Composting on the Farm

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http://www.puyallup.wsu.edu/soilmgmt/

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Let's consider composting

Time and Money
Lack of Equipment
Land
Odor
Weather
Materials
Nitrogen Loss

What can I compost?

- **Animal manures**
- **Stray hay**
- **Vegetable matter**
- **Yard debris**
- **Wood shavings/chips**
- **News paper**
- **Animal mortalities**
- **Fish processing waste**

Composting

Decomposition of organic materials by aerobic microorganisms under controlled conditions

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This is not composting

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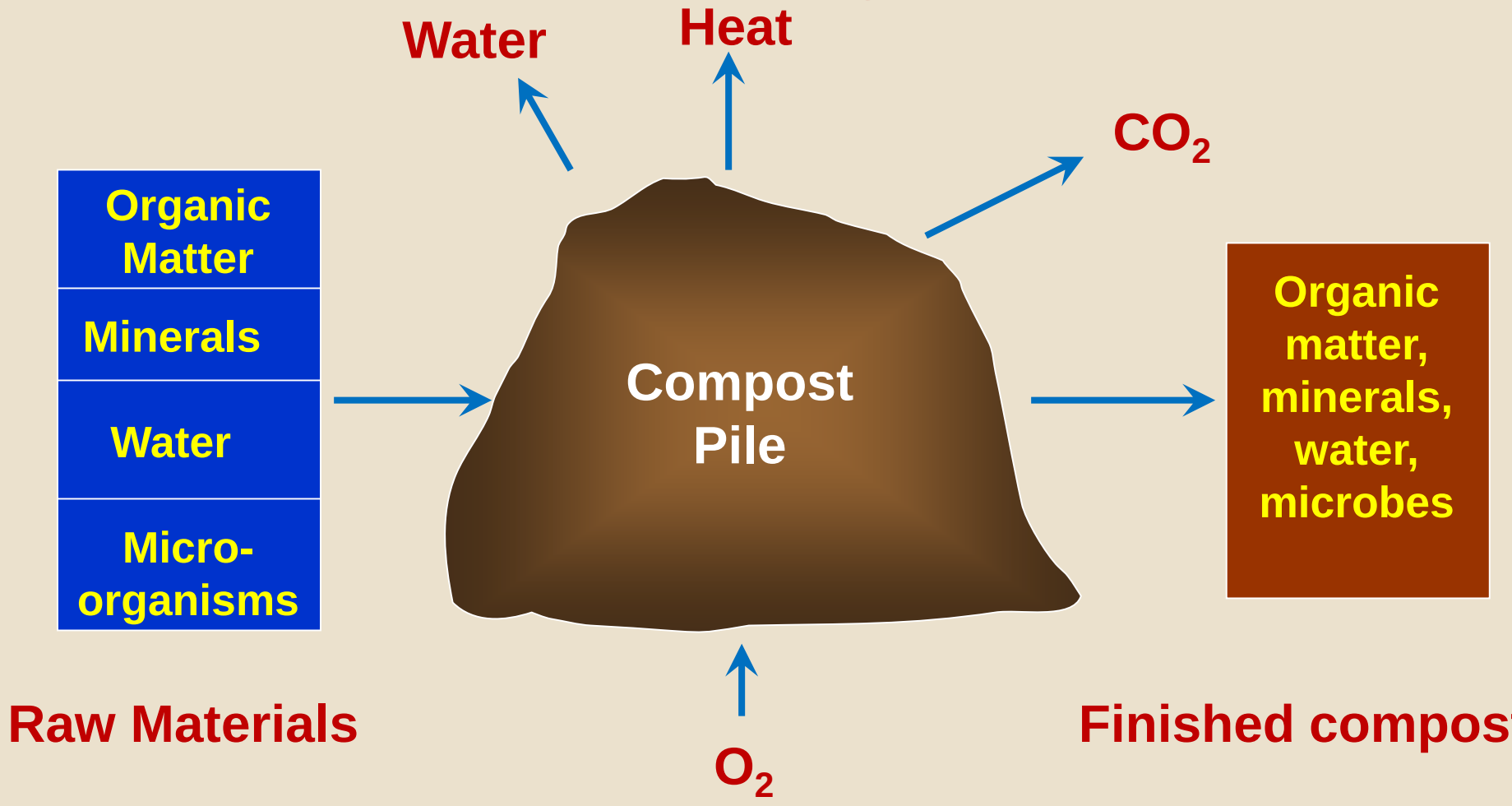
Aerated Static Piles

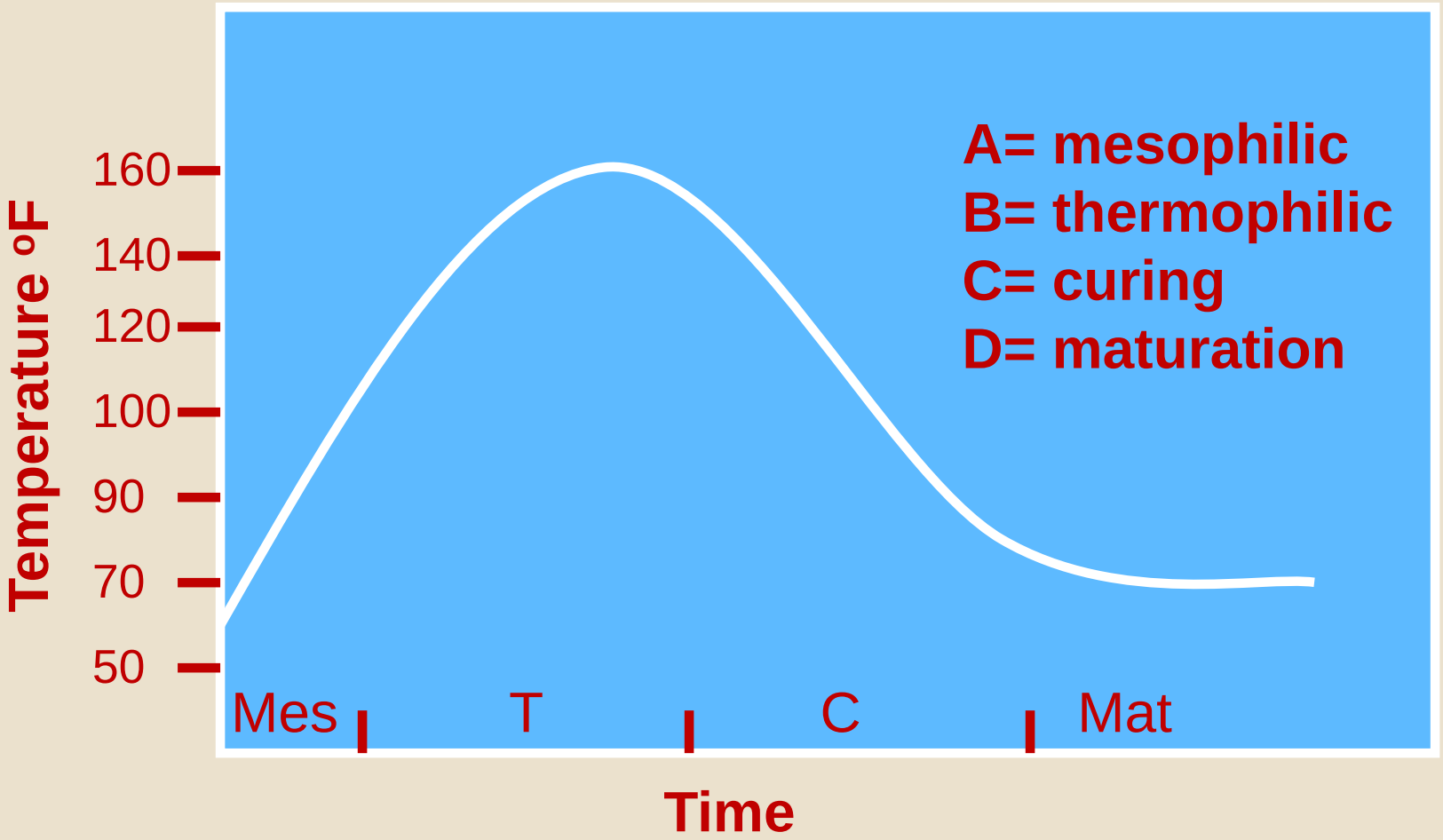
Turned Windrow/piles

The Composting Process



Raw Materials

Finished compost


Temperature °F
160
140
120
100
90
70
50
Mes
T
C
Mat
Time
A= mesophilic
B= thermophilic
C= curing
D= maturation

Phases of Aerobic Composting

Mesophilic phase: moderate temps, lasts for a few days

Thermophilic phase, high temps. Lasts from a few days to several weeks

Curing and maturation phase, moderate to ambient temps. Lasts 1-2 months.

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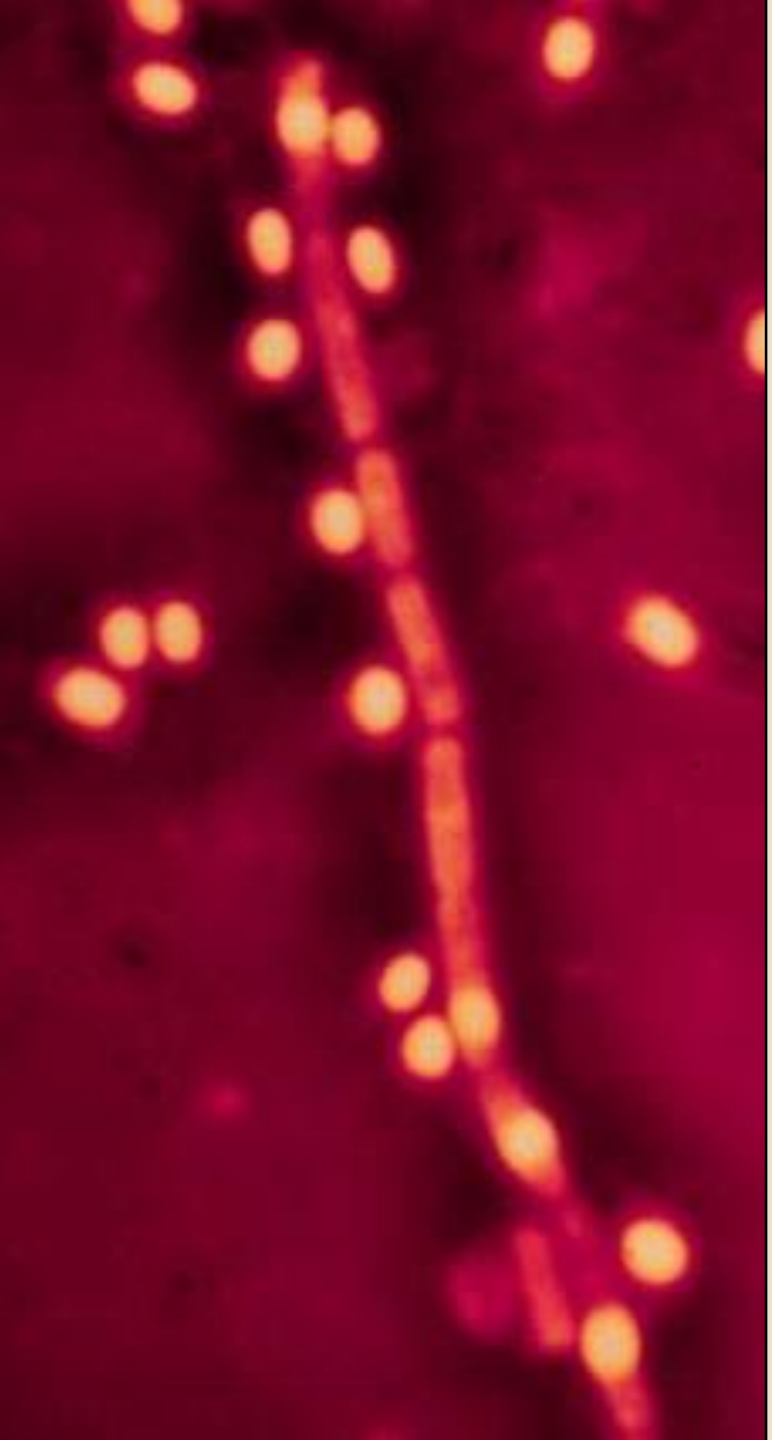

Succession of Microbial Communities During Composting

1. **Mesophilic bacteria** break down soluble, readily degradable compounds (sugars, starches), initiating the compost process

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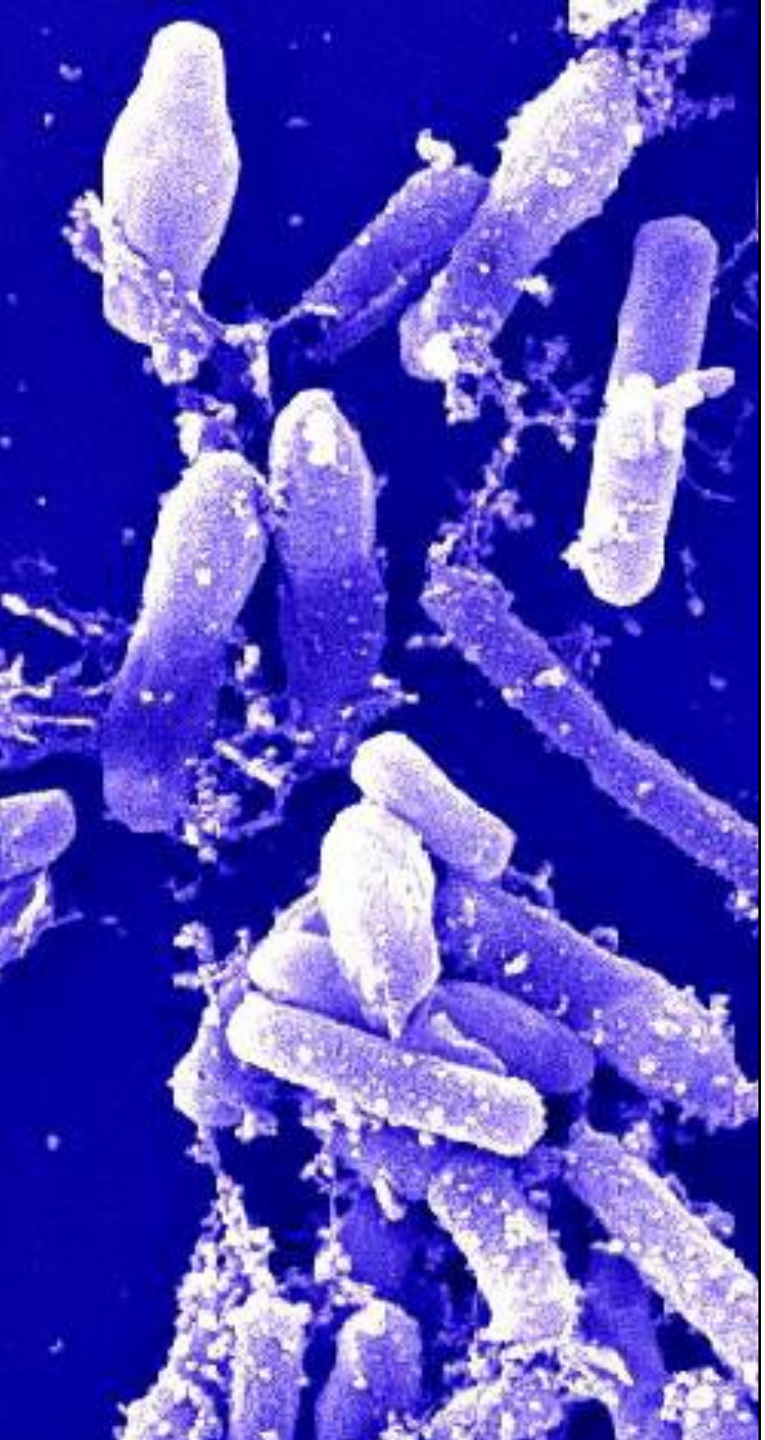

Succession of Microbial Communities

2. Thermophilic bacteria take over as the temperature increases, breaking down proteins, fats, cellulose, and hemicellulose.

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Succession of Microbial Communities

3. Fungi and actinomycetes

are important during curing phase in attacking the most resistant compounds.

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Factors that affect composting

C:N ratio
Moisture
Oxygen
Particle size
pH
Temperature

Compost	15-25:1
Grass clippings	15:1
Biosolids	5:1
Food wastes	15:1
Dairy manure	20:1
Leaves and foliage	60:1
Straw	80:1
Bark	115:1
Paper	170:1
Wood or sawdust	500:1

C:N Ratio

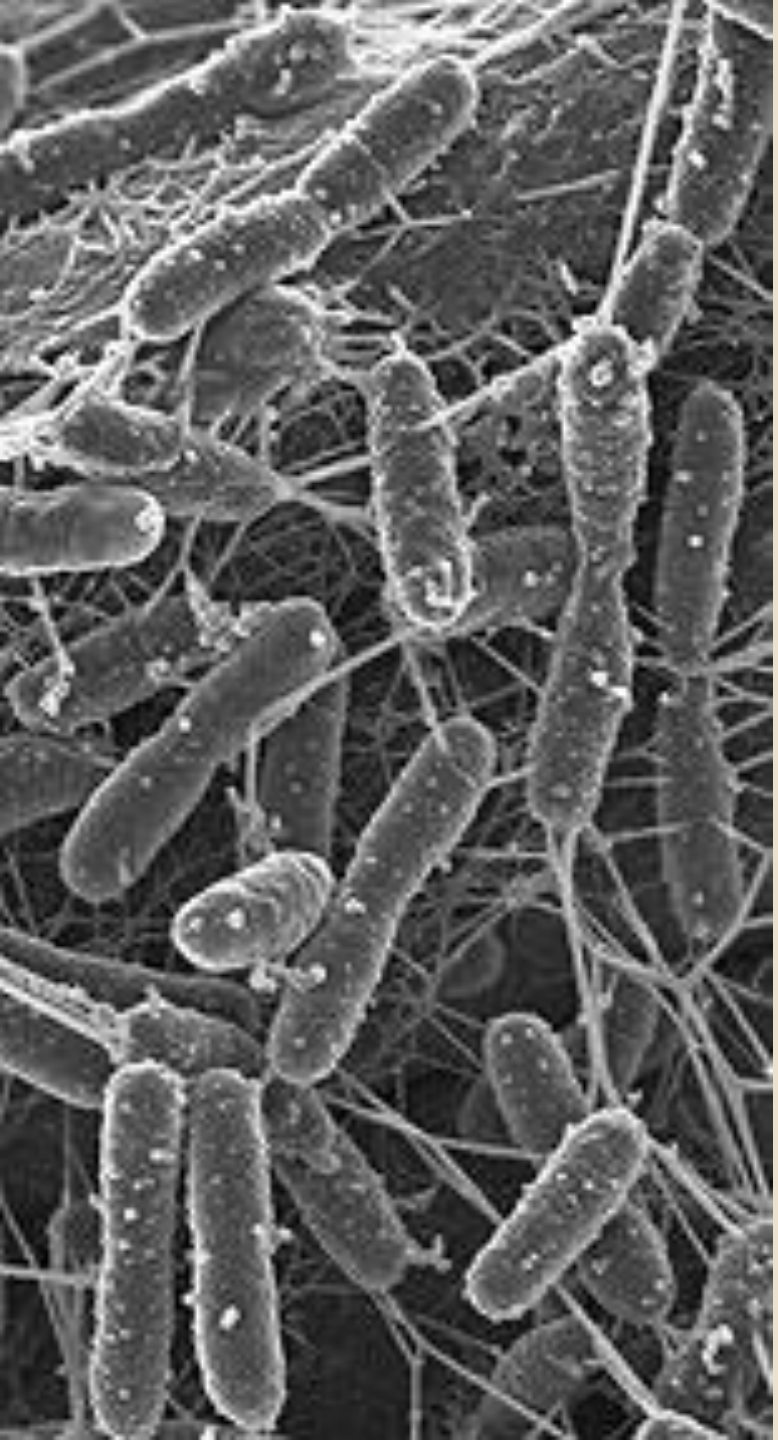
Carbon Compounds and Decomposition

Carbohydrates (sugars, starches)

- Cellulose
- Hemicellulose
- Chitin
- Lignin

Plant and animal structural components

Fats and oils



Effects of Moisture on Decomposition

- Microbes need water to carry out life functions.
- Try to keep pile moisture content at 40 to 65% by weight.

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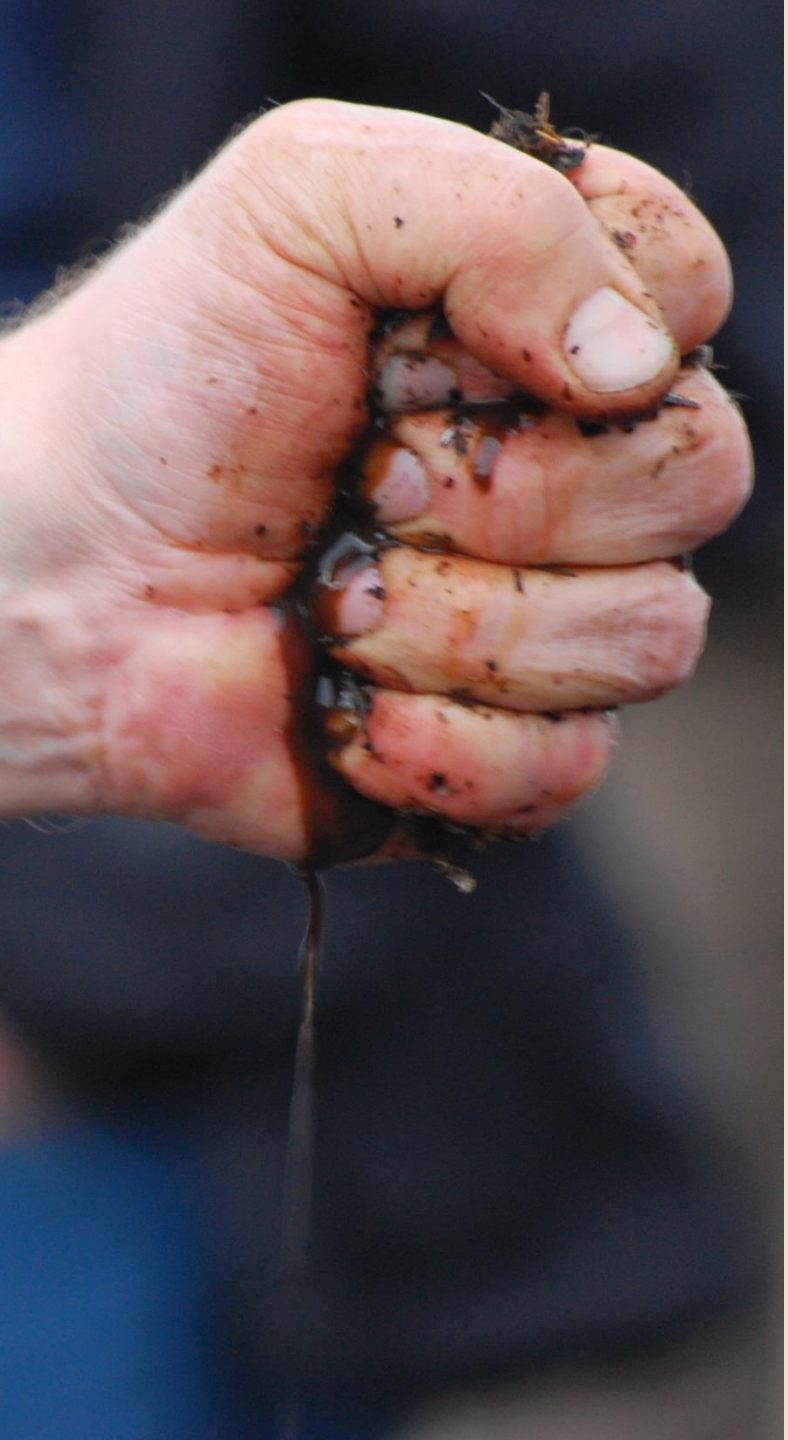

Moisture

- To dry microbes can't move round and break down organic matter
- Too wet not enough O_2 for aerobic microbes and produce foul odors

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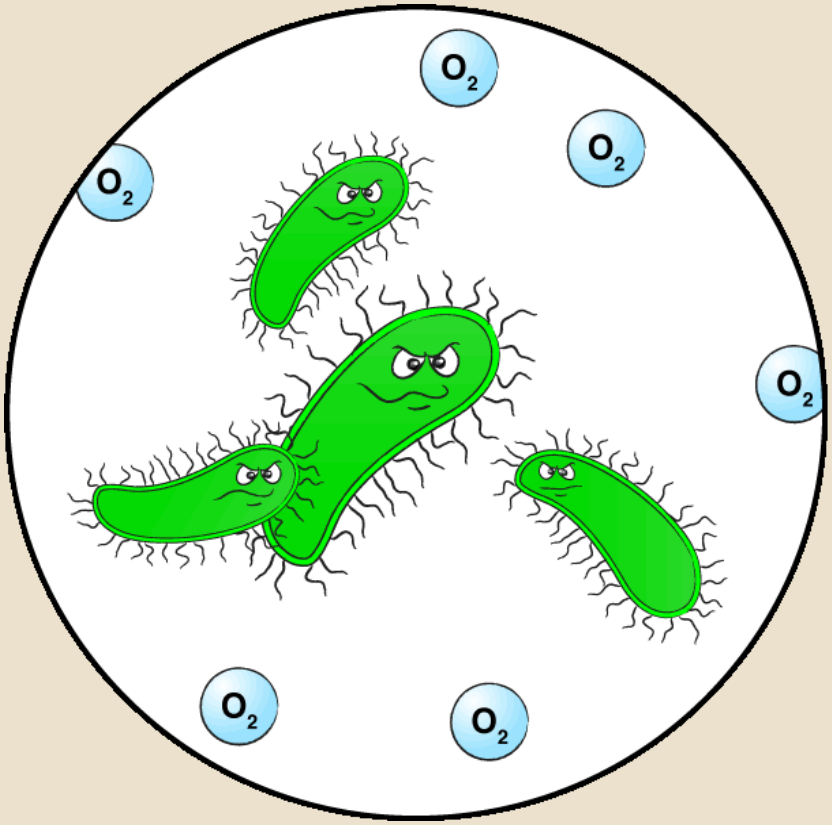
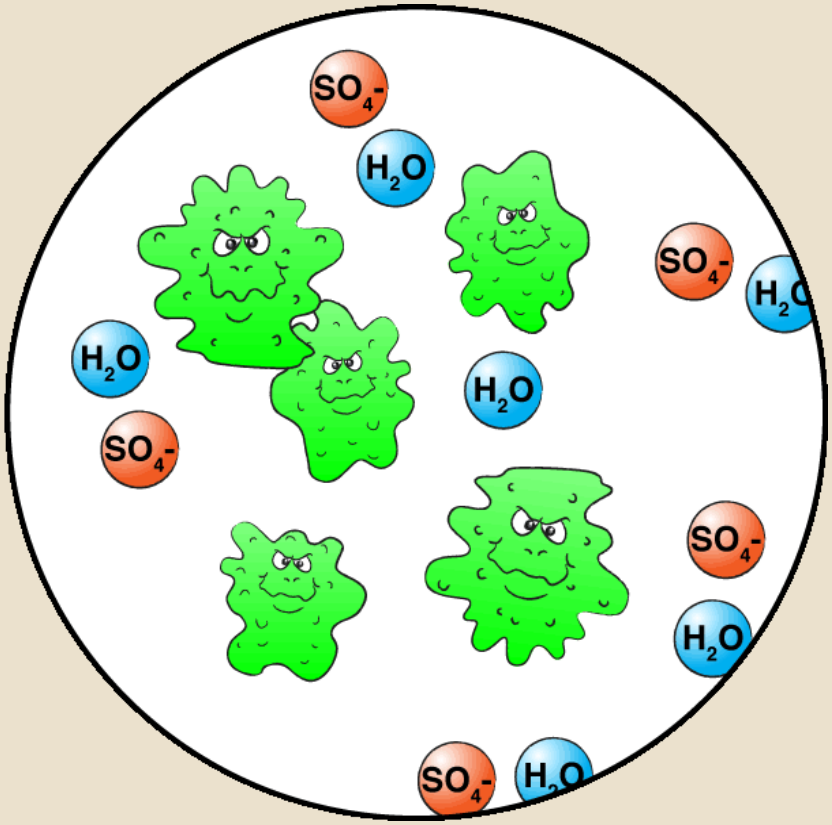
Oxygen Management
The Biochemistry of Microbial Breathing

Aerobic & Anaerobic respiration





Substrate (Feedstock) Quality Affects Composting Process

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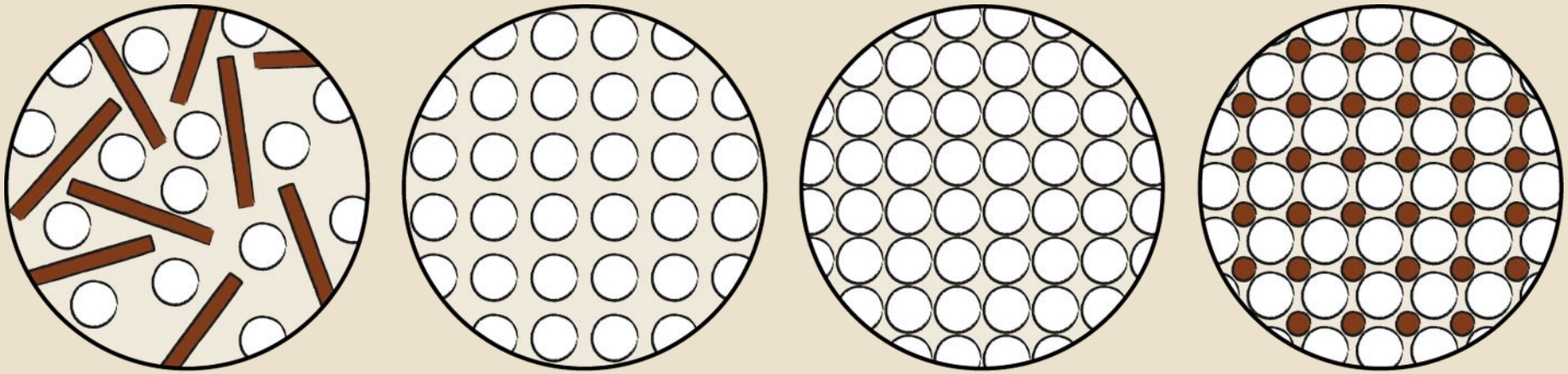
Effects of Particle Size and Porosity on Aeration



Loosely packed, well structured

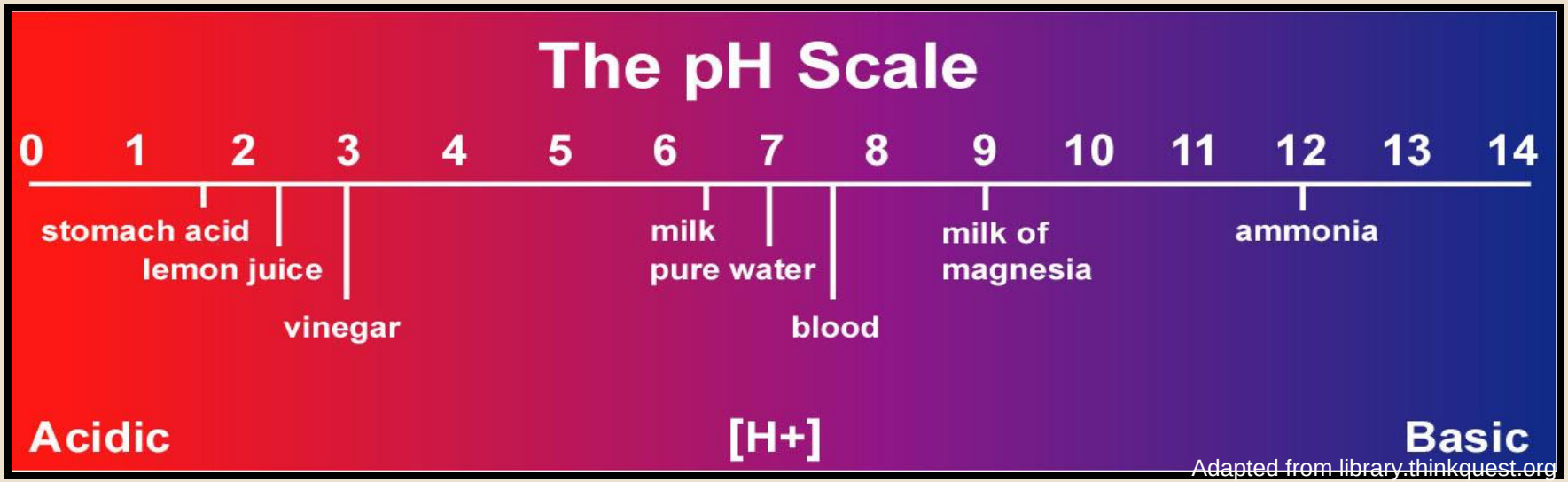
Loosely packed, uniform size

Tightly packed, uniform size

Tightly packed, varied size

pH: Measure of Acidity or Alkalinity

- Bacterial decomposers prefer pH 6.0 to 7.5.
- Fungal decomposers prefer pH 5.5 to 8.0.
- Ideal range is 5.8 to 7.2.
- pH exceeding 7.5 can promote ammonia gas loss.



Adapted from library.thinkquest.org

- **Oxygen:** aerobic vs anaerobic microbes and odor production, slower process >5%
- **Particle size:** too large won't break down, too small effects oxygen content
- **pH:** Ideal range 5.5-8.0 high pH promotes ammonia

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Temperature

PFRP Process to Further Reduce Pathogen

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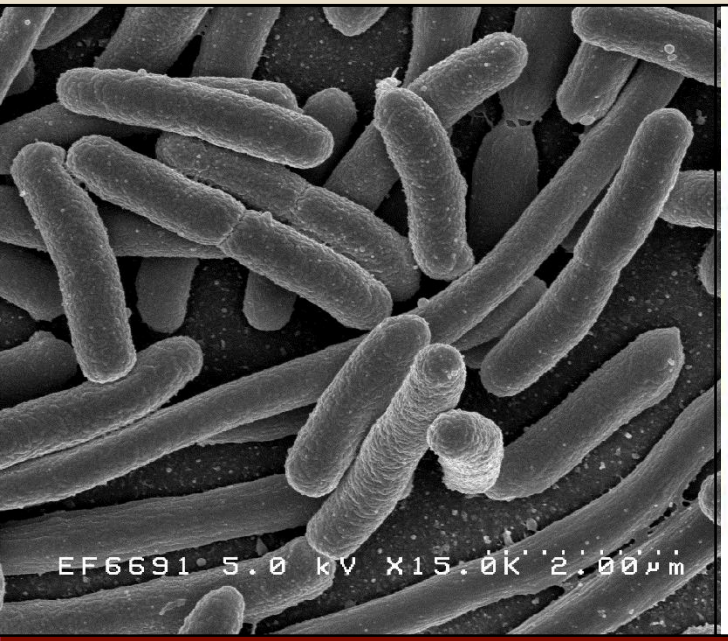
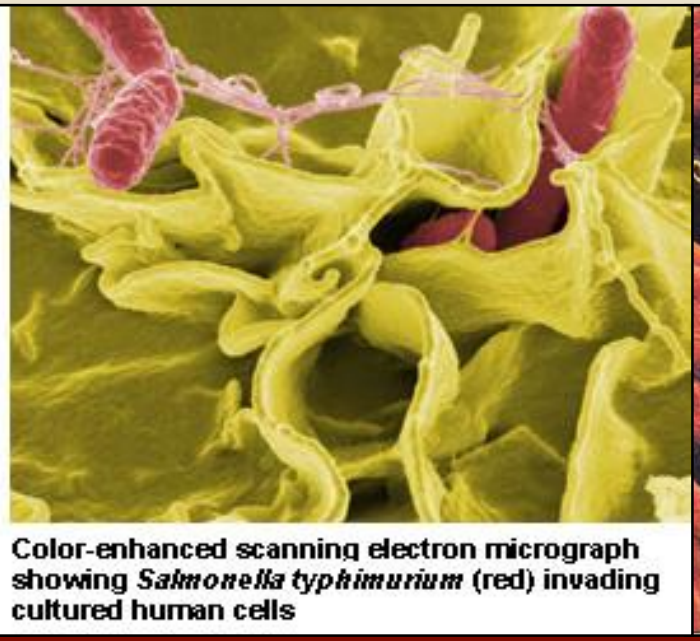
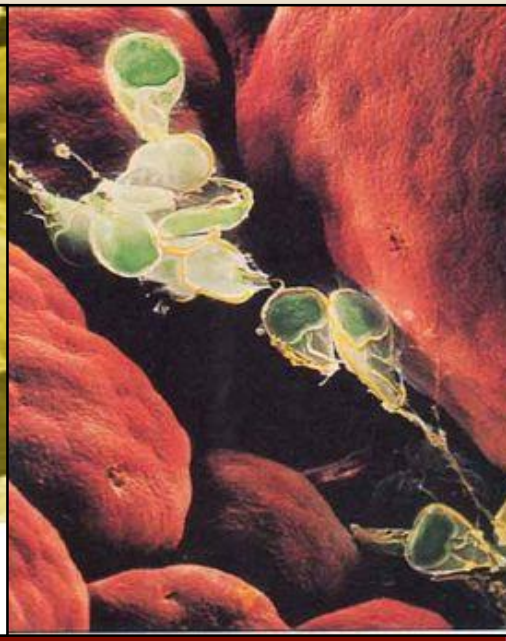
Pathogens

Escherichia coli, Salmonella spp., Staphylococcus aureus, Bacillus subtillus, Cryptosporidium, and Giardia are most common.





Color-enhanced scanning electron micrograph showing *Salmonella typhimurium* (red) invading cultured human cells



Pathogen Destruction

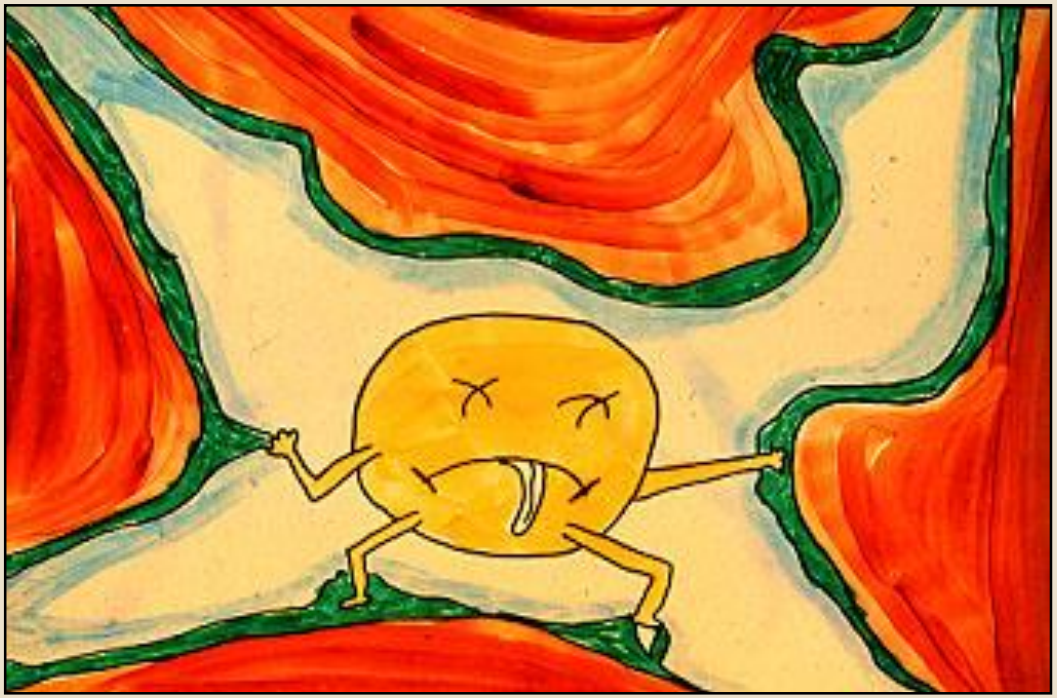
Heat

UV light

Desiccation

Competition

Toxicity



Which of these are at work during composting?

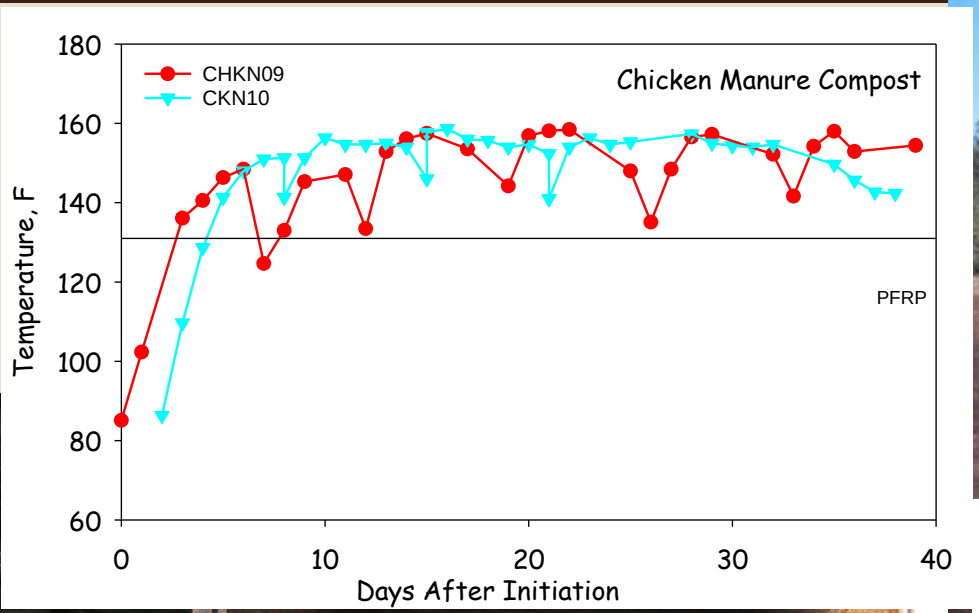
Pathogen Reduction (PFRP)

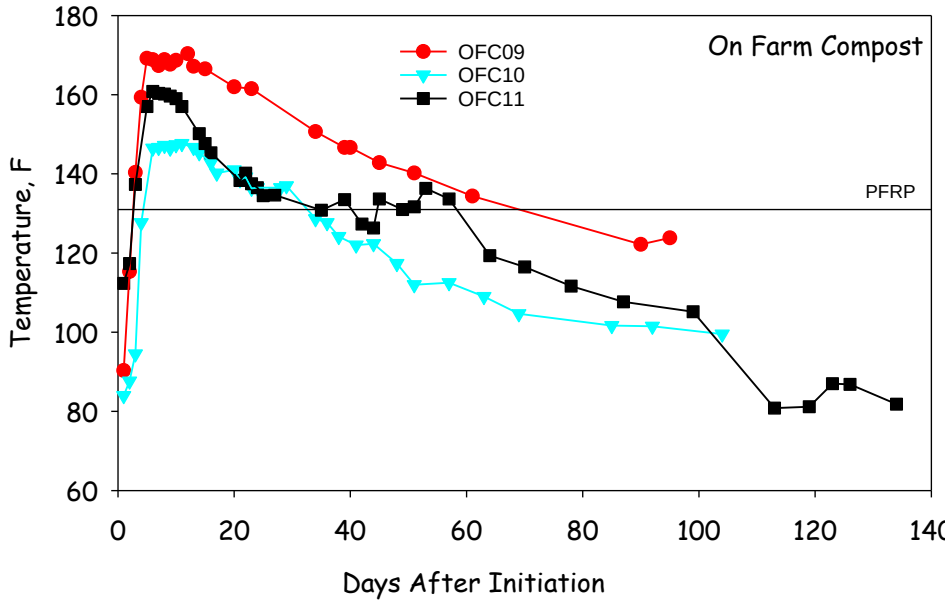
Turned pile composting

At least 15 days above 131ºF with 5 turns

Aerated Static piles or in vessel composting

At least 3 days above 131ºF





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Aerated Static Pile Composting

Maintains aerobic conditions

Controls objectionable odors

Manage pile temperatures

- Expedite active composting & curing
- Produce superior compost products
- Changes PFRP times
- Bigger piles
- Moisture needs to be right from the get go
- Potential for over aerating (heat and moisture loss)
- Disposable materials

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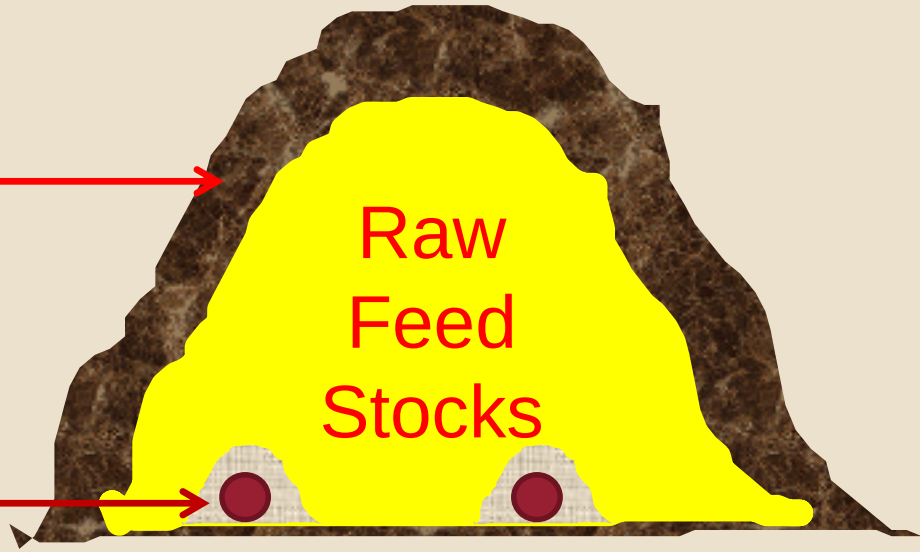
Insulating layer is needed because edges of pile are cooler than center

Finished Compost



Porous material

Turned Windrow Composting

Controls objectionable odors

Manage pile temperatures

- Expedite active composting & curing
- Changes PFRP times
- Smaller piles
- Easier to add water
- Bigger composting foot print required
- No electricity required

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	Reasonable ranges	Preferred ranges
C:N ratio	20-40:1	25-30:1
H_2O content	40-65%	50-60%
O_2	>5%	>5%
Particle size	1/8-1/2in.	varies
pH	5.5-6.5	6.5-8.0
Temperature	110-150F	130-140F

Turned Windrow/piles

NRCS Compost Facility Design

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Ag Bag

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Aerated Static Pile

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Aerated Static Pile

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Passively Aerated Static Pile

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Turned Windrow

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Turned Bins

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Turned Bins

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Rotating Drum

Earth Tub

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Wood Wire Portable Bin

Earth Machine

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Rotating Drum

Tilterator

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Mortality Slaughter Waste Offal Composting

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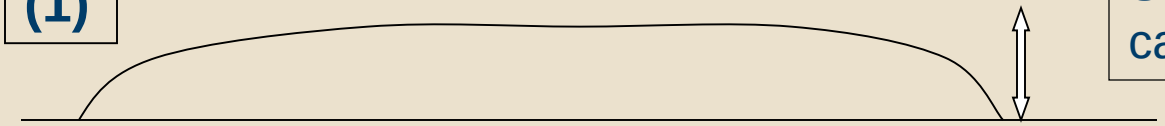
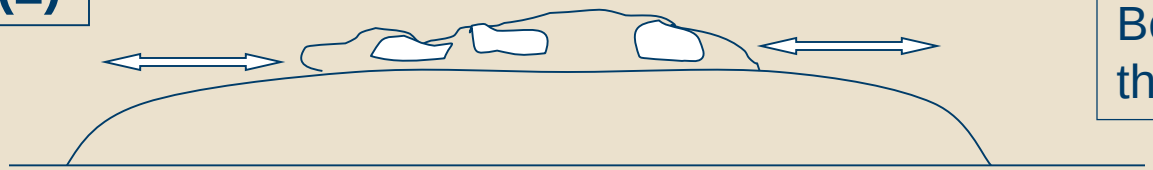
Find a good location away from any *ground water, neighbors*, or *other animals*. Make sure there is adequate drainage.

(1)



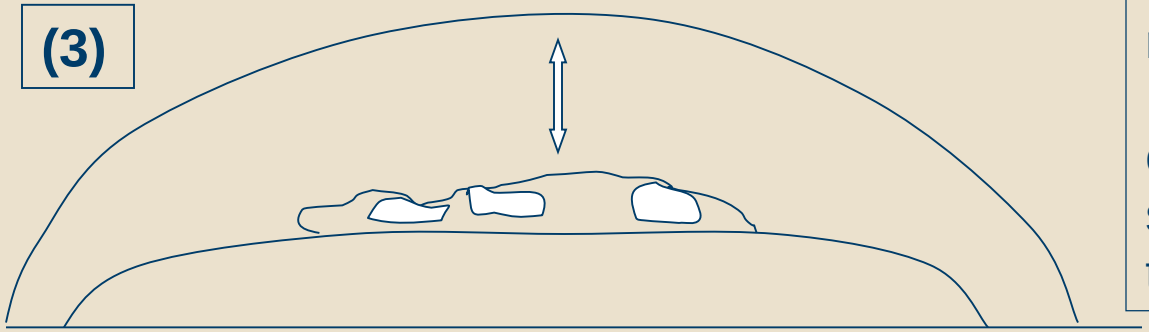
Start with a 2-3 ft base of high carbon, absorbent material .

(2)



Add the carcass in the middle. Be sure there is at least 2 ft of the base material on each side.

(3)



Cover with another 2-3 ft of material. This is very important! If there is not enough material covering the carcass it will smell bad, attract pests, and take longer to break down.

[10 – 15 feet]

Kitsap County