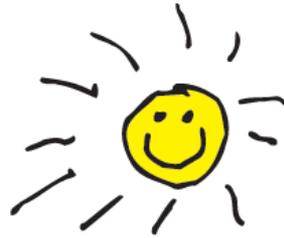


Composting



Learning Objectives

- A. Understand the various roles of compost on a farm
 - B. Have basic understanding of the processes involved in decomposition
 - C. Learn how to make good compost pile and proper application method
 - D. Understand the definition and importance of quality “tilth” in soil
- 

Two Types of Decomposition

Anaerobic decomposition is the breakdown of raw materials in the absence of oxygen and can be identified by a distinct foul smell and a generally "slimy" feel.

Aerobic decomposition is the breakdown of raw materials in which oxygen is present. This is the type of decomposition that is relevant for composting.

Definition of compost

Compost is the action and end result of decomposing organic materials in their raw form turning into vitally important soil amendment that improves the overall quality tilth of soil.



Compost can be produced through the act of decomposing plant matter as well as decomposing animal manure

Compost Ingredients

[Watch a Video on Composting](#)

[Composting video](#)

[Compost bin building](#)



Roles of Compost on a Farm

Recycles waste material on site



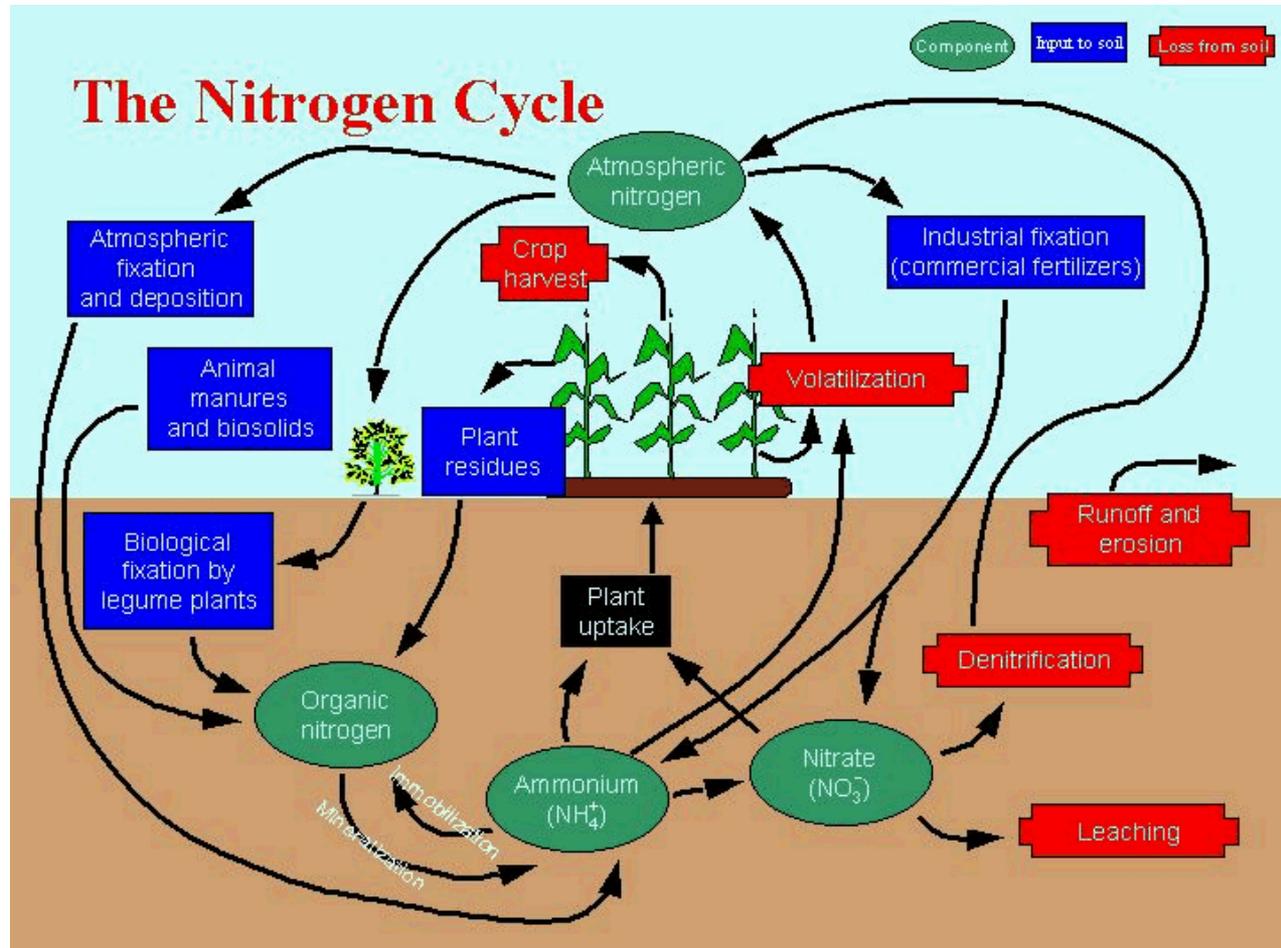
Humus

Adds large amounts of humus to soil



Humus is a brown or black complex variable material resulting from partial decomposition of plant or animal matter and forming the organic portion of soil

Increases soil fertility and stabilizes elements such as nitrogen

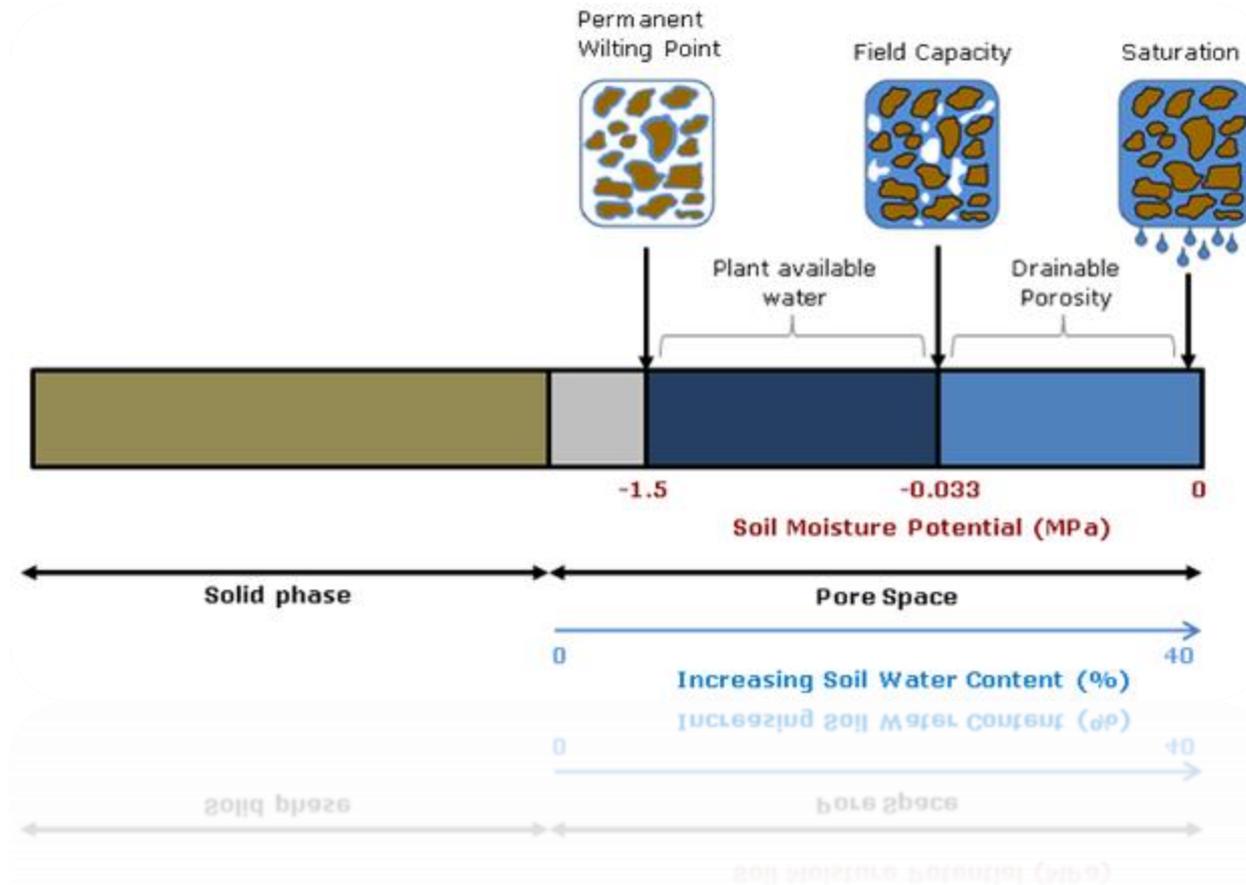


<http://msucares.com/crops/soils/nitrogen.html>

Hugely increases biological activity in the soil



Improves soil structure and ability to retain water or create percolation of water through soil



<http://www.nature.com/scitable/knowledge/library/soil-water-dynamics-59718900>

Creates outlet for potentially harmful excess of raw manure in animal based agriculture

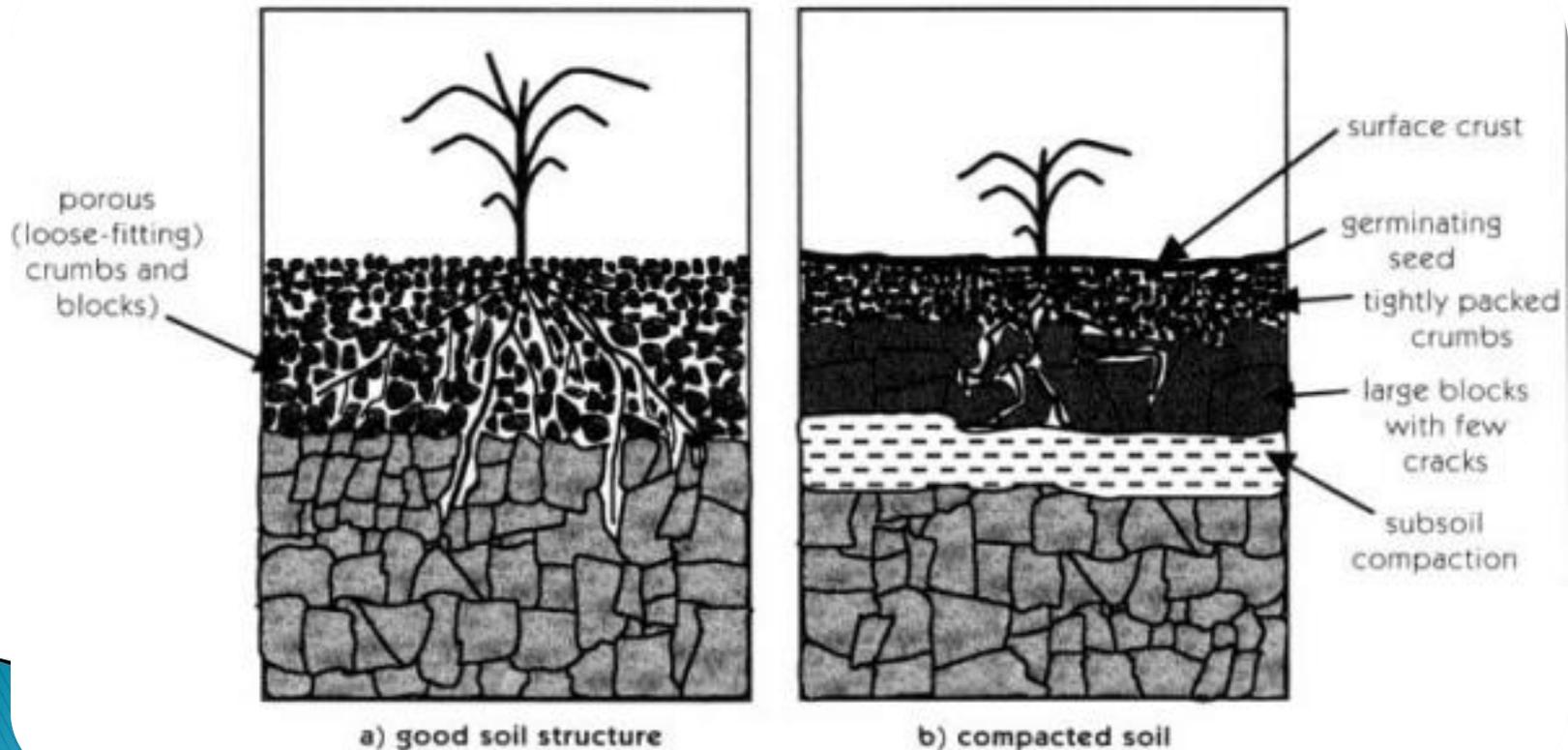


Compost Improves Tilth

Tilth is the state of aggregation of soil and its condition for supporting plant growth.

This refers to the general overall suitable nature of soil's capacity to grow and sustain cultivated plant life.

Compost is key to attaining a good soil structure and maximum fertility. It is the foundation of organic gardening.

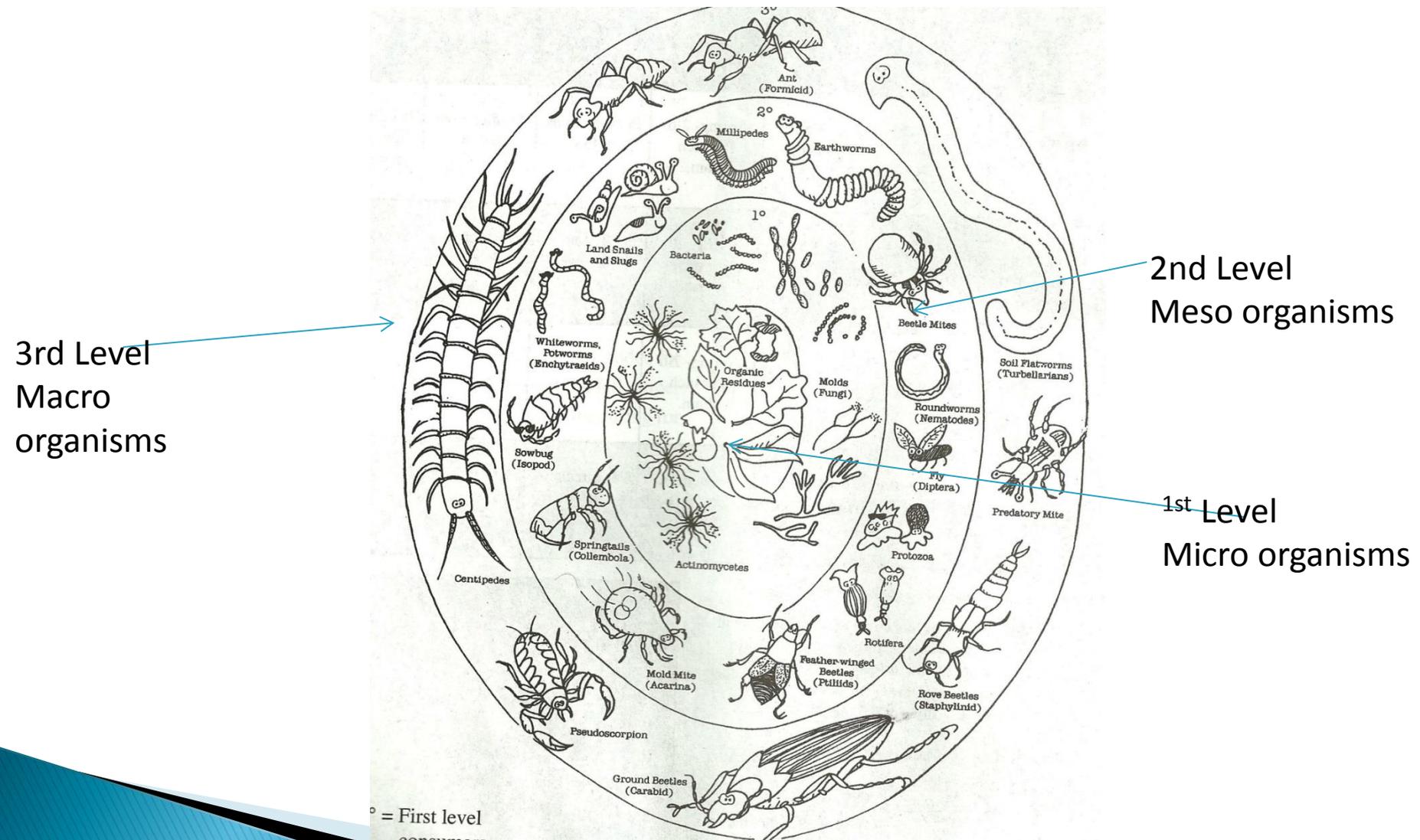


Compost is a wonderful example of alchemy, changing waste material into vitally important materials



Processes in Composting

Decomposers 3 levels of consumers (organisms that feed on each other and the organic matter).



A wide array of micro-organisms live in a compost pile.

Bacteria

Bacteria are the smallest living organisms and the most numerous in compost; they make up 80 to 90% of the billions of microorganisms typically found in a gram of compost. Bacteria are responsible for most of the decomposition and heat generation in compost. They are the most nutritionally diverse group of compost organisms, using a broad range of enzymes to chemically break down a variety of organic materials.

Fungi

Fungi include molds and yeasts, and collectively they are responsible for the decomposition of many complex plant polymers in soil and compost. In compost, fungi are important because they break down tough debris, enabling bacteria to continue the decomposition process once most of the cellulose has been exhausted.

Actinomycetes

Actinomycetes are organisms that resemble fungi but actually are filamentous bacteria. Like other bacteria, they lack nuclei, but they grow multicellular filaments like fungi. In composting they play an important role in degrading complex organics such as cellulose, lignin, chitin, and proteins.

Micro-organisms

Bacteria

Bacteria →



Bacteria are micro-organisms that aid in the breakdown of carbonaceous material.

Micro-organism: Fungi

Performs more complex decomposition roles such as the breakdown of cellulose.



Fungi binds free particulates together improving overall soil structure.

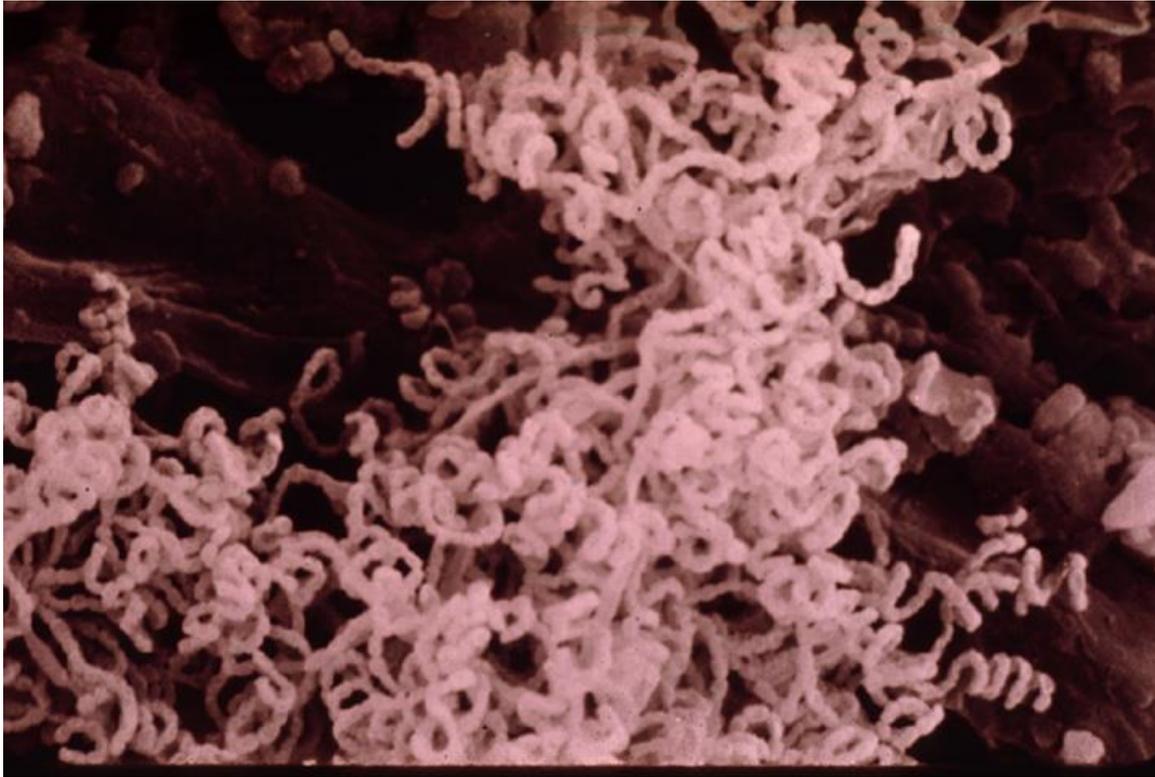
Fungi breaks down woody particulates in compost pile

Rotten tree trunk. The capacity of brown rot fungus to break down the cellulose in wood led to its selection for sequencing in 2007, with the goal of identifying the enzymes involved in the degradation process and using the information to improve cellulosic biofuels production. (Credit: © microimages / Fotolia)



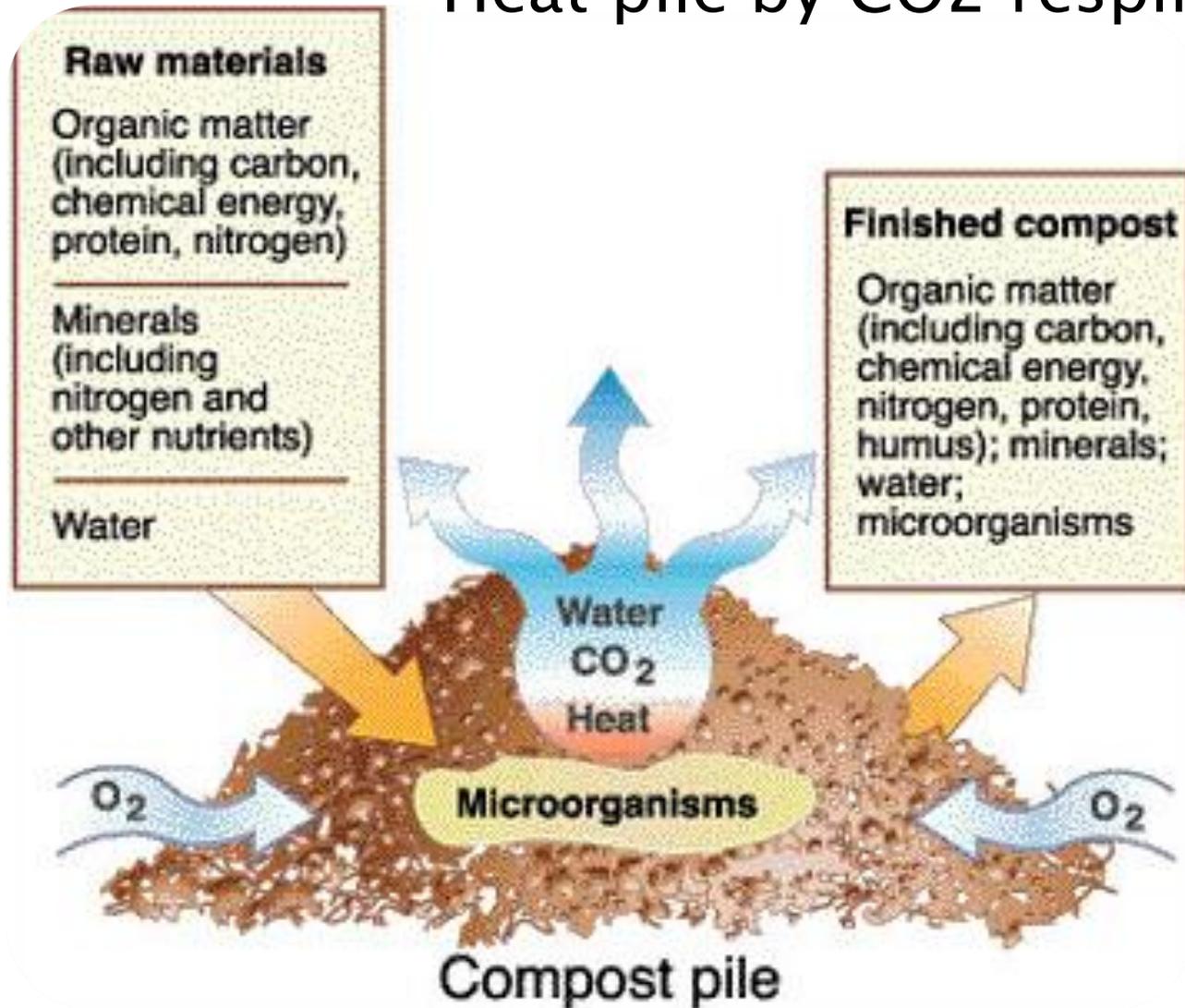
Micro-Organisms

Actinomycetes bind aggregates in pile through fungal like gray growths



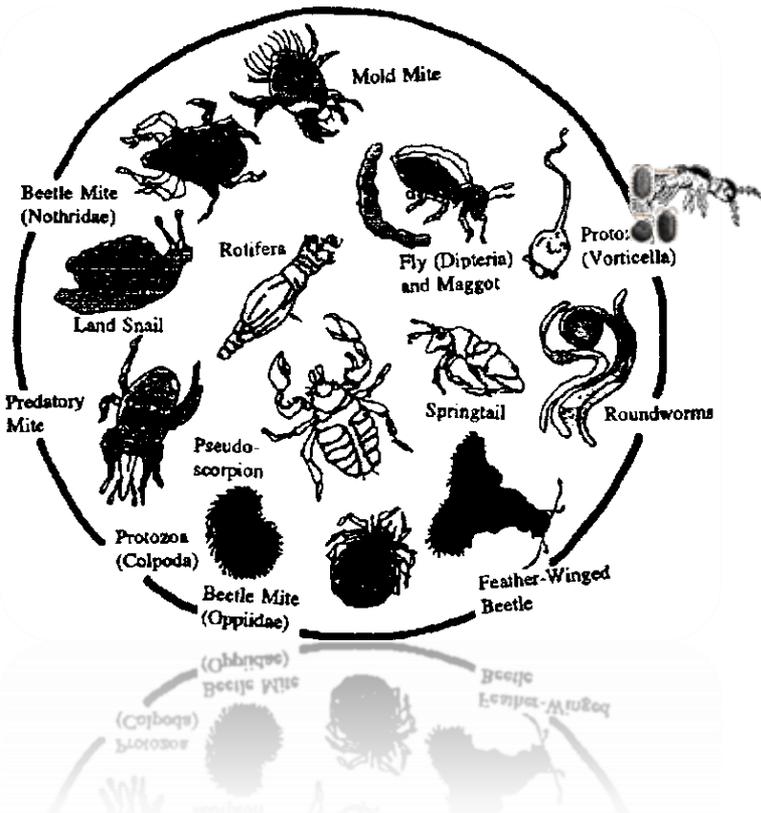
Actinomycetes, such as this *Streptomyces*, give soil its "earthy" smell

Heat pile by CO₂ respiration



In the process of composting, microorganisms break down organic matter and produce carbon dioxide, water, heat, and humus.

2nd Level Consumers (Meso-organisms)



Nematodes or roundworms: They are the most abundant invertebrates in soil. Less than one millimeter in length, they prey on bacteria, protozoa, fungal spores and each other. Most nematodes in the soil are beneficial

Fermentation mites or mold mites: These transparent bodied creatures feed primarily on yeast in fermenting masses or organic debris. They can develop into seething masses over a fermenting surface such as a winery, but are not pests in compost.

Springtail: Along with nematodes & mites, they share numerical dominance among soil invertebrates. They feed on fungi, nematodes and small bits of organic detritus. They help control fungi.

3rd Level Consumers (Macro-organisms)

Most macro-organisms feed on earlier inhabitants of the compost pile. They're beneficial in their support of the food chain inside the compost pile. Worms are a very important part of the macro-organism family found in the compost pile.

They produce castings, which contribute to the overall fertility of the soil



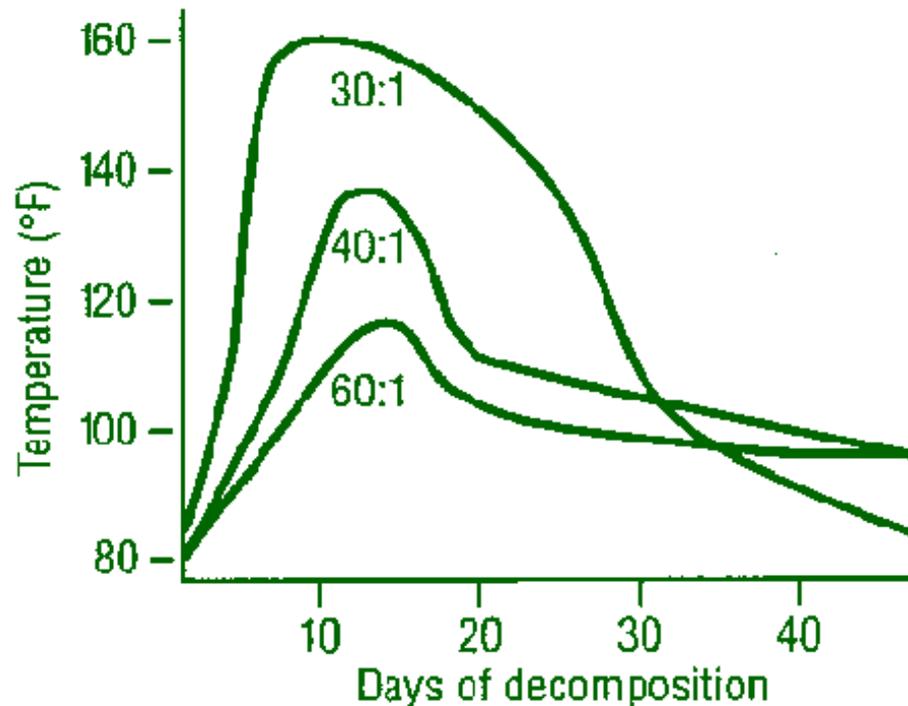
Worm castings are the end result of organic matter that has been processed by worms

They also aerate the compost mix, which introduces more oxygen, which in turn helps the pile finish faster and decompose more thoroughly.

Components of Good Compost

Carbon to nitrogen ratio is important to overall viability and health of pile. Initial ration should originally be 30:1 by weight

Carbon:Nitrogen Ratio Effects on Composting



Days of decomposition

Here are some typical compost items and their carbon to nitrogen ratio. Brown compost ingredients have higher carbon (above 30:1), while green are higher in nitrogen (below 30:1). 30:1 is the desired ratio.

GREEN (Nitrogen)		BROWN (Carbon)	
Kitchen waste	25:1	Shredded newspaper	175:1
Coffee grounds	25:1	Twigs	700:1
Grass clippings	17:1	Shredded cardboard	350:1
Fresh Weeds	20:1	Leaves	60:1
Fruit waste	25-40:1	Pine needles	60-110:1

Manure C:N Ratios

Manure, farmyard (avg.)	14:1
Manure, chicken	7:1
Manure, cow	18:1
Manure, horse	25:1
Manure, human	6-10: 1
Manure, pig	8:1
Manure, poultry	15:1
Manure, sheep	8:1
Manure, steer	25.3:1

<http://www.homecompostingmadeeasy.com/carbonnitrogenratio.html>

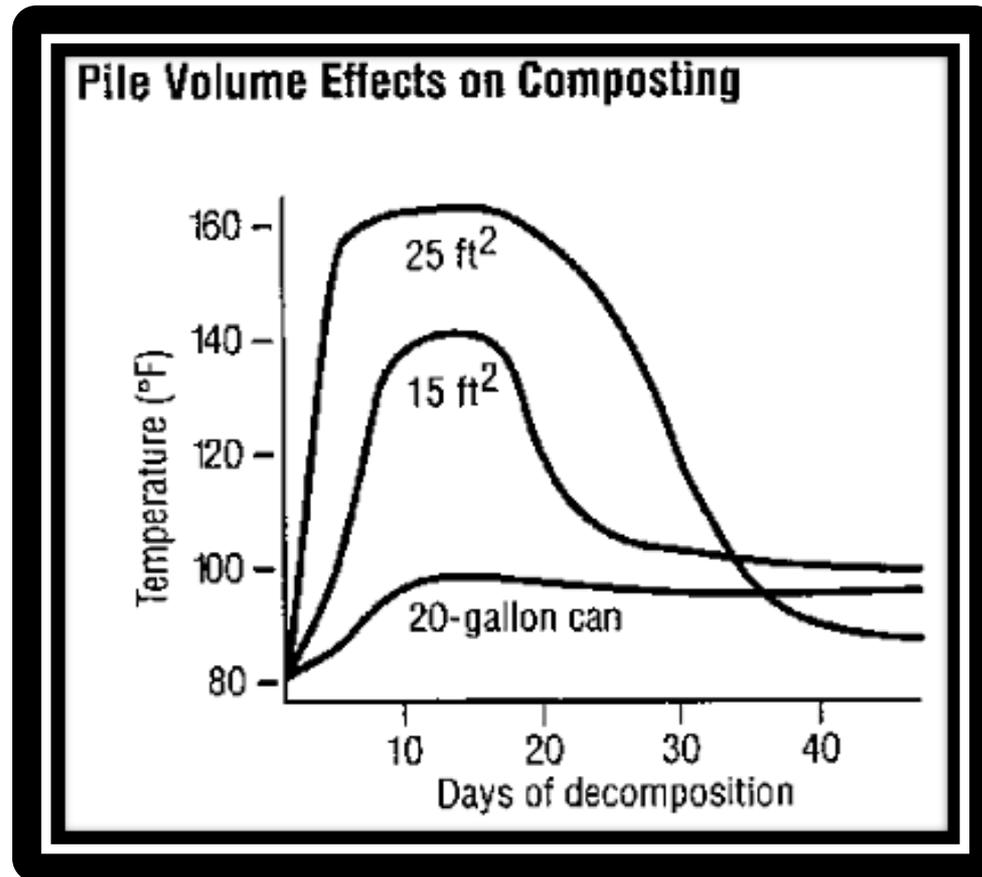
http://www.weblife.org/humanure/chapter3_7.html

Moisture in pile should be equivalent to a moist sponge. A good rule of thumb should be the fist crumble test. One should be able to grab a fist full of compost and squeeze it into a ball that holds its form, but that crumbles under the slightest pressure.

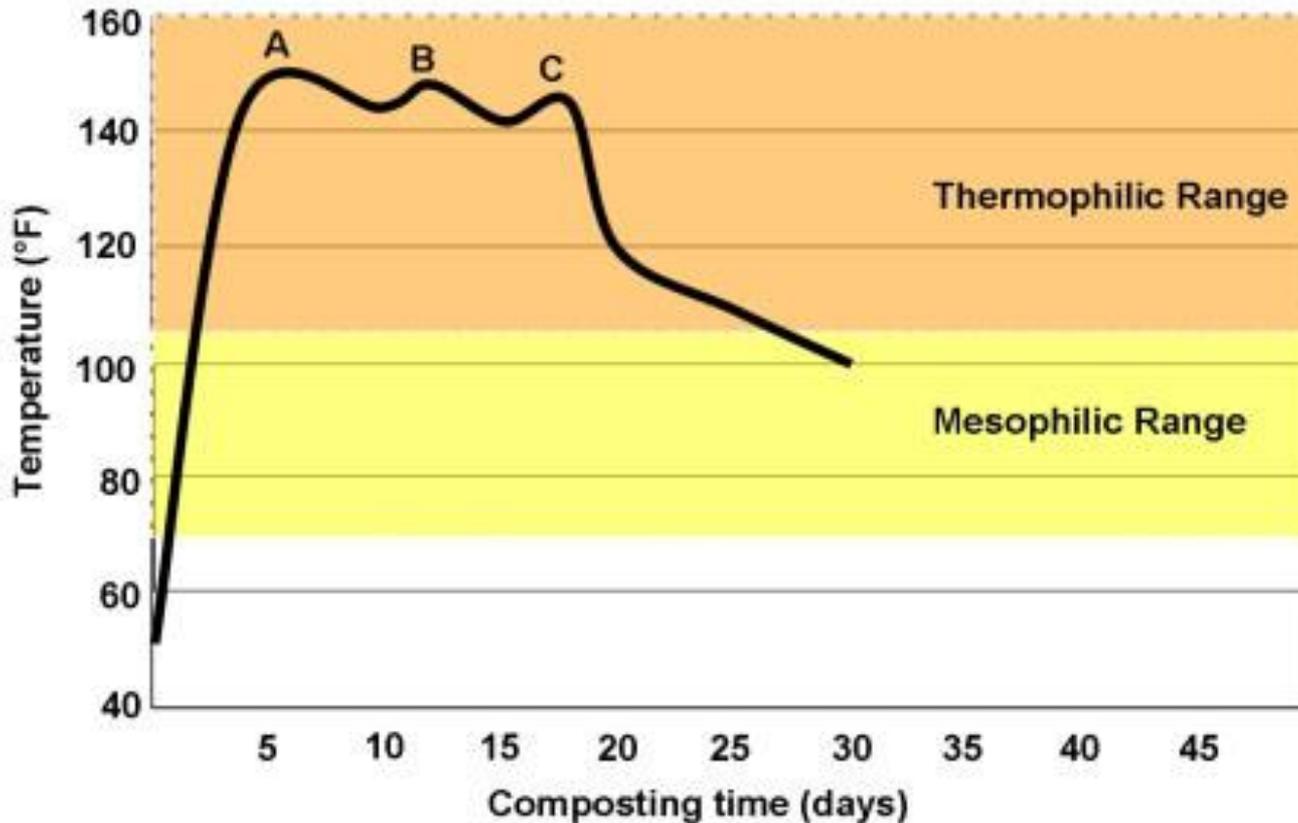


[Video of Squeeze ball Test](#)

Dimensions of the piles are important. Optimal size is 6'x6'x6'. This creates conditions that are most manageable and appropriate for a hot compost pile.



Optimal temperatures should be between 130 F to 150 F. Anything over 150F can begin to kill beneficial microbes.



A well-made compost pile will go through distinct three phases. First, it will enter into the mesophilic stage (68-104 degrees Fahrenheit). Second, it will enter into the thermophilic stage (105-150+ degrees Fahrenheit). Finally, the pile will enter into the maturation stage (not indicated on the graph).

The compost pile should be covered in most situations. This will prevent excess water from leaching out good nutrients and possibly having negative runoff. It will also retain moisture in times of no rain and times of excessive heat, cutting down on the need to introduce water to the pile.



The compost pile should be turned regularly using one of many different available means. Turning the pile redistributes heat, biological activity, and moisture content. Turning the pile redistributes heat, biological activity, and moisture content. Turning a pile can finish compost up to ten times faster than letting a pile sit unturned.



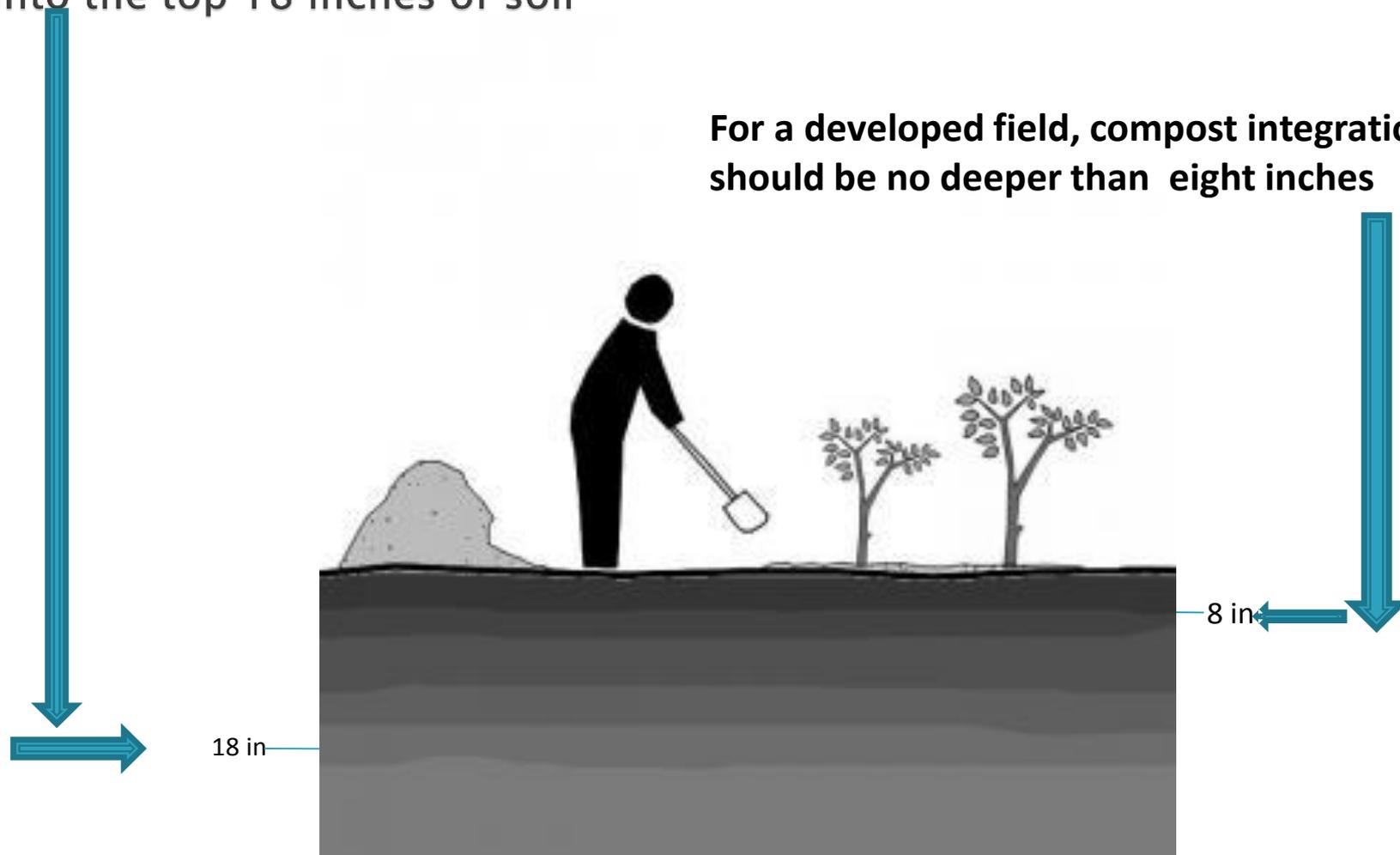
[Video showing proper turning technique](#)

Application of Compost

- ▶ Five to seven tons of compost per acre is a generally acceptable rate of application for field dispersal
 - ▶ Intensive garden situations can use up to 10 tons per acre
- 

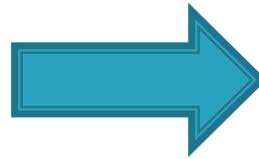
When developing a new garden or field, compost should be integrated into the top 18 inches of soil

For a developed field, compost integration should be no deeper than eight inches



Compost should be applied 3 times...

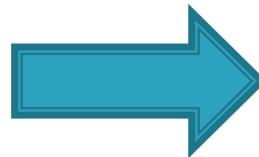
Compost should be applied in the spring prior to planting



midseason as an amendment side dress



and in fall prior to cover cropping



Assessment/Review

- ▶ Name several roles of compost on the farm.
 - ▶ What types of organisms help the decomposition process?
 - ▶ Why is it important to turn a compost pile on a regular basis?
- 

Roles of Compost

- Recycles waste material on site
 - Adds large amounts of humus to soil
 - Increases soil fertility and stabilizes elements such as nitrogen
 - Hugely increases biological activity in soil
 - Improves soil structure and ability to retain water or create percolation of water through soil
 - Creates outlet for potentially harmful excess of raw manure in animal based agriculture
 - Compost is a wonderful example of alchemy, changing waste material into vitally important materials.
- 

What types of organisms help the decomposition process?

- ▶ Bacteria
 - ▶ Fungi
 - ▶ Ace
 - ▶ Meso & Macro-organisms
- 

Why is it important to turn a compost pile on a regular basis?

- ▶ Turning the pile redistributes heat, biological activity, and moisture content.
 - ▶ Turning a pile can finish compost up to 10 times faster than letting a pile sit unturned.
- 

Additional Viewing

- ▶ SOIL by Geoff Lawton
- ▶ [http://www.geofflawton.com/sq/15449-geoff-lawton, Jeoff Lawton](http://www.geofflawton.com/sq/15449-geoff-lawton,JeoffLawton)
- ▶ <http://permaculturenews.org/2010/09/23/soils-dvd-available-october-2010/>