

Honey Hollow Watershed Symposium

Enhancing Soil Biology

Improving soil health and crop performance through natural solutions

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BioOrganics

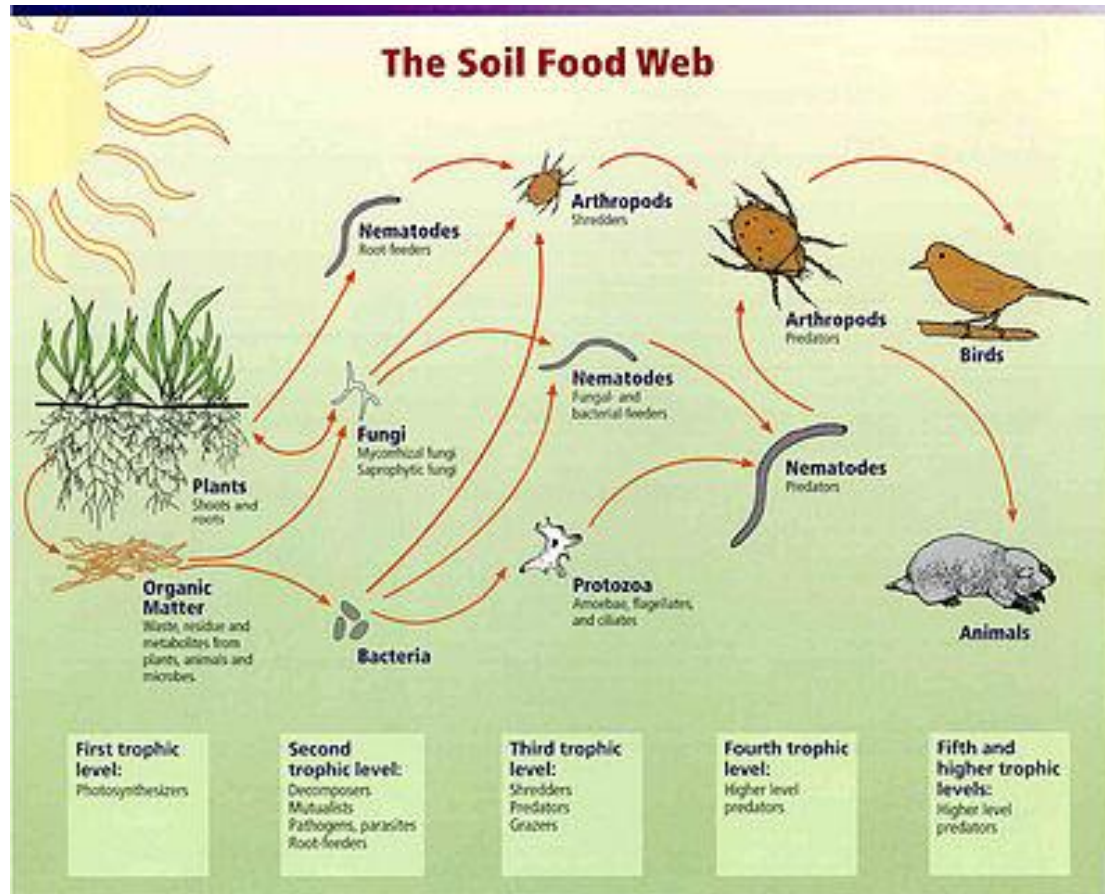


Soil Biology & Soil Conservation

1. What is “Soil Biology”?
2. Why is it important?
3. How can we add/maintain/enhance it?



SOIL BIOLOGY



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html

Soil Biology/Soil Food Web

Organic Matter

Waste and residue from plants, animals and microbes

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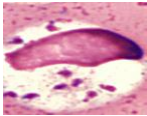
ARTHROPODS



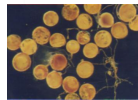
BACTERIA



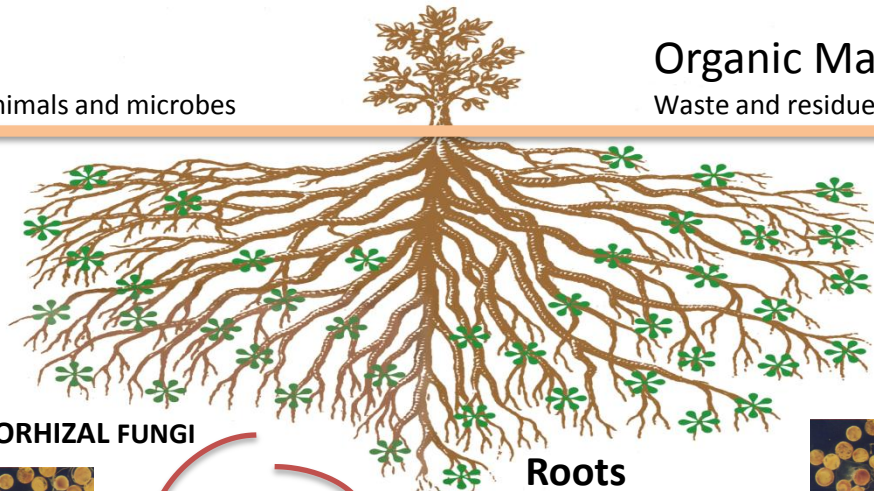
PROTOZOA –



MYCORRHIZAL FUNGI



NUTRIENTS

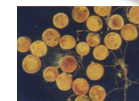


Roots

EARTHWORMS



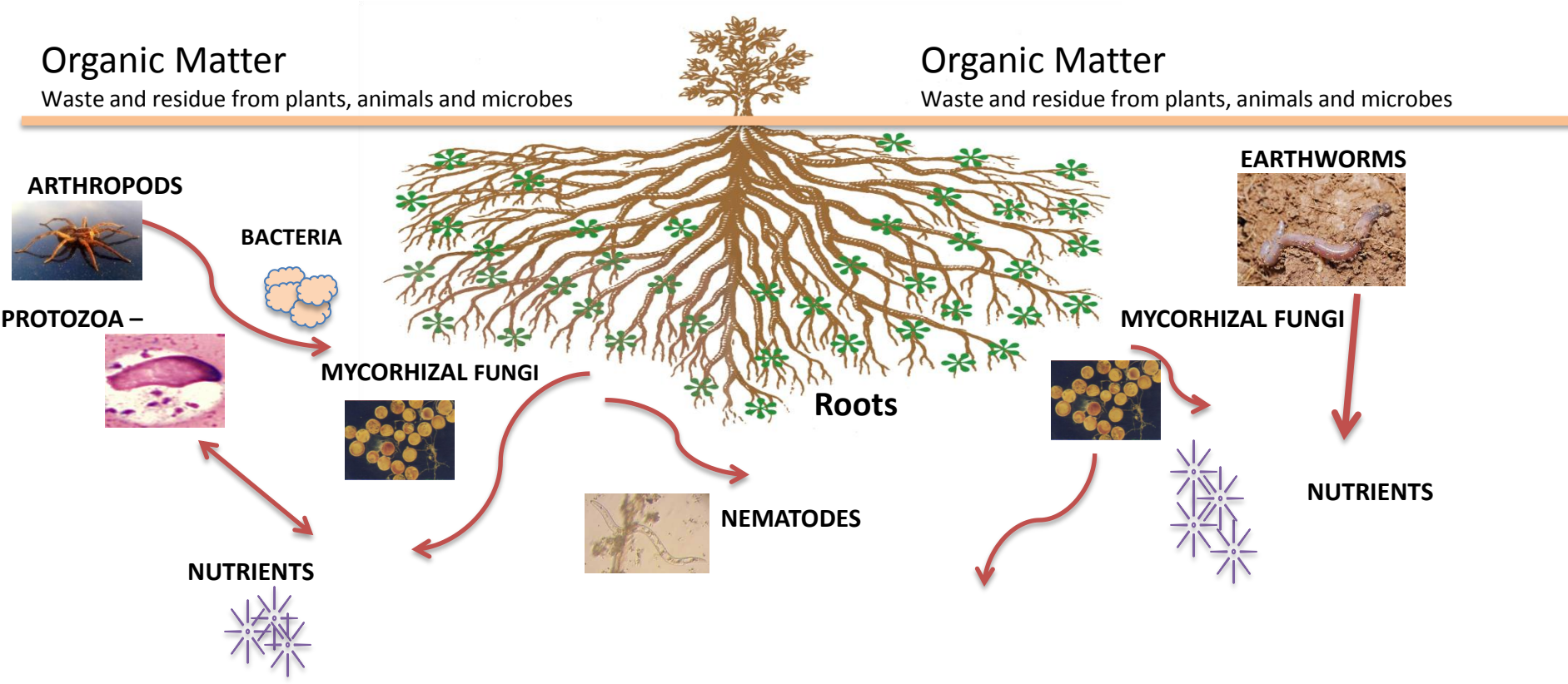
MYCORRHIZAL FUNGI



NUTRIENTS



NEMATODES



Soil Biology/Soil Food Web



- Purpose is to break down organic matter to create nutrients for plants
- Life in soil converts them to food
- Different than plants being fed nutrients directly through chemicals
- Plants become stronger working for themselves

Soil Biology/Soil Food Web

Beneficial Bacteria

- Rhizobacteria: symbiotic relationship with plant by converting nitrogen (from air) into a nutrient for the plant once embedded in root system
- Actinobacteria: Critical for decomposition of organic matter and humus formation
- Bacillus: Protect roots and aid in nutrient uptake.



SOIL BIOLOGY/SOIL FOOD WEB

Earthworms:

- Bioturbation – disturbance of the soil, creates passages ways for air and water
- Worm castings are a source of nutrients that roots can feed off, creating NPK with soil
- Easy to see sign of healthy soil

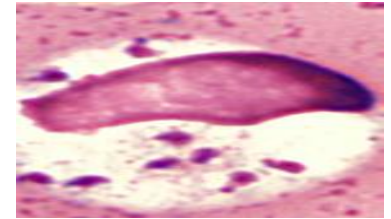


SOIL BIOLOGY/SOIL FOOD WEB

Beneficial Nematodes: Microscopic organisms
- Predatory nematodes kill pests (borers, cutworms, grubs, etc.)



Protozoa: (single cell) Eat bacteria which then releases nitrogen (in form of ammonium)
-Regulate bacteria populations



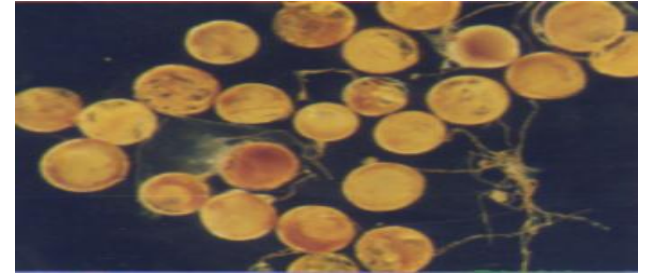
Arthropods (Bugs): Very important for nutrient release in the soil
-Centipedes, spiders,
-Shred organic matter, mineralize nutrients, control pests



SOIL BIOLOGY/SOIL FOOD WEB

Mycorrhizae (Biological Quarterback)

- Mycorrhizal fungi forms a symbiotic relationship with plant roots
- Mycorrhizae help plant reach further for food, bind mineral particles together, improve soil quality and store carbon and nitrogen.
- Plant feeds fungi carbohydrates
- Helps plant roots fight disease and drought
- Protect plants from toxic conditions
- Interacts well with other biology



FUNCTIONS OF SOIL BIOLOGY

Soil biology and soil conservation

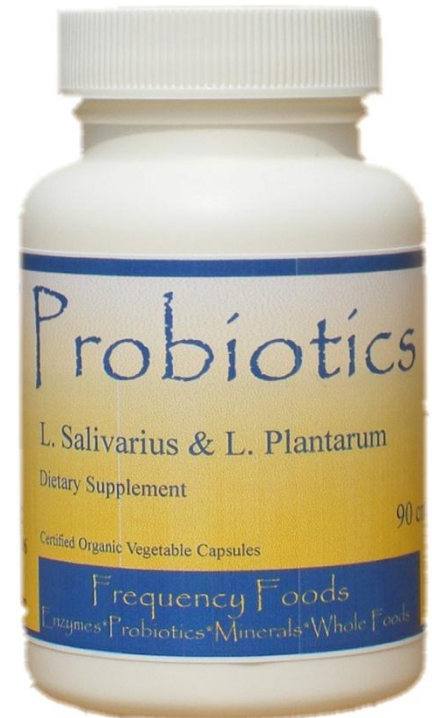
1. Healthier plants/disease prevention
2. Soil/resource conservation
3. Healthier humans



FUNCTIONS OF SOIL BIOLOGY

Biology as preventative

- Avoid medication, where possible, similar to Probiotics
- Stop trying to treat symptoms and focus on a healthy biological system
- Increase overall health



FUNCTIONS OF SOIL BIOLOGY

Creating Healthy Soil and Plants

- Analogy to human health and taking preventative measures to avoid medications
- Holistic approach
- Eating and living healthy
- Medication can cause other problems
 - Treating a symptom vs. treating the root cause



FUNCTIONS OF SOIL BIOLOGY

Current Approach Fertilizers/Pesticides

Synthetic Chemicals

- Usually derived from petroleum
- After WWII, scientists began to use concentrated forms of nitrogen
- Science became more advanced – each iteration focusing on addressing specific needs

Soil depletion: Gradually destroying beneficial soil

- runoff, negative feedback loop



FUNCTIONS OF SOIL BIOLOGY

Conservation through Soil Biology

Current Programs: Inputs

- ***Water***: obviously can't eliminate but healthy soil requires less
- ***Fertilizer***: derive it from the food web
- ***Pesticide***: make plants less susceptible to infection or predators



FUNCTIONS OF SOIL BIOLOGY

Water

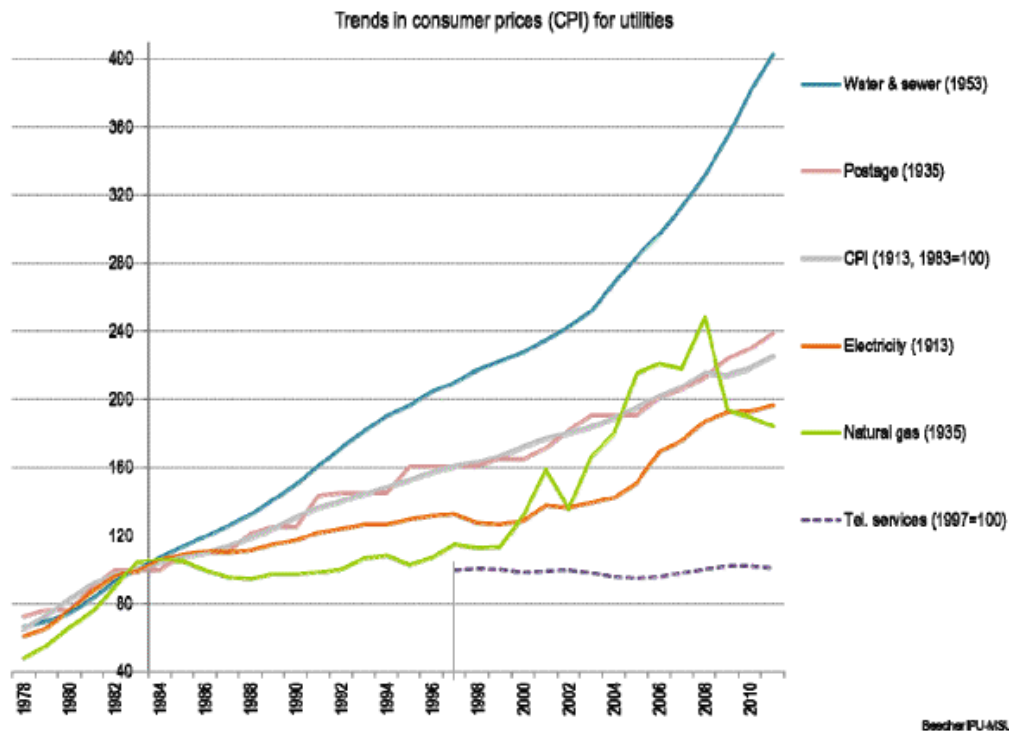
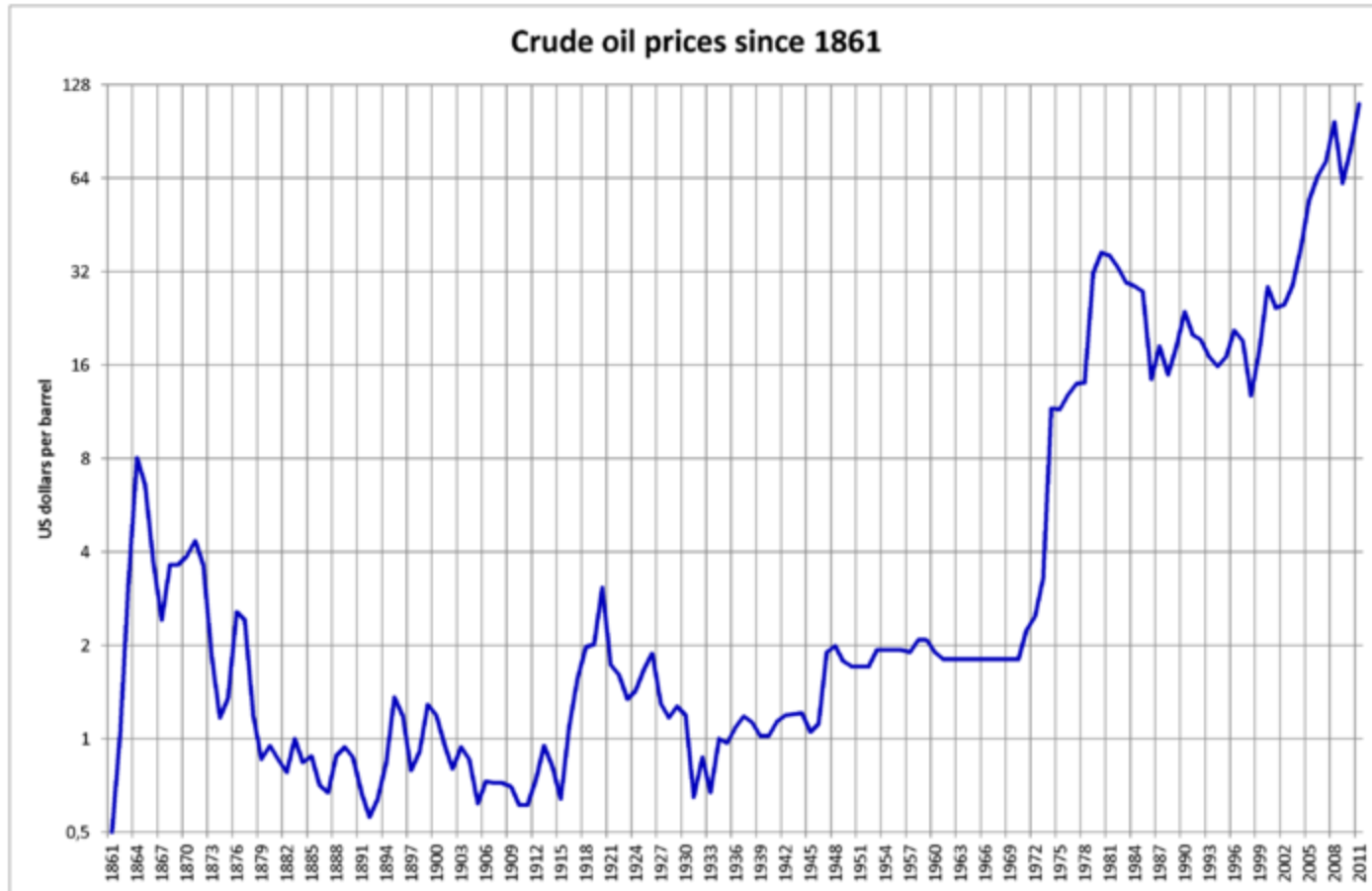


Exhibit 2. Trends in the Consumer Price Index for utilities (general, 1979-2011).
The index is set to 100 for 1982-1984 except for telephone services, where the index is set to 100 for 1997.

FUNCTIONS OF SOIL BIOLOGY

Petroleum



FUNCTIONS OF SOIL BIOLOGY

Using Biology for Human Health

- Health and wellness issue
- Concern about the substances we inhale, ingest and are exposed to
- Many chemicals, once deemed safe have proven toxic to long-term health
 - Pesticides



FUNCTIONS OF SOIL BIOLOGY

Organic/Natural Food

- Organic food study
 - Researchers tried to show that many studies did not indicate more nutrients
 - However, much less pesticide exposure was a finding



ENABLING SOIL BIOLOGY



Methods to Build/Enhance/Maintain Soil Biology



ENABLING SOIL BIOLOGY

Methods:

No Till/Limited Till:

- Growing without disturbing the biology through tillage
- Adds organic matter
- Reduces erosion



ENABLING SOIL BIOLOGY

Methods:

Cover Crop

- “Green Manure” increases nutrients in soil
- Plowed under – increases organic matter
- Enhance soil structure – less erosion
- Disease and pest management (introduce predators or draw away pests)



ENABLING SOIL BIOLOGY

Methods:

Crop Rotation

- Decrease pests and pathogens
- Build nutrients and soil biology
- Reduce erosion



ENABLING SOIL BIOLOGY

Increasing Organic Matter (compost, mulch)

- Breaking down organic matter into humus for fertilization and soil biology
- Provides minerals and nutrients
- Increases organic matter and reduces erosion



CONCLUSIONS

Sustaining Natural Practices

- ***Patience***: unlike current synthetics it does not happen overnight
- ***Variability in results***: results will always vary based on the biology and factors

CONCLUSIONS

Sustaining Natural Practices

- ***Interaction of Natural vs. Synthetic***: ok to use mix of synthetics if it is more practical but make sure the interaction does not negate the biology