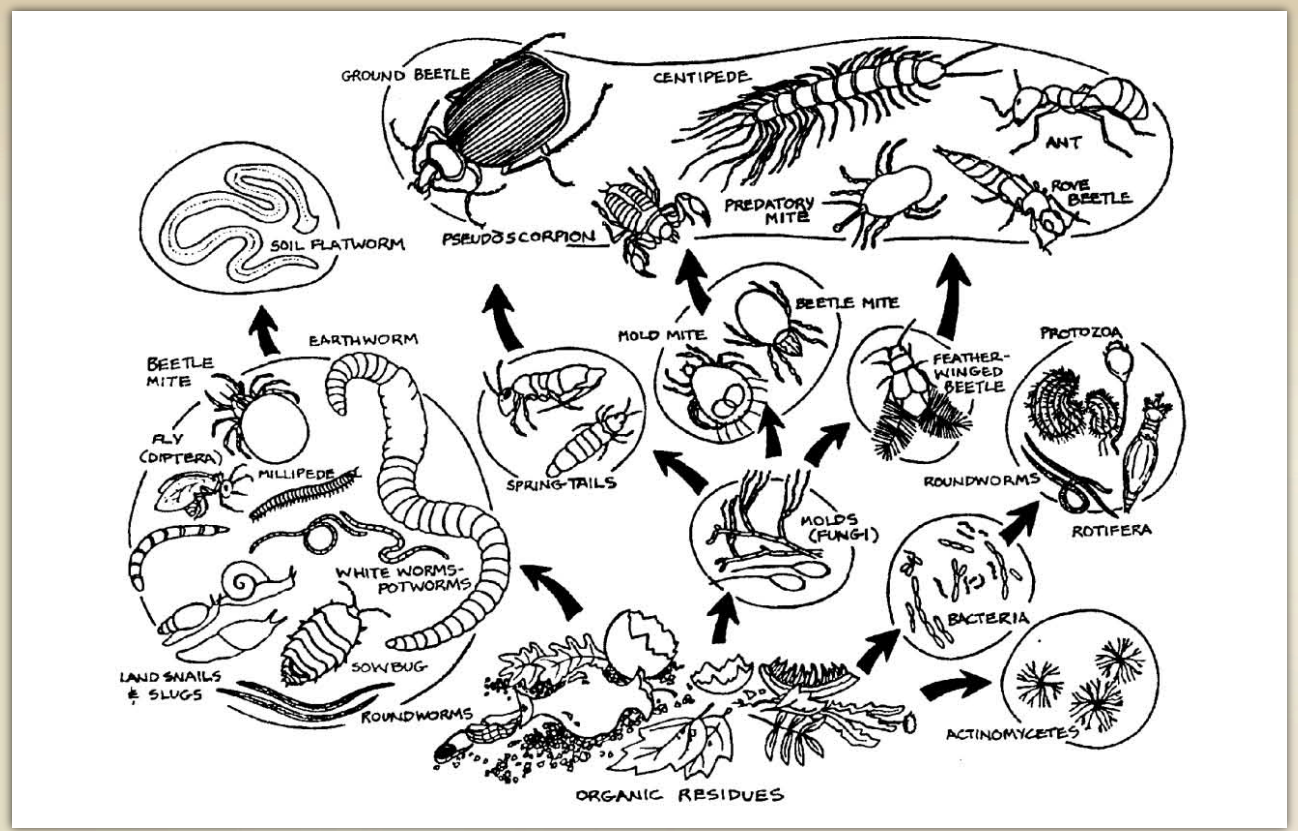
I. Organisms Involved in the Compost Process



Source: Vermicompost: A Living Soil Amendment video by Allison Jack

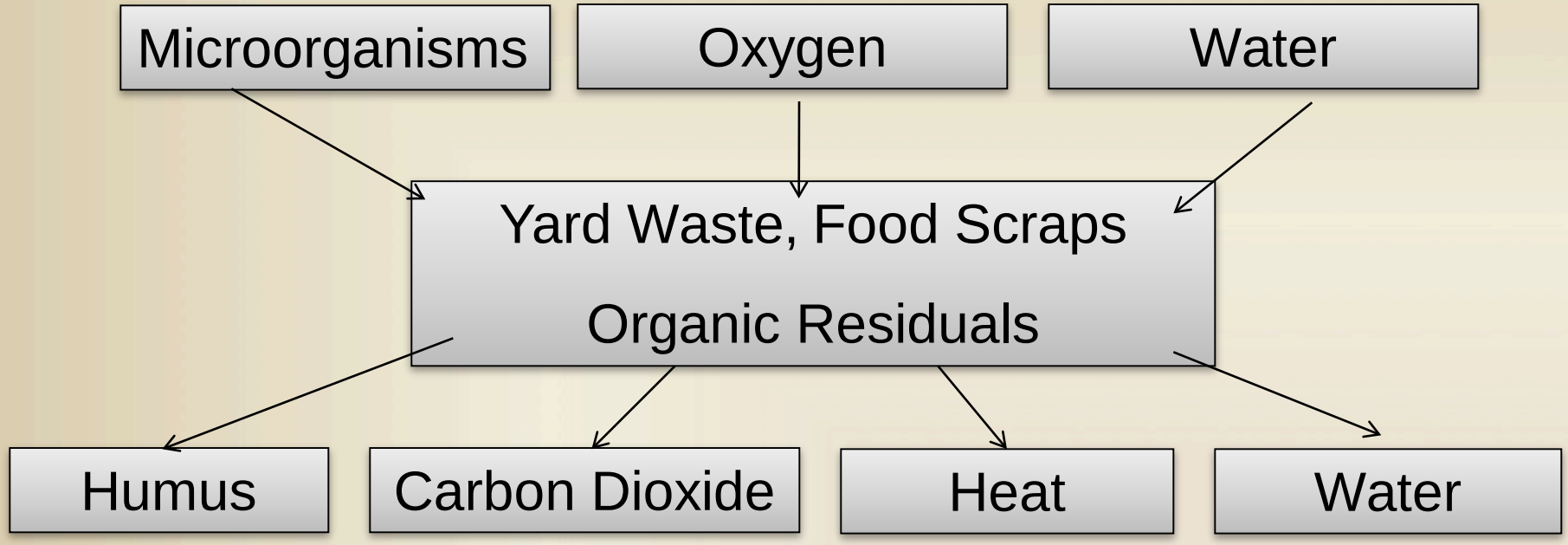
Earthworms are perhaps the most familiar decomposer. By blending soil and organic matter in their digestive track, they produce stable, nutrient-rich aggregates (worm castings) that improve the structure of soil.



Composting is a microbiological process. Organisms use decaying matter as their food source. Bacteria are among the simplest and most common organisms. Single-celled and microscopic, they are found almost everywhere in the environment.

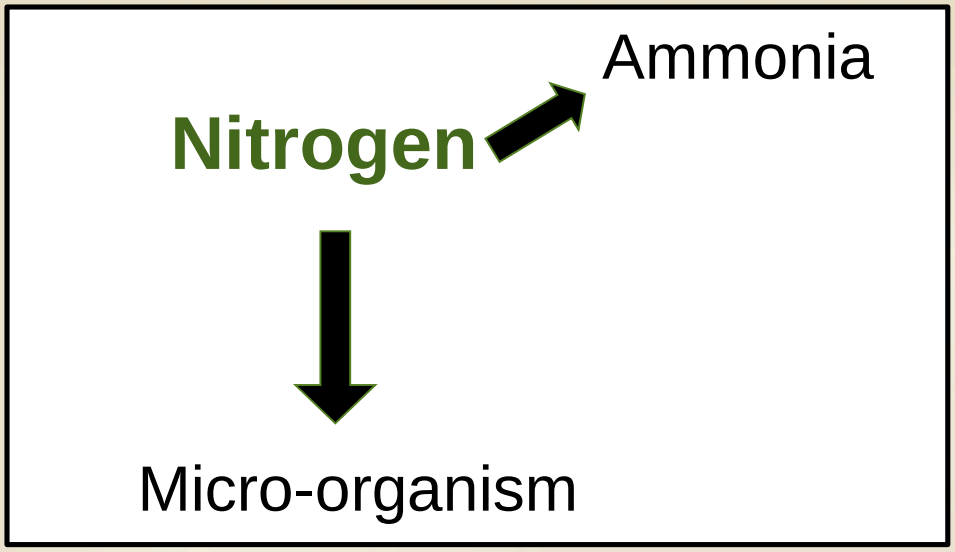
Fungi and molds are also important. This *Meripilus giganteus* (giant polypore fungi) appears on stumps and at the base of some living broad-leaved trees.

The Composting Process



While the natural process of decomposition will occur without any assistance from us, several factors can be managed to accelerate the compost process.

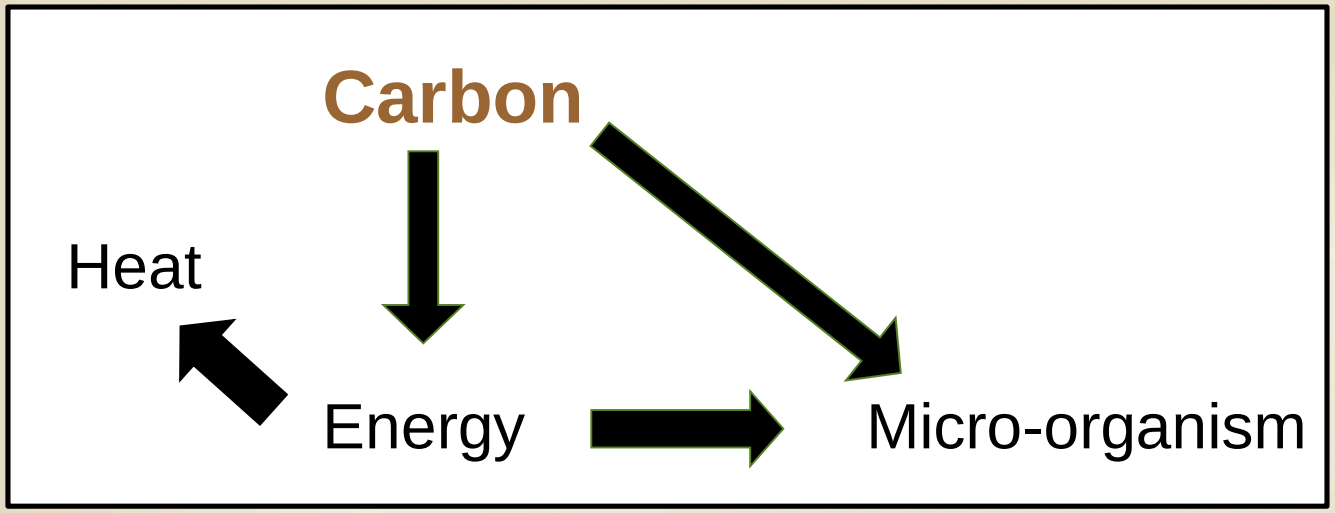
Nitrogen Cycle



Organisms use nitrogen to grow and reproduce.

Low nitrogen = slow decomposition
Excess nitrogen = ammonia will volatilize, creating odor

Carbon Cycle



Organisms utilize carbon as a source of energy.

Low carbon = wet pile, dense conditions
Excess carbon = dry pile, slow decomposition

Materials With High Nitrogen Value

Material	C:N
Humus	10:1
Food Wastes	15:1
Grass Clippings	20:1
Cow Manure	20:1
Horse Manure	25:1

The optimum C:N ratio is about 30 to 1. This ratio will make fast, hot compost. Grass, animal manures and fresh green plants are high in nitrogen.

Materials With High Carbon Value

Material	C:N
Fruit Wastes	35:1
Foliage	40-80:1
Corn Stalks	60:1
Straw	80:1
Bark	100-130:1
Paper	170:1
Sawdust	500:1
Wood	700:1

Leaves, brush, sawdust and wood chips are good sources of carbon. Blending carbon sources with nitrogen-rich materials can balance C:N ratio.

3 Carbon : 1 Nitrogen

Then layer the carbon and nitrogen. Lasagna Method- layering C and N with no food showing

Almost any type of organic material can be composted; some decompose more easily than others.

Maple leaves have a C:N ratio near the optimum level of 30:1. With the right moisture and frequent turning, maple leaves can break down in just a few weeks time.

Oak leaves have a C:N ratio of about 60:1 and have high levels of tannins which are resistant to decay. Mixing leaves with high nitrogen material will accelerate their decomposition.

Clippings from home lawns treated with pesticides may contain chemical residues. With few exceptions, these residues will not persist from one growing season to the next. If the type and level of pesticide used is unknown, those materials should not be added to the compost pile.

Wood ash is not recommended as a compost feedstock. Ash contains potassium but also contains other contaminants that may not be good in vegetable gardens.

Surface area is another key factor to consider; decomposition occurs in thin films on the surface of particles. A large particle has less total surface area than the same particle chopped up.

*Large particles (woodchips) = better aeration and less labor but take longer to breakdown.

*Small particles (sawdust) = more surface area, less pore space to circulate air and more labor to aerate.

Fresh grass clippings are high in nitrogen, about 20:1. They are too wet and will mat, creating unpleasant anaerobic odors. They will compost well when mixed with a carbon source such as leaves or brush.

Manures are high in nitrogen and contain many organisms helpful to the compost process. While livestock manure is a great feedstock, dog and cat feces may contain parasites which can spread disease.

Addressing Climate Differences

Moisture & Humidity

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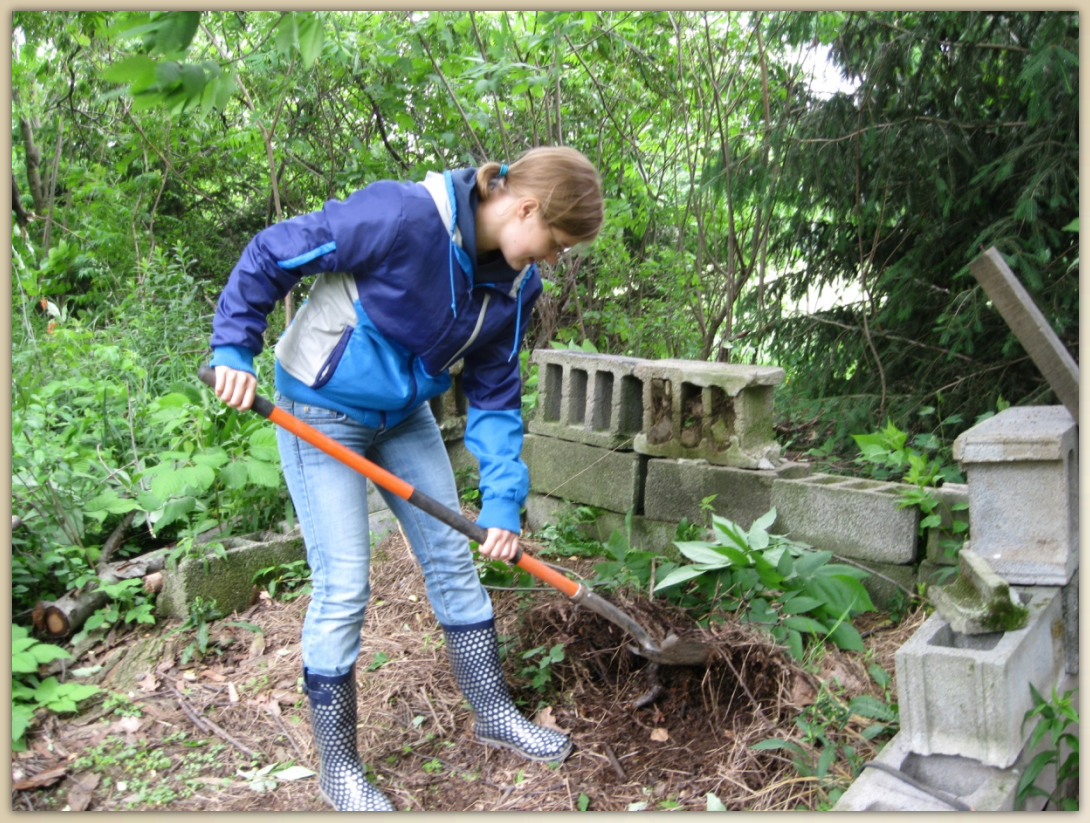
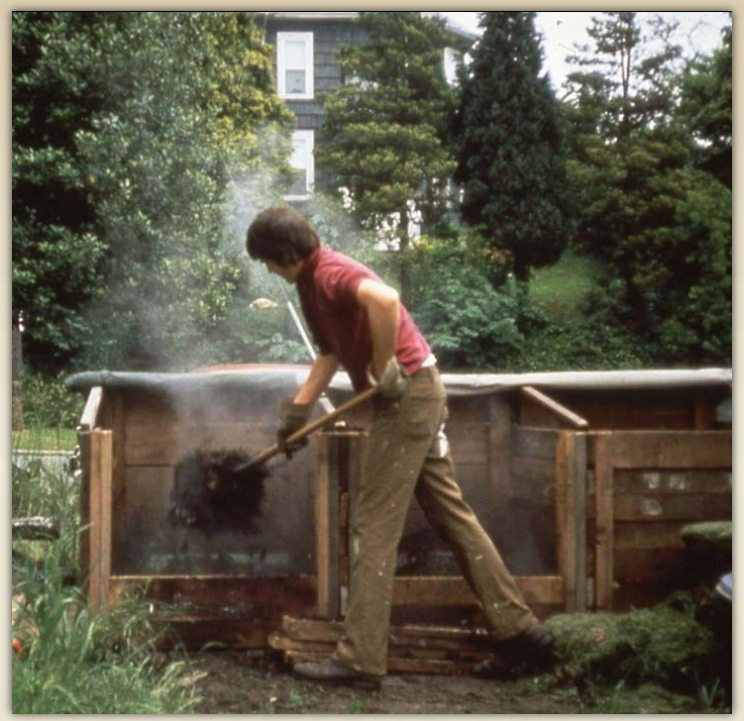
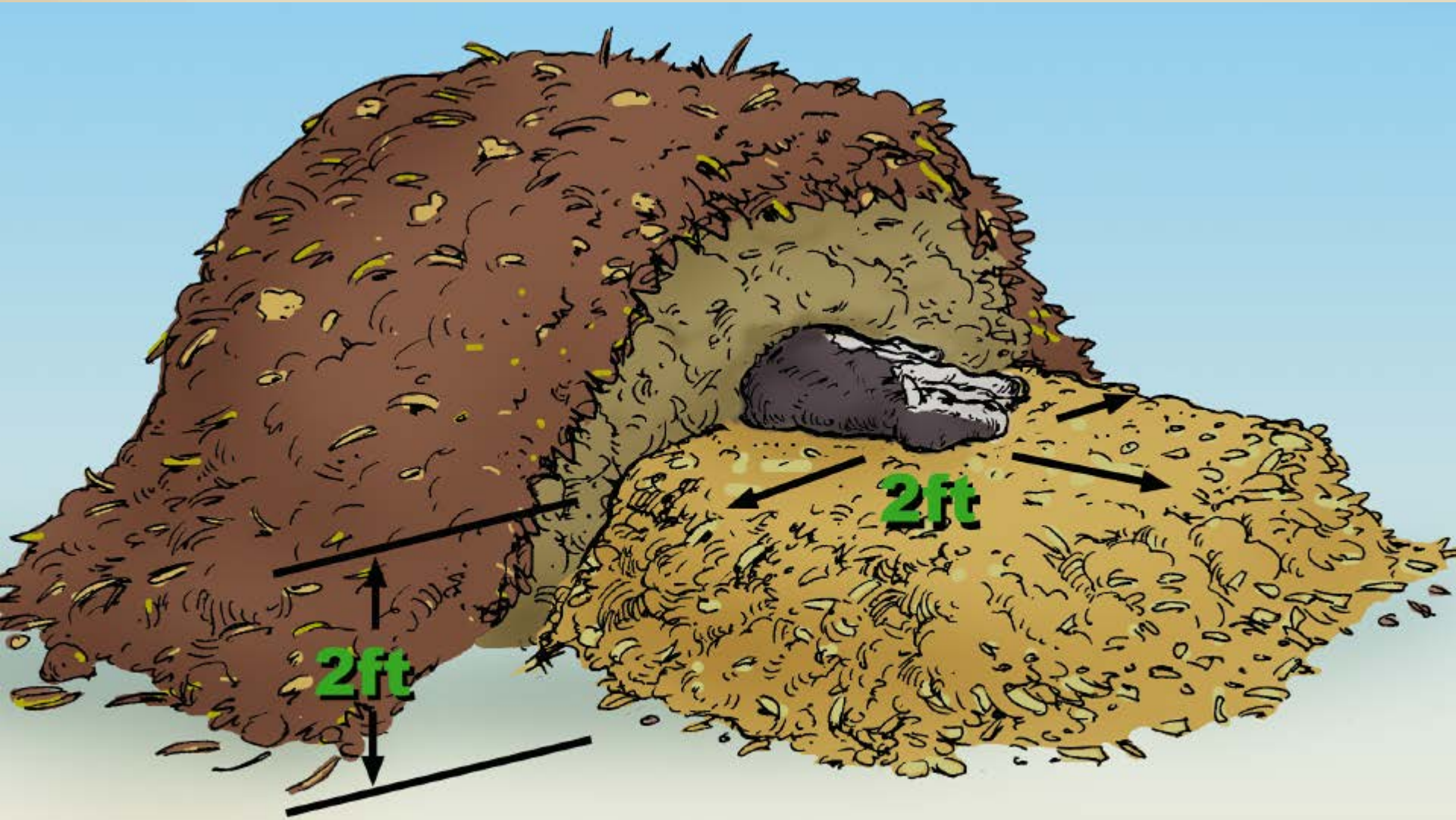
Organisms need moisture. Decomposition will slow with too much or too little moisture. The optimum moisture content for compost is 40-60%, damp enough so that a handful feels moist to the touch, but dry enough that a hard squeeze produces no more than a drop or two of liquid.



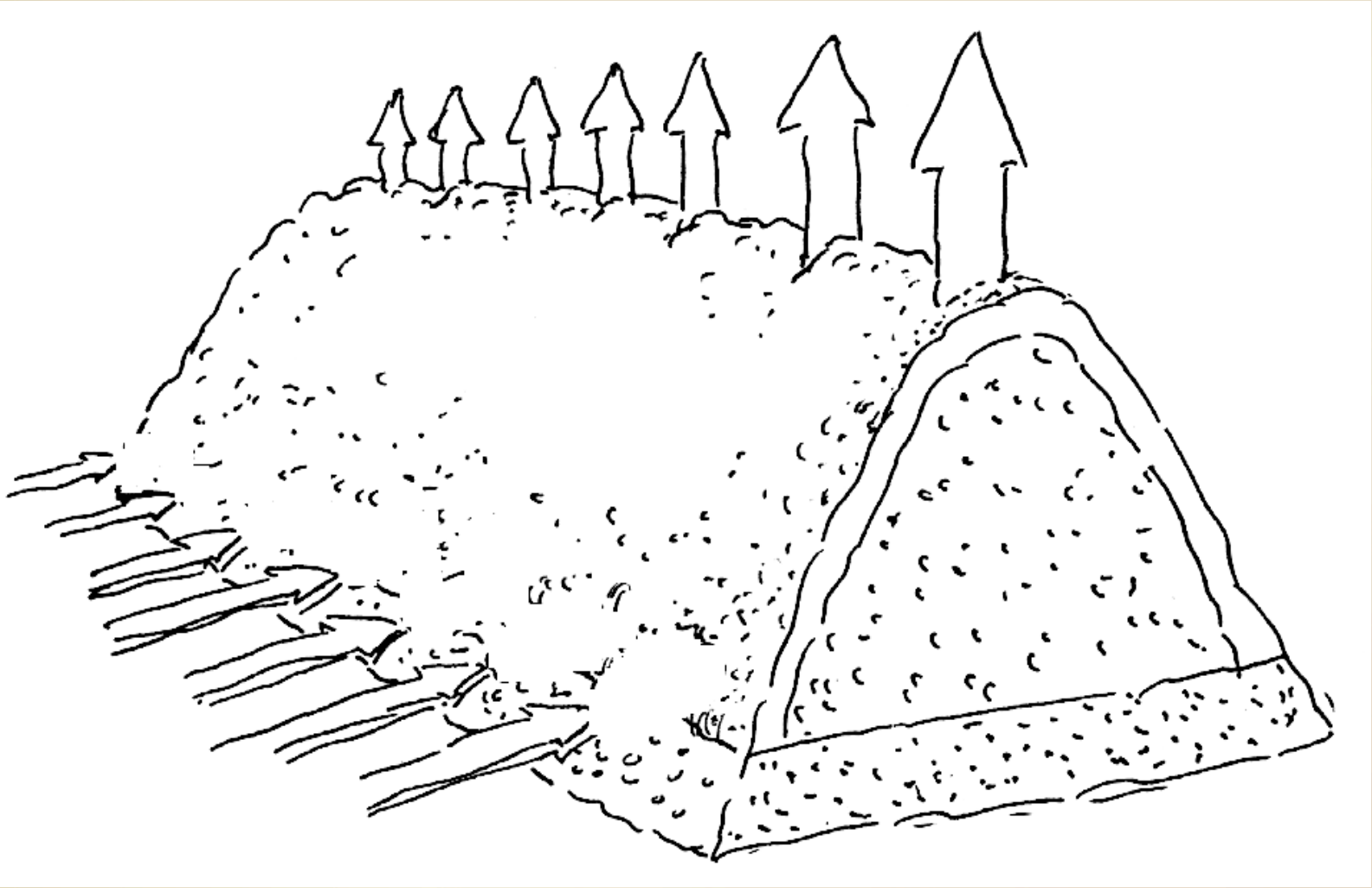


Oxygen will move into the pile if it is loose and there is plenty of space between particles, as when straw is mixed in the pile. Finer material may need to be aerated by turning the pile with a pitch fork or shovel. With the rapid decomposition that occurs with high nitrogen materials, turning becomes necessary to prevent anaerobic conditions from developing.

Recipe for Large Animal



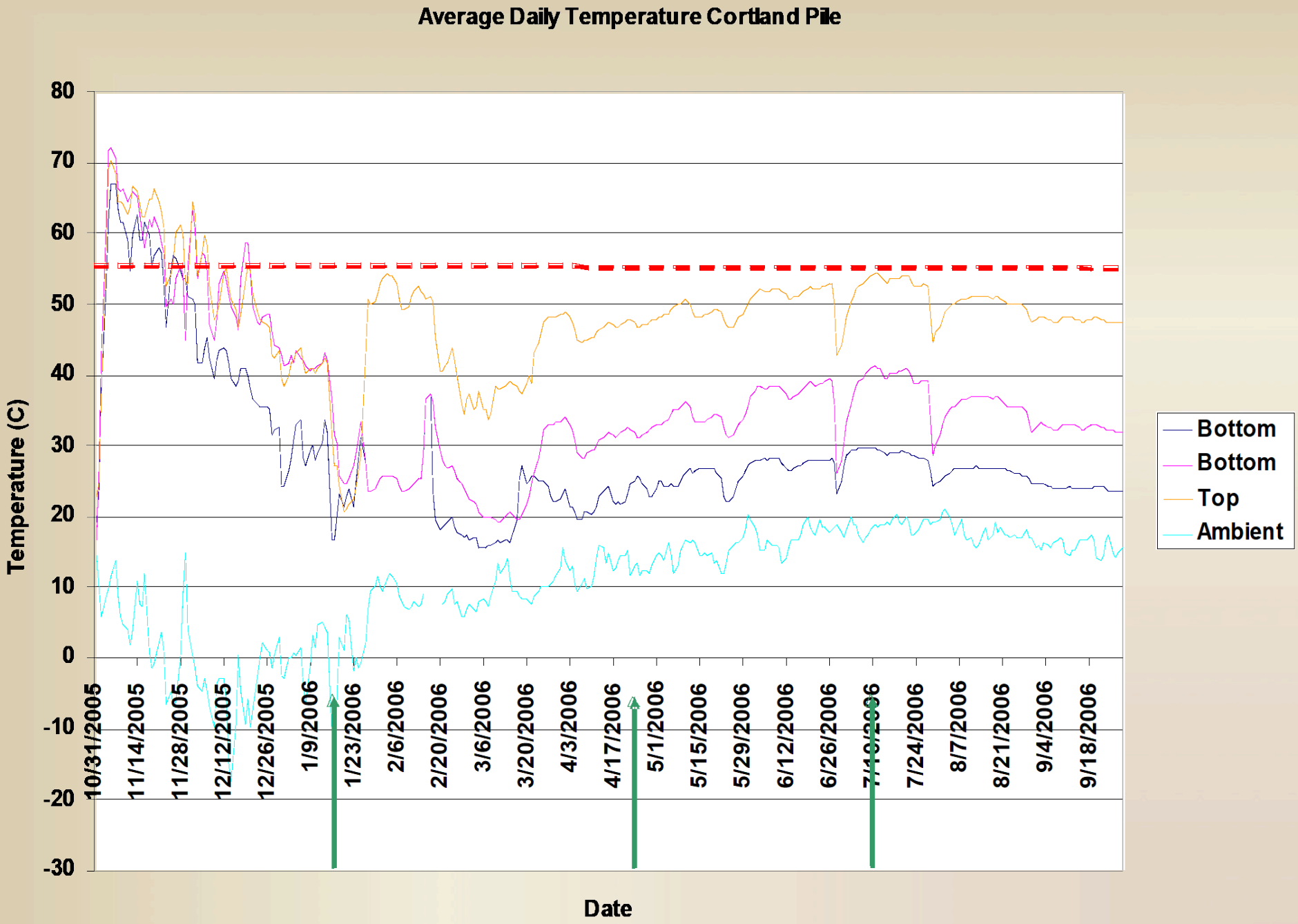
Static aerated pile



pH

- **5.5 and 8.5 is optimal** for compost microbes. As bacteria and fungi digest organic matter, they release organic acids.
- **RESULT**-pH drops facilitating growth of fungi and the breakdown of lignin and cellulose. Usually the organic acids become further broken down during the composting process.
- **If anaerobic**, acid accumulation can lower the pH to 4.5, limiting microbial activity.

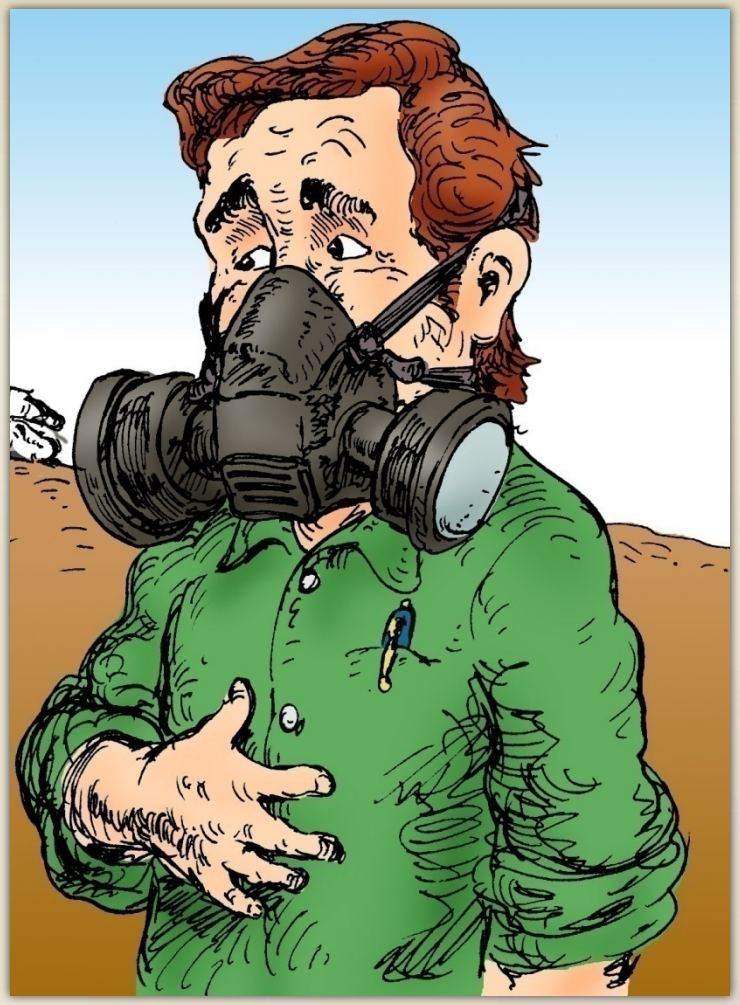
Heat will be given off as organisms feed on wastes and break them down into less complex molecules. Ideal temperatures for composting are between 90º - 150ºF. High temperatures can help kill weed seeds and disease organisms, but temperatures above 150ºF will also kill the decomposers and slow the process.


Average Daily Temperature Cortland Pile
Temperature (C)
80
70
60
50
40
30
20
10
0
-10
-20
-30
10/31/2005
11/14/2005
11/28/2005
12/12/2005
12/26/2005
1/9/2006
1/23/2006
2/6/2006
2/20/2006
3/6/2006
3/20/2006
4/3/2006
4/17/2006
5/1/2006
5/15/2006
5/29/2006
6/12/2006
6/26/2006
7/10/2006
7/24/2006
8/7/2006
8/21/2006
9/4/2006
9/18/2006
Date
Bottom
Bottom
Top
Ambient

Aerobic organisms require oxygen to live. Their "aerobic" activity forms carbon dioxide and heat as by-products. If oxygen starved, the process can become "anaerobic."

IT STINKS!

The by-products of anaerobic decomposition include methane and hydrogen sulfide gas. Hydrogen sulfide smells like rotten eggs.



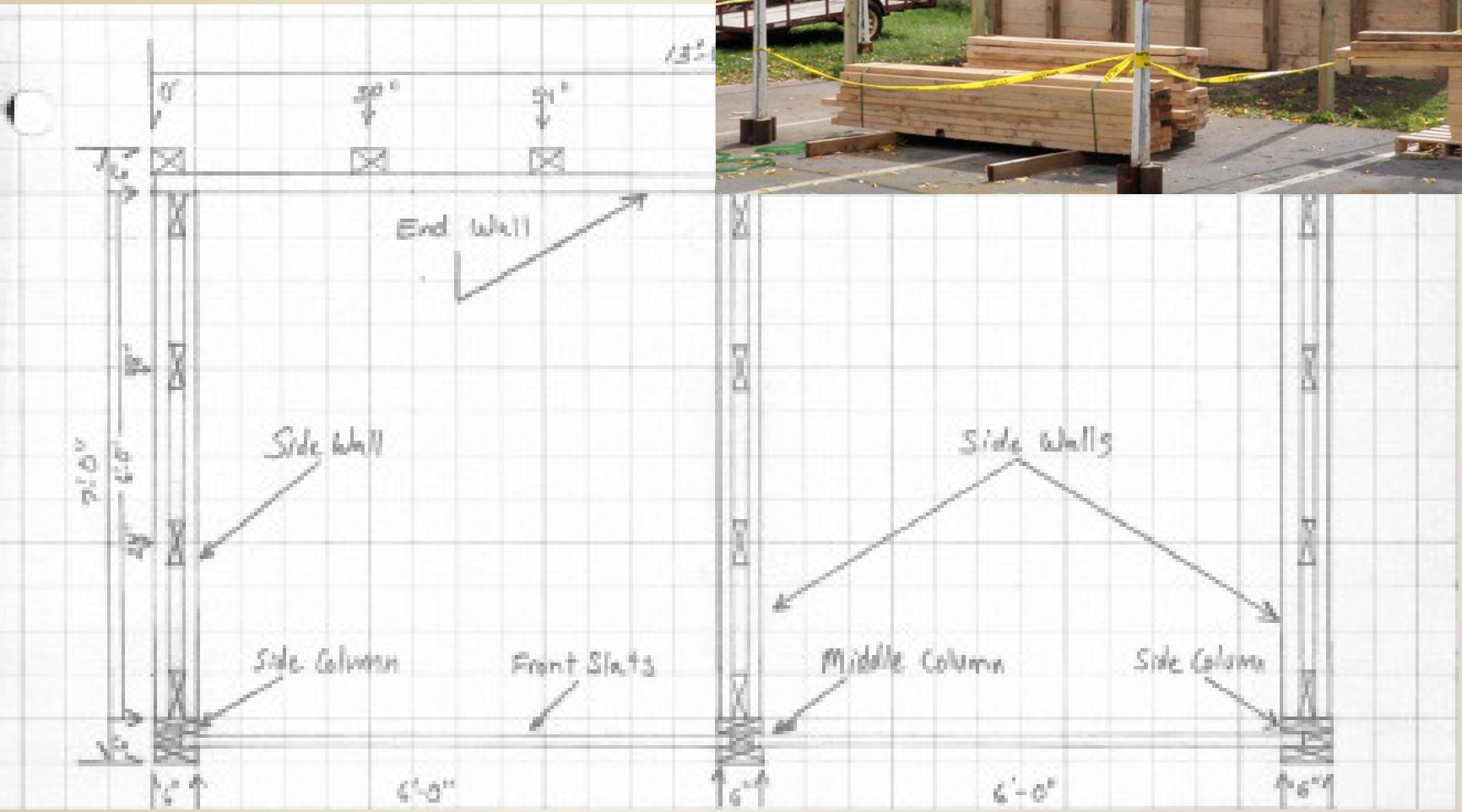
Odor Compounds in Composting

Source	**Odorous Products**
Carbohydrates [C]	Alcohols Aldehydes Volatile Organic Acids Ketones
Proteins [C, N, S]	Ammonia Amines Sulfide Mercaptans Volatile Organic Acids
Lipids [C, N, S, P]	Alcohols Sulfides Mercaptans Volatile Organic Acids

SITING

- Convenient location
- Sun or Shade?
- Against Buildings?
- Indoors?
- Densely populated areas?
- On hard pad?
- Does it fit in to the landscape

Plans for 2-bin System -6'x6'x6'



South Lewis 3 Bin System

Vermicompost Containers

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Resources

- It's Gotten Rotten (video)
  http://hdl.handle.net/1813/11656
- Composting at Home: the Green and Brown Alternative
  http://cwmi.css.cornell.edu/compostingathome.pdf
- Composting at Home slide show
  http://compost.css.cornell.edu/homecompostingslides.pdf
- Composting: Wastes to Resources
  http://cwmi.css.cornell.edu/compostingwastestoresources.pdf
- Composting to Reduce the Waste Stream
  http://cwmi.css.cornell.edu/compostingtoreduce.pdf
- Cornell Cooperative Extension (county offices)
  http://cce.cornell.edu/learnAbout/Pages/Local_Offices.aspx
- Vermicompost: A Living Soil Amendment
  http://cwmi.css.cornell.edu/vermicompost.htm

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Recycling Organics Makes Good Sense!

Healthy Soils =
Healthy Food!

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