

# Soil Biology

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# Why Compost?

- Compost is a great way to create a natural **soil** conditioner.
- Composting is copying what Mother Nature is conducting in natural environments.

# Anyone can create compost!

- Either outside in a pile or bin.
- Or inside with a little help from composting worms.

# Soil, aka Dirt

- Soil is the top layer of the Earth's surface.
- Gardeners are primarily interested in the top 6-16 inches of soil.



# Looking at **soil** contents

- Various sizes of rock. From clay particles to sand to gravel to rocks.
- Organic matter such as dead plant material.
- Water which can become depleted (drought) or saturated (flooding).
- Oxygen - if not compacted or flooded.
- Living organisms - micro to macro.
- It's a complex ecosystem and **It's Alive!!!!**

# What does soil do?

- It holds plants up.
- Makes food for plants.
- Helps rain and snow soak into the ground.
- Provides a home for lots of organisms.
- In most ecosystems, more life and diversity lives underground than above.

# Soil Communities

- Help cycle nutrients through the environment.
- Decomposition - help rot dead plants and animals to recycle nutrients.
- Degrade pollutants before they reach groundwater or surface water.
- Each organism carries out a function that contributes to the entire ecosystem.

# Bacteria

- Bacteria are microscopic one-celled organisms that aren't plants or animals.



Photo Credit: Michael T. Holmes, Oregon State University, Corvallis.



# Bacteria

- Bacteria help rot dead plants and animals to recycle nutrients into plant food.
- They help make nitrogen (a plant food) for plants.
- Some live free in the soil; others grow on the roots of plants (legumes).

# Bacteria

- One cup of soil can hold as many bacteria as there are people on Earth

That's over 6 billion!

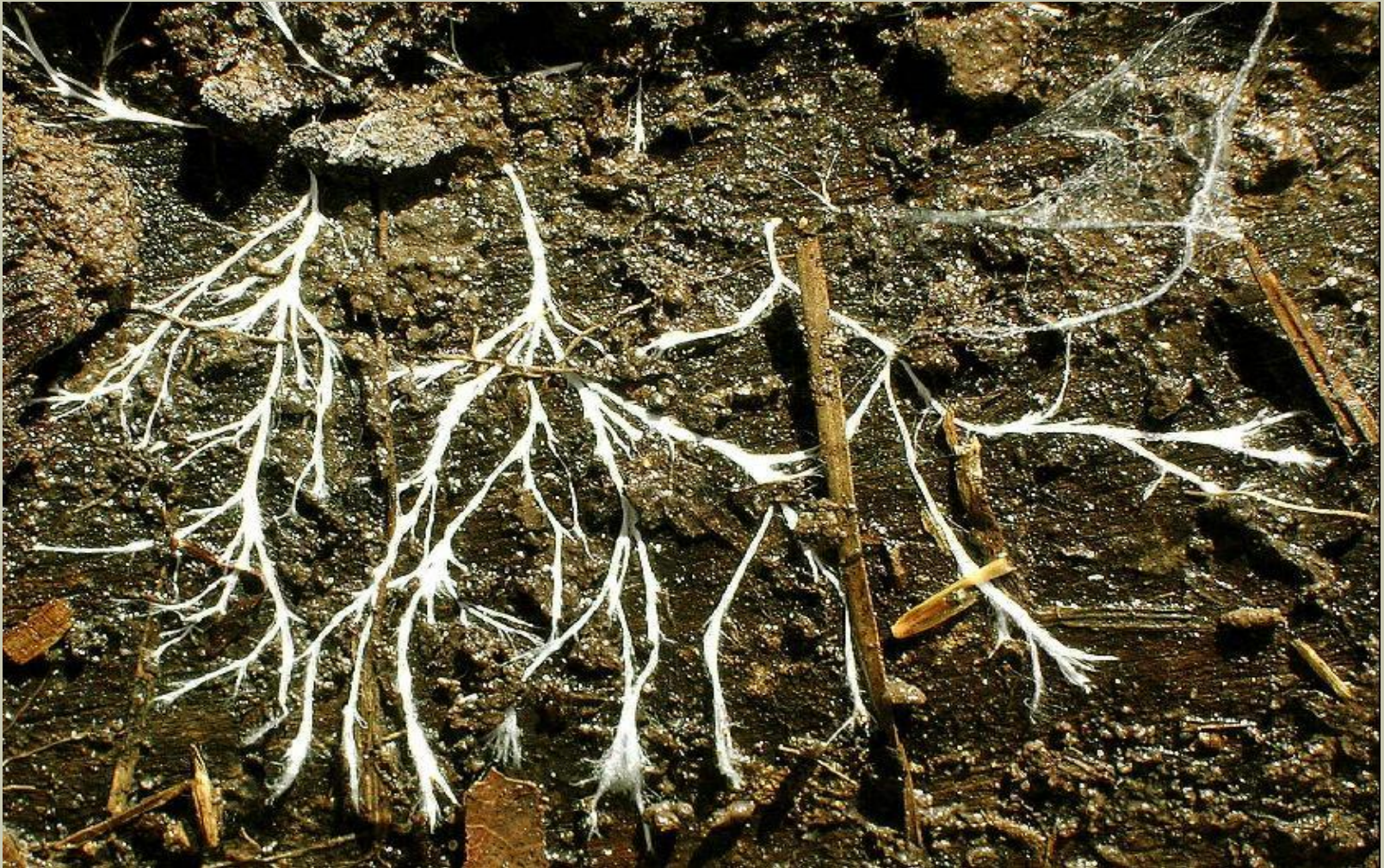
- The weight of all bacteria in 1 acre (about the size of a football field) can equal the weight of one or two cows.

# Fungi

- Fungi help plants get food and water from the soil.
- Other fungi help rot dead plants to recycle nutrients.
- A teaspoon of farm soil or grassland may contain tens of yards of fungi.
- The same amount of soil from a coniferous forest may hold tens of miles of fungi.



# Fungi grow in threads called hyphae.





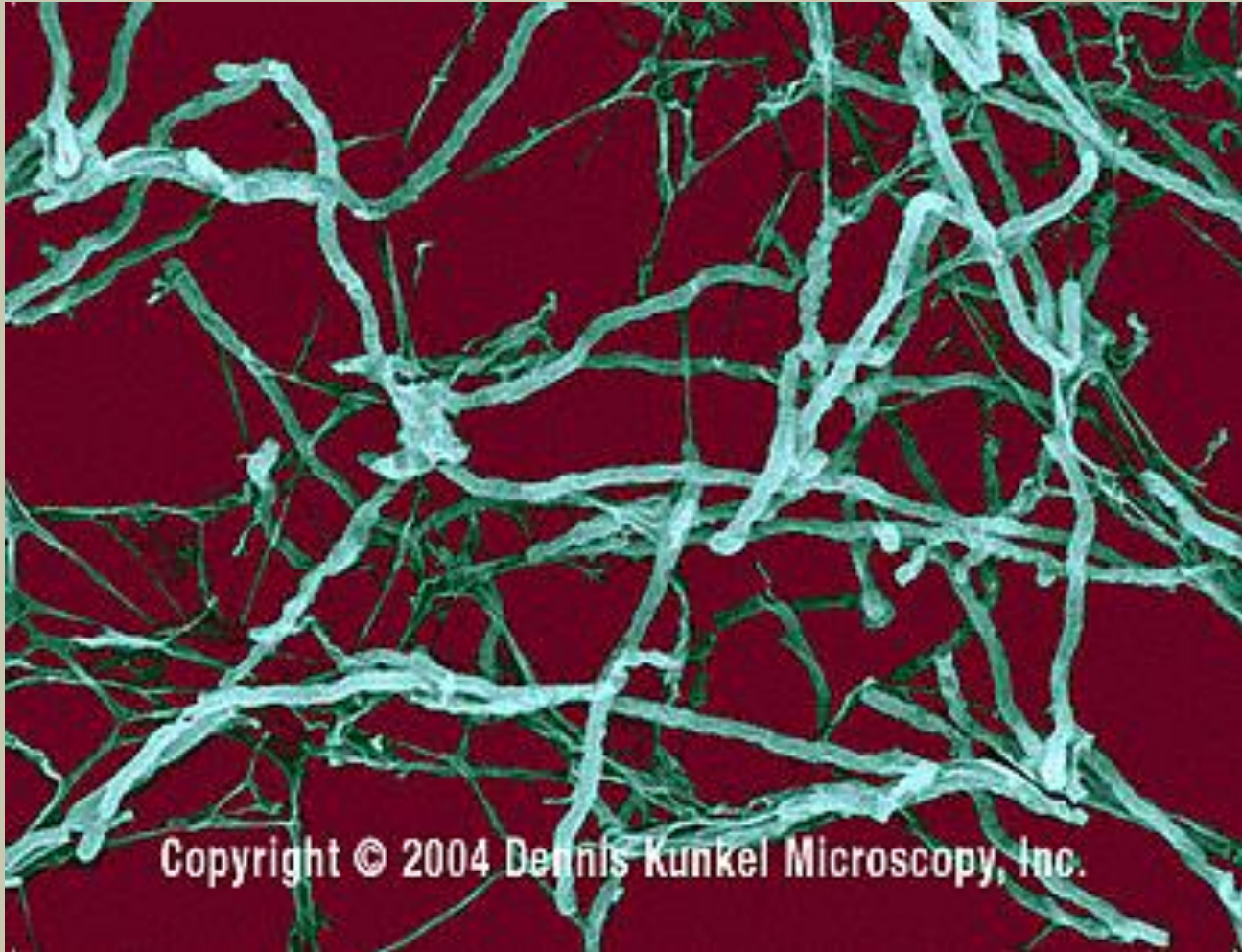
Some fungi produce large above ground structures.



# Actinomycetes

- Have cells like bacteria, but grow in threads like fungi.
- Help degrade tough materials, like cellulose, for bacteria to further degrade.
- Source of the antibiotic Streptomycin.
- Produce geosmin - that wonderful "earthy" smell of fresh plowed ground.

# Actinomycetes



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# Protozoa

- Are tiny animals that feed on bacteria and move through the soil.
- When they eat bacteria, they help release nutrients for plants to use.
- Some live in termite guts and help digest wood fibers.



# Protozoans



Flagellate soil protozoa.



Ciliate soil protozoa eat tens of thousands of bacteria daily.

Photo credit: Wilhelm Foissner, Institute of Zoology, University of Salzburg

# Nematodes

- Tiny roundworms that are common in farm or grassland soils.
- Some are serious pests, but many help provide plant food for plants
- They help mix up the soil.
- 5,000 soil species have been described.

# Nematodes



Plant-parasitic and non-parasitic nematodes recovered from soil by sieving. (Greg Tylka)

# Arthropods

- Don't have a backbone, but do have jointed legs.
- They include ants, termites, spiders, mites, centipedes, millipedes and many others.
- They stir up the soil so it gets more air and moves nutrients around.

# Arthropods

- They chew up dead plants into tiny pieces for bacteria and fungi.
- When you take a step in a forest, you are being held up on the backs of thousands of bugs.

How cool is that?!!!!!!

# Arthropods



Image source : <http://macromite.wordpress.com/2009/04/29/a-menagerie-of-microarthropods>



# Earthworms

- Some live on the surface in leaf litter, some lie just beneath the surface, some burrow deep in the soil.
- As they move around, they move organic material from the soil surface to the lower layers.
- They also create cavities for air and water to move.
- Where earthworms are active, they can turn over the top 6 inches of soil in 10-20 years.

# Earthworm

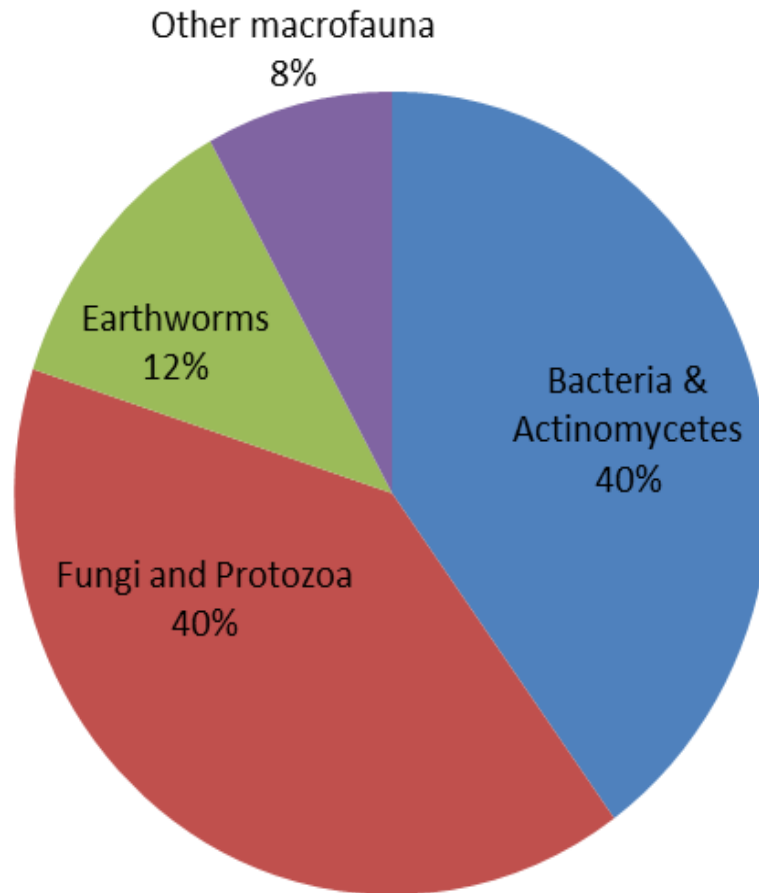




# Small Scale Vermicomposting

- Common earthworms won't work!
- Need red wigglers or African red worms.
- Can't tolerate extreme temperatures.
- Works quite well in small living spaces.
- Takes several months to create worm compost.
- A great additive to potting soil!
- Worm tea is also a benefit to watering plants.

# Organisms living in soil



# Making compost is managing a microbe farm.

- All it takes is food, air, and water.
- The food needs to be balanced.
- Principal concerns are carbon and nitrogen.
- Water and oxygen are also necessary.
- The microbes will do the rest!

# Diversity is best!

- Nutrient diversity - balanced diet.
- Biological diversity - inoculum to get started.
- Particle size diversity- prevents compaction and allows for aeration.
- Water content - not too wet or too dry.

# Carbon vs. Nitrogen

- Carbon sources are leaves, straw, and wood shavings.
- Nitrogen sources are manure and plant material.
- Try to maintain a 3:1 ratio of Carbon to Nitrogen.

# Air

- Develops faster when turned.
- Compaction results in anaerobic zones that will create bad odors.
- Varied particle size will help prevent compaction.
- Large 4" PVC pipe drilled with holes and placed in center can help.

# Water

- Microbes need water.
- Good when you can squeeze a hand full and it stays together.
- Too much can cause it to smell.
- Too little can slow it down and likely not compost evenly.
- Don't count on rainfall to be adequate!

# Temperature

- Compost must heat to develop properly.
- Center of pile can reach above 130 F.
- Too hot for a human hand.
- Test temperature by placing hand in pile. If too hot, then aeration is necessary to bring temperature down.
- If not heating, then may be too dry or not enough nitrogen present.



# pH

- pH is a measure of acidity or alkalinity
- The ideal pH is  $<7.5$
- The pH will decline as the compost matures.
- For home gardeners, testing is usually not necessary.

# Adding compost to soil

- Spread on soil surface and turn into the top 6 inches.
- Mix with potting soil or use to make your own potting soil.
- Additional mulch added on top is necessary to help hold in moisture.

# Benefits of adding compost

- Rebuilds soil structure.
- Improves clay soil.
- Slows rain run-off.
- Increases water holding capacity.
- Releases nutrients at a slow rate.

Adding compost creates healthy soil.



The End

*Thank you!*