

# GREEN FINGERS GARDEN CLUB PREVIEW OF SPRING 2009 Exhibit

THE GREENER GARDEN GROWS FROM

## Living Soil

a billion bacteria  
yards of fungi  
and thousands of other organisms

a teaspoon of healthy garden soil contains

BACTERIA and FUNGI form the ground floor of an interrelated food chain known as the SOIL FOOD WEB.

**EXTRA CREDIT !  
The Soil Food Web**



Bacteria are the primary decomposers of fresh green plant material. They retain high levels of nitrogen essential to the growing of plants.

Bacteria produce slime in order to stick to surfaces, which also binds soil particles together to create pockets air and water.



**THE FOOD THAT FEEDS THE SOIL**

Fungi feast on aged brown organic matter such as old leaves. They grow by producing long, tubular segments called hyphae that transport nutrients from organic matter on the soil surface to plant roots.

Hyphae intertwine to create structure in soil.

**HOMEWORK**

Work at home with the natural processes of the soil food web.

- DO test your soil for pH, structure, and nutrient content.
- DO add well balanced, aged compost (rich in organic matter and concentrated levels of microbial) to the soil.
- DO add mycorrhizal species to shrubs, trees and other plants, to each approx. 1/2 cup of planting.



DON'T use chemical fungicides, insecticides, herbicides or salt based fertilizers.

DON'T compact or over-kill the soil and disrupt fragile beneficial fungal structures.



BACTERIA SWIM IN AQUEOUS SOLUTION



FUNGI GROW IN AQUEOUS SOLUTION



THE MYCORRHIZAL FUNGUS OF THE PLANT ROOT SYSTEM



**MEMBERSHIP**

Join our club today!

**THE AREA SURROUNDING EVERY PLANT AND TREE ROOT (or rhizosphere), is a "hot zone" of microbial activity. Roots secrete sugars and hormones to attract beneficial bacteria which crowd out harmful organisms. In the image to the right, the soil bacterium Pseudomonas fluorescens multiplies rapidly in the rhizosphere, crowding out the fungus Pythium ultimum while also producing antibiotics that inhibit it's growth.**



More than 90% of plants benefit from a symbiotic relationship with fungi known as mycorrhizae. The hyphae of these fungi grow within or extend out of a plant's root system increasing it's absorption by up to 1000 times. Phosphorus (needed for flower bud growth and root formation) is one the main nutrients delivered to roots in this manner.

Soil Products to add 1/2 "ONE OUNCE" and mix in your Soil Food Web.

**ALL PRODUCTS AVAILABLE AT SAW BRIDGE'S NURSERY**



**THE GREENER GARDEN GROWS FROM**

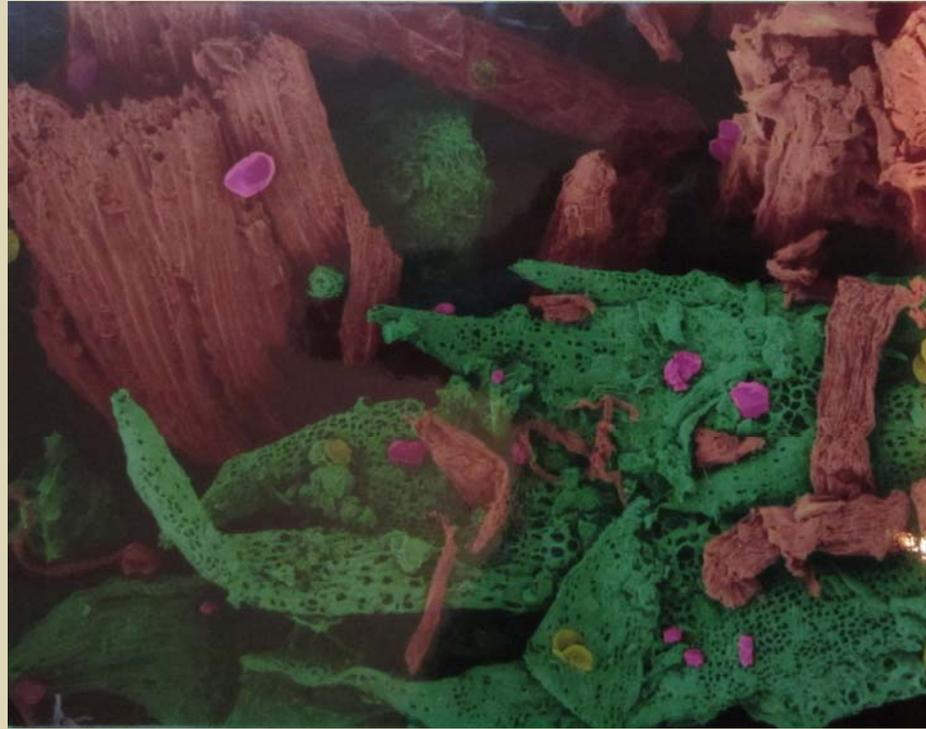
# **Living Soil**



**BACTERIA and FUNGI form the ground floor of an interrelated food chain known as THE SOIL FOOD WEB.**

**Bacteria and Fungi each play a different role in :**

## **1. Recycling nutrients from dead plant matter**



**The Food that Feeds the Soil Food Web:**

Electron microscopic image of humus (brown), decaying plant matter (green), and mineral particles (pink and chartreuse). Image Copyright Dennis Kunkle Microscopy, Inc.

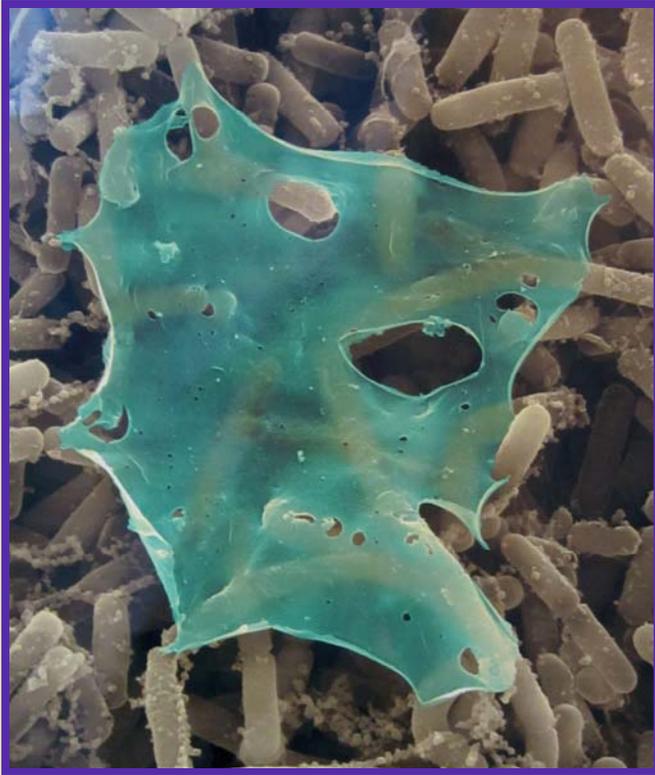
**BACTERIA** are the primary decomposers of fresh green plant material.

They retain high levels of nitrogen essential to the greening of plants.

**FUNGI** feast on aged brown organic matter such as dead leaves.

They grow by producing long, tubular segments called hyphae that transport nutrients from organic matter on the soil surface to plant roots.

## 2. Creating Structure in the Soil



*Streptomyces hygrosopicus*, is a biofilm or slime producing bacterium that causes the musty odor in soil. Image Copyright Dennis Kunkle Microscopy, Inc.



Hyphae and fruiting structures of the fungus *Absidia corymbifera*, which is found worldwide in soil. Image Copyright Dennis Kunkle Microscopy, Inc.

**BACTERIA produce slime in order to stick to surfaces, which also binds soil particles together to create pockets for air and water.**

**The hyphae of FUNGI intertwine to create structure in soil.**

### 3. Affecting the pH of the Soil

**Alkaline soils have a higher pH**

**Acidic soils have a lower pH**

Vegetable & annual garden soils → lawn soils → deciduous forest soils → conifer forest soils



**BACTERIA thrive in alkaline soils.**

**FUNGI dominate in acid soils.**

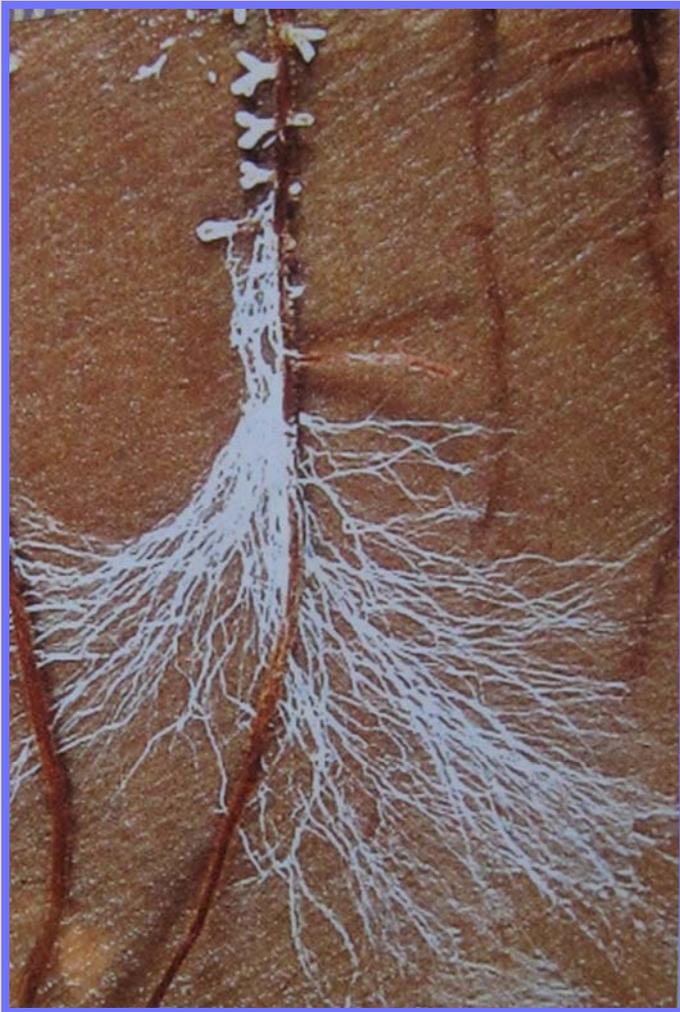
# Disease Protection



Image Copyright Dennis Kunkle Microscopy, Inc.

The area surrounding every plant and tree root (or rhizosphere) is a “hot zone” of microbial activity. Roots exude sugars and hormones to attract beneficial bacteria which crowd out harmful organisms. In the picture above, the soil bacterium *Pseudomonas fluorescens* multiplies rapidly in the rhizosphere crowding out the fungus *Pythium ultimum* while also producing antibiotics that inhibit its growth.

# Nutrient Absorption



**Mycorrhizal Fungi growing on the roots of a White Pine.**

Reprinted with permission from Bryce Kendrick [www.mycolog.com](http://www.mycolog.com)

More than 90% of plants benefit from a symbiotic relationship with fungi known as mycorrhizae. The hyphae of these fungi grow within or extend out of a plant's root system increasing its absorption by up to 1000 times. Phosphorous (needed for flower bud growth and root formation) is one of the main nutrients delivered to the roots in this manner.

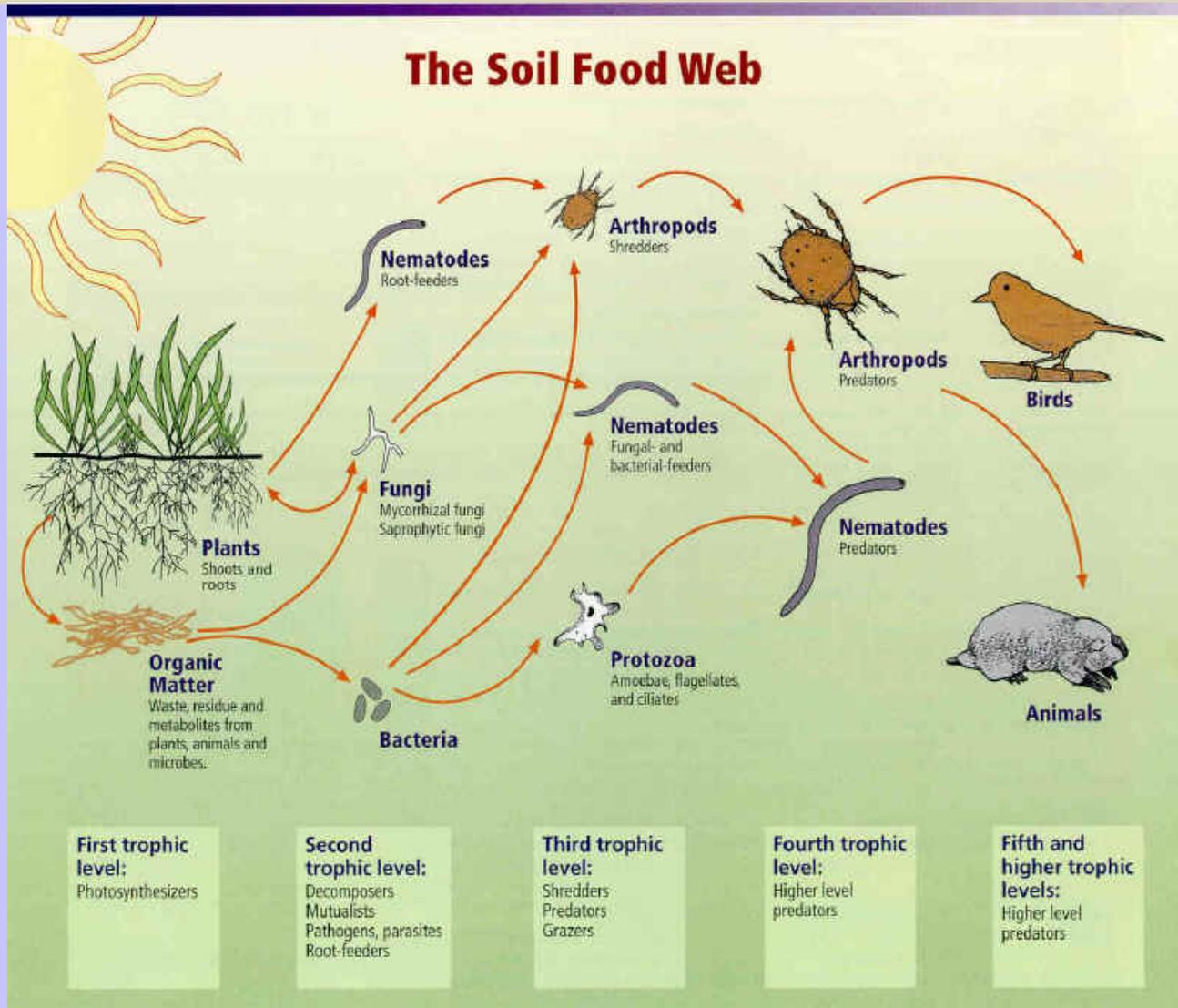
# HOMEWORK

**Work at home with the natural processes of the soil food web.**

- **DO** test your soil for ph, structure, and nutrient content.
- **DO** add well balanced, aged compost (rich in organic matter and concentrated levels of microbes) to the soil.
- **DO** add mycorrhizae specific to shrubs, trees and other plants, to root area at time of planting.
- **DON'T** use chemical fungicides, insecticides, herbicides or salt based fertilizers.
- **DON'T** compact or over-till the soil and disrupt fragile beneficial fungal structures.

# EXTRA CREDIT !

## THE SOIL FOOD WEB



From the Soil Biology Primer (online) [soils.usda.gov/sqi/concepts/soil\\_biology/biology.html](https://soils.usda.gov/sqi/concepts/soil_biology/biology.html)

## **THE SOIL FOOD WEB cont.**

**The earth's soil is composed of 45% minerals, 25% water, 25% air and 5% organic matter, but the first 2" to 8" of healthy top soil is where nearly all the organic matter and living components of the Soil Food Web are located. Bacteria, fungi, protozoa, nematodes, arthropods, and earthworms are all part of this soil-based ecosystem and each play an important role in the decomposition of organic matter and related slow release of nutrients needed by plants. When in balance, the soil food web creates a self-sustaining cycle that benefits plants with enhanced soil structure, moisture retention, and disease protection. A healthy soil food web = healthy plants.**

## **THE SOIL FOOD WEB cont.**

**It may take a mind shift to think of bacteria and fungi as good, but as the foundation of a balanced soil food web, they are a “green gardener’s” best friends.**

**You can't have healthy soil without organic matter. Every time you leave grass clippings or leaves on the lawn, add compost to the soil, or top dress with natural mulch, you are adding organic matter and feeding the soil food web.**

**So how's your soil food web doing? See the different ways to test your soil, and assess it's organic content and living components below.**

# Assess Your Soil's Organic Matter and Biological Activity

**1. Earthworm Count** Counting the number of earthworms per square foot in your soil is a “short hand” way of determining it's biological health, since earthworms feed on large amounts of bacteria and protozoa. Look for 10 to 50 worms per square foot of lawn, 5 to 30 per square foot of vegetable garden.

**2. Berlese Funnel** You can make a berlese funnel by cutting off the bottom of a large plastic bottle, covering the top with a screen, inverting it and filling it with soil and leaf litter, and then placing a light over it and putting it into a 1 quart container with some ethyl alcohol on the bottom. Soil organisms will move away from the heat and light and drop into the container. After three days, the micro-arthropods collected should be both numerous and diverse.



## 3. Soil Testing Services



It's **FREE!** See reverse side for details

THE CONNECTICUT  
AGRICULTURAL EXPERIMENT STATION

### Tests Performed

Soil samples are tested for texture, organic matter, pH, nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, and magnesium.

<http://www.soilfoodweb.com/>



**SOIL FOODWEB, INC.**

This company was founded by Elaine Ingham PhD, one of the foremost scientific experts on the soil food web, and provides tests that quantify the presence of key components of the soil ecosystem.

## RESOURCES

**Much of the information provided in this exhibit came from these informative publications:**

**TEAMING WITH MICROBES *A Gardener's Guide to the Soil Food Web* by Jeff Lowenfels and Wayne Lewis. Timber Press, Inc. 2006.**

**SOIL BIOLOGY PRIMER Soil and Water Conservation Society (SWCS). 2000. *Soil Biology Primer*. Rev. ed. Ankeny, Iowa: Soil and Water Conservation Society.**

**and**

**Healthy Soil Healthy Water power point presentation by Denise Savageau, Conservation Director, Town of Greenwich**