



University of Idaho
Extension

SUPPORTING THE SOIL FOOD WEB IN YOUR GARDEN

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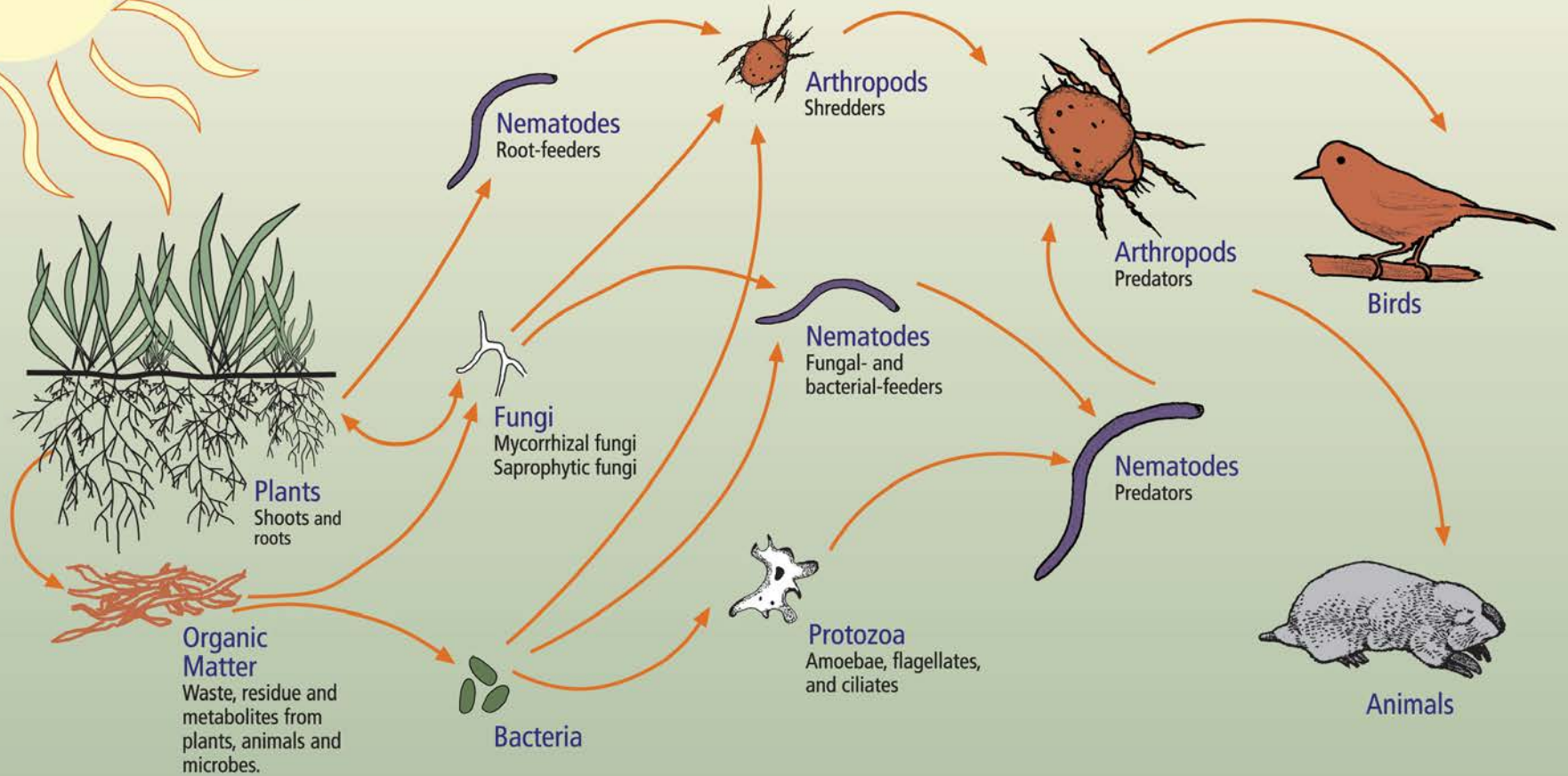
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ACKNOWLEDGMENTS

USDA-NRCS Soil Biology Primer. See **Resources**.

Landscape for Life. Landscape For Life™ is a collaboration between the Lady Bird Johnson Wildflower Center and the United States Botanic Garden based on the principles of the Sustainable Sites Initiative (SITES®). See **Resources**.

The Soil Food Web



First trophic level:
Photosynthesizers

Second trophic level:
Decomposers
Mutualists
Pathogens, Parasites
Root-feeders

Third trophic level:
Shredders
Predators
Grazers

Fourth trophic level:
Higher level predators

Fifth and higher trophic levels:
Higher level predators

A Soil Food Web Glossary

Arthropods	Invertebrate animals with jointed legs. They include insects, crustaceans, sowbugs, arachnids (spiders), and others.
Bacteria	Microscopic, single-celled organisms that are mostly non-photosynthetic. They include the photosynthetic cyanobacteria (formerly called blue-green algae) and actinomycetes (filamentous bacteria that give healthy soil its characteristic smell).
Fungi	<p>Multi-celled, non-photosynthetic organisms that are neither plants nor animals. Fungal cells form long chains called hyphae and may form fruiting bodies such as mold or mushrooms to disperse spores. Some fungi, such as yeast, are single-celled.</p> <p>Saprophytic fungi: Fungi that decompose dead organic matter.</p> <p>Mycorrhizal fungi: Fungi that form associations with plant roots. These fungi get energy from the plant and help supply nutrients to the plant.</p>
Grazers	Organisms, such as protozoa, nematodes, and microarthropods, that feed on bacteria and fungi.
Microbes	An imprecise term referring to any microscopic organism. Generally, "microbes" includes bacteria, fungi, and sometimes protozoa.
Mutualists	Two organisms living in an association that is beneficial to both, such as the association of roots with mycorrhizal fungi or with nitrogen-fixing bacteria.
Nematodes	Tiny, usually microscopic, unsegmented worms. Most live free in the soil. Some are parasites of animals or plants.
Protozoa	Tiny, single-celled animals, including amoebas, ciliates, and flagellates.
Trophic levels	Levels of the food chain. The first trophic level includes photosynthesizers that get energy from the sun. Organisms that eat photosynthesizers make up the second trophic level. Third trophic level organisms eat those in the second level, and so on. It is a simplified way of thinking about the food web. In reality, some organisms eat members of several trophic levels.

Functions of Soil Organisms

Type of Soil Organism

Photosynthesizers

- Plants
- Algae
- Bacteria

Decomposers

- Bacteria
- Fungi

Mutualists

- Bacteria
- Fungi

Pathogens

- Bacteria
- Fungi

Parasites

- Nematodes
- Microarthropods

Root-feeders

- Nematodes
- Macroarthropods (e.g., cutworm, weevil larvae, & symphylans)

Bacterial-feeders

- Protozoa
- Nematodes

Fungal-feeders

- Nematodes
- Microarthropods

Shredders

- Earthworms
- Macroarthropods

Higher-level predators

- Nematode-feeding nematodes
- Larger arthropods, mice, voles, shrews, birds, other above-ground animals

Major Functions

Capture energy

- Use solar energy to fix CO₂.
- Add organic matter to soil (biomass such as dead cells, plant litter, and secondary metabolites).

Break down residue

- Immobilize (retain) nutrients in their biomass.
- Create new organic compounds (cell constituents, waste products) that are sources of energy and nutrients for other organisms.
- Produce compounds that help bind soil into aggregates.
- Bind soil aggregates with fungal hyphae.
- Nitrifying and denitrifying bacteria convert forms of nitrogen.
- Compete with or inhibit disease-causing organisms.

Enhance plant growth

- Protect plant roots from disease-causing organisms.
- Some bacteria fix N₂.
- Some fungi form mycorrhizal associations with roots and deliver nutrients (such as P) and water to the plant.

Promote disease

- Consume roots and other plant parts, causing disease.
- Parasitize nematodes or insects, including disease-causing organisms.

Consume plant roots

- Potentially cause significant crop yield losses.

Graze

- Release plant available nitrogen (NH₄⁺) and other nutrients when feeding on bacteria.
- Control many root-feeding or disease-causing pests.
- Stimulate and control the activity of bacterial populations.

Graze

- Release plant available nitrogen (NH₄⁺) and other nutrients when feeding on fungi.
- Control many root-feeding or disease-causing pests.
- Stimulate and control the activity of fungal populations.

Break down residue and enhance soil structure

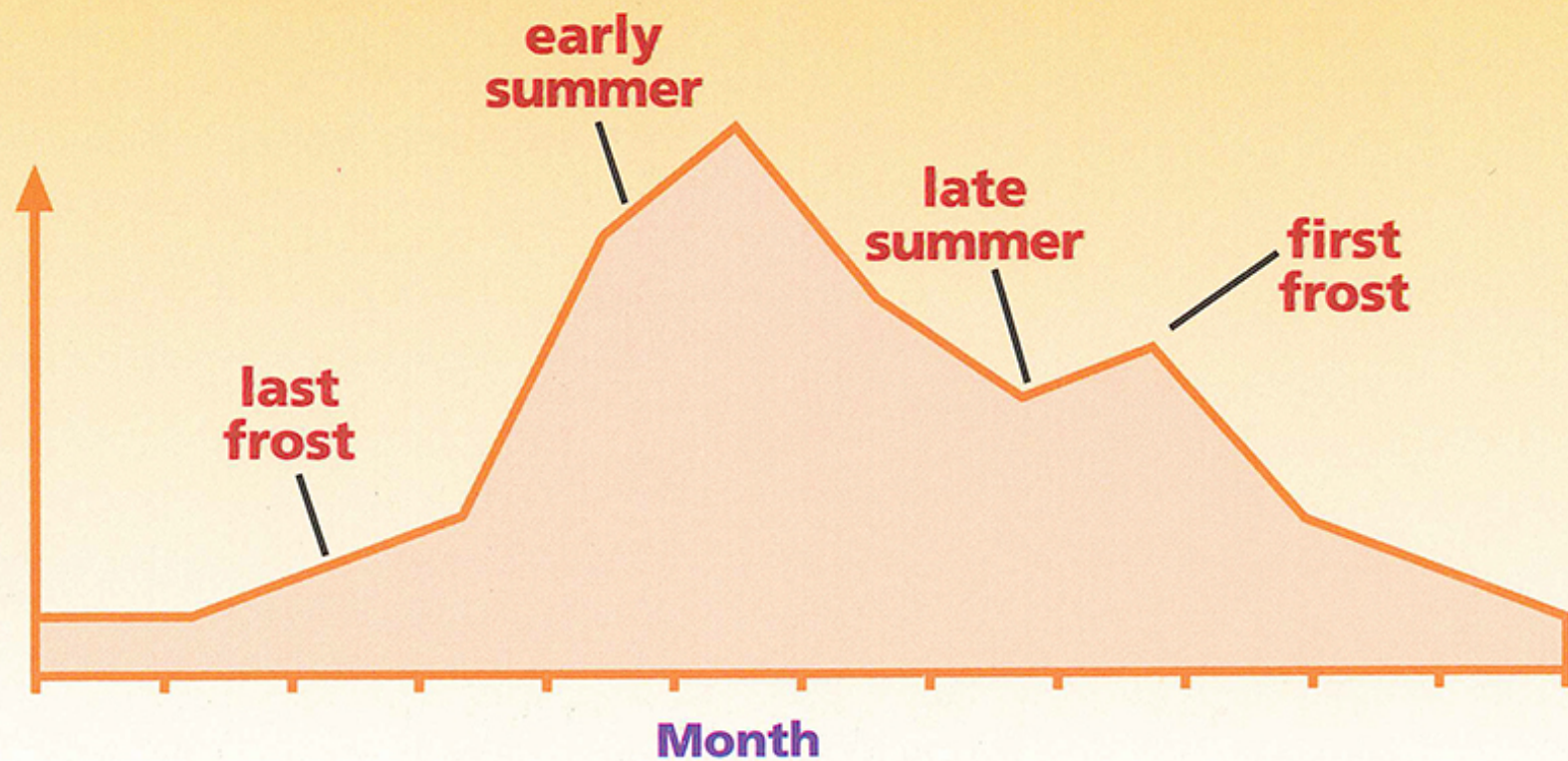
- Shred plant litter as they feed on bacteria and fungi.
- Provide habitat for bacteria in their guts and fecal pellets.
- Enhance soil structure as they produce fecal pellets and burrow through soil.

Control populations

- Control the populations of lower trophic-level predators.
- Larger organisms improve soil structure by burrowing and by passing soil through their guts.
- Larger organisms carry smaller organisms long distances.

Seasonal Microbial Activity

Bacterial and Fungal Activity
in a temperate grassland or cropland.

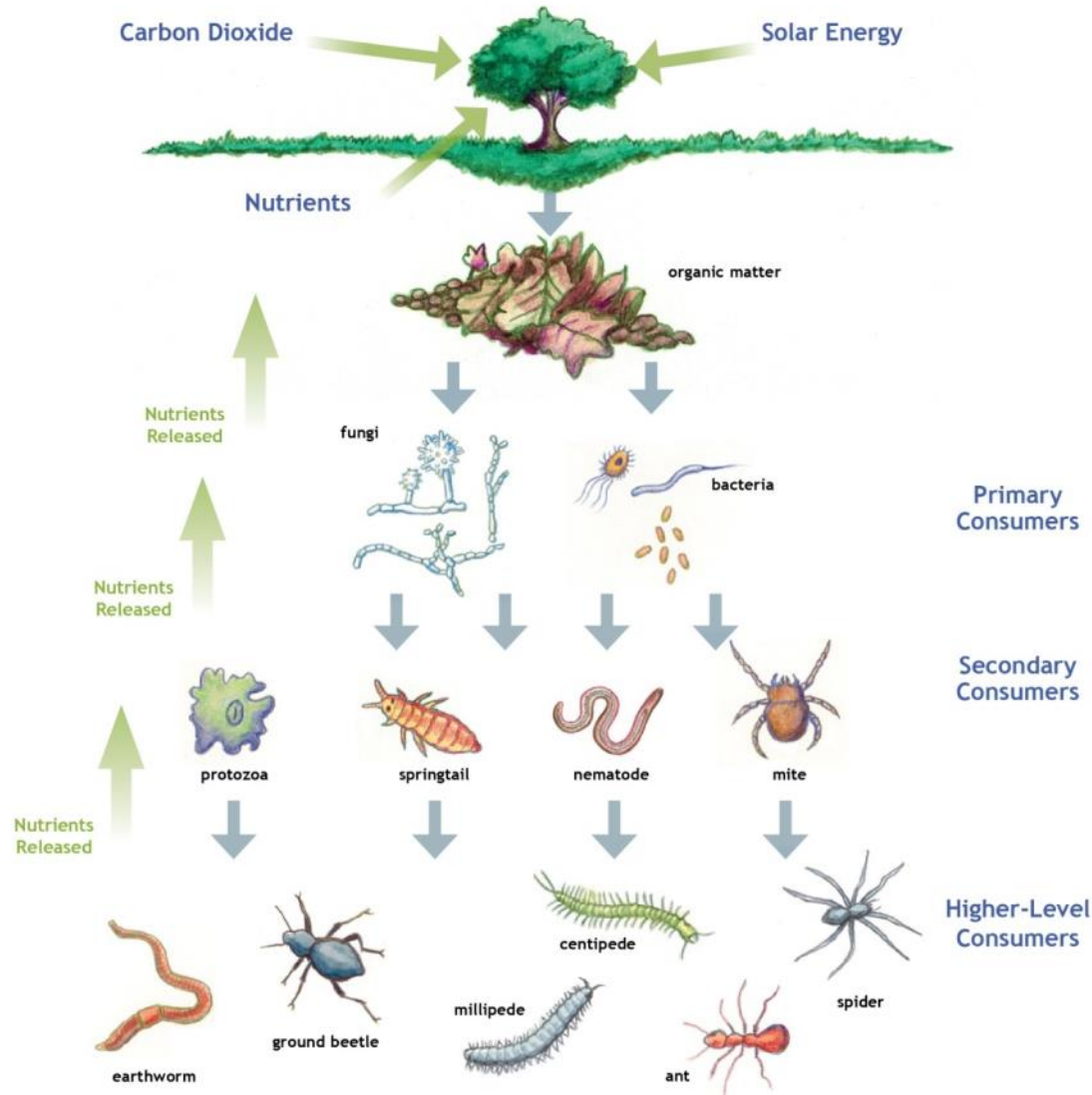




Maintaining Soil Fertility



Strategy: Support a Healthy Soil Food Web



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The Soil Biota

By: [Ann-Marie Fortuna](#) (*Dept. of Crop & Soil Sciences, Washington State University*) © 2012 Nature EducationCitation: Fortuna, A. (2012) The Soil Biota. *Nature Education Knowledge* 3(10):1

A 'biological universe' exists in a gram of soil. Find out how the soil biota within this tiny universe transform energy, create and modify their habitat, influence soil health, and aid in the regulation of greenhouse gases.



In his famous poem, *The Auguries of Innocence*, the poet William Blake wrote:

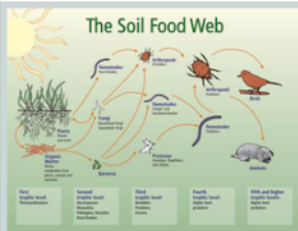
"To see a world in a grain of sand,

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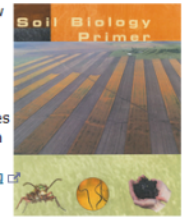
Soil Biology Primer Photo Gallery

Soil Biology

The creatures living in the soil are critical to soil health. They affect soil structure and therefore soil erosion and water availability. They can protect crops from pests and diseases. They are central to decomposition and nutrient cycling and therefore affect plant growth and amounts of pollutants in the environment. Finally, the soil is home to a large proportion of the world's genetic diversity.

Soil Biology Primer

The online Soil Biology Primer is an introduction to the living component of soil and how it contributes to agricultural productivity and air and water quality. The Primer includes chapters describing the soil food web and its relationship to soil health and chapters about soil bacteria, fungi, protozoa, nematodes, arthropods, and earthworms.



The online Primer includes all of the text of the printed original, but not all of the images of the soil organisms. The full story of the soil food web is more easily understood with the help of the illustrations in the printed version. Printed copies of the Soil Biology Primer may be purchased from the Soil and Water Conservation Society www.swcs.org

=> Copyright restrictions: Many photographs in the online Soil Biology Primer cannot be used on other Web sites or for other purposes without explicit permission from the copyright owners. Please contact the Soil and Water Conservation Society at pubs@swcs.org for assistance with copyrighted (credited) images tagged throughout the online Primer.

=> The text, graphs, tables, non-credited photos, and graphics from USDA sources may be used freely; however, please credit the Soil Biology Primer or this Web site.

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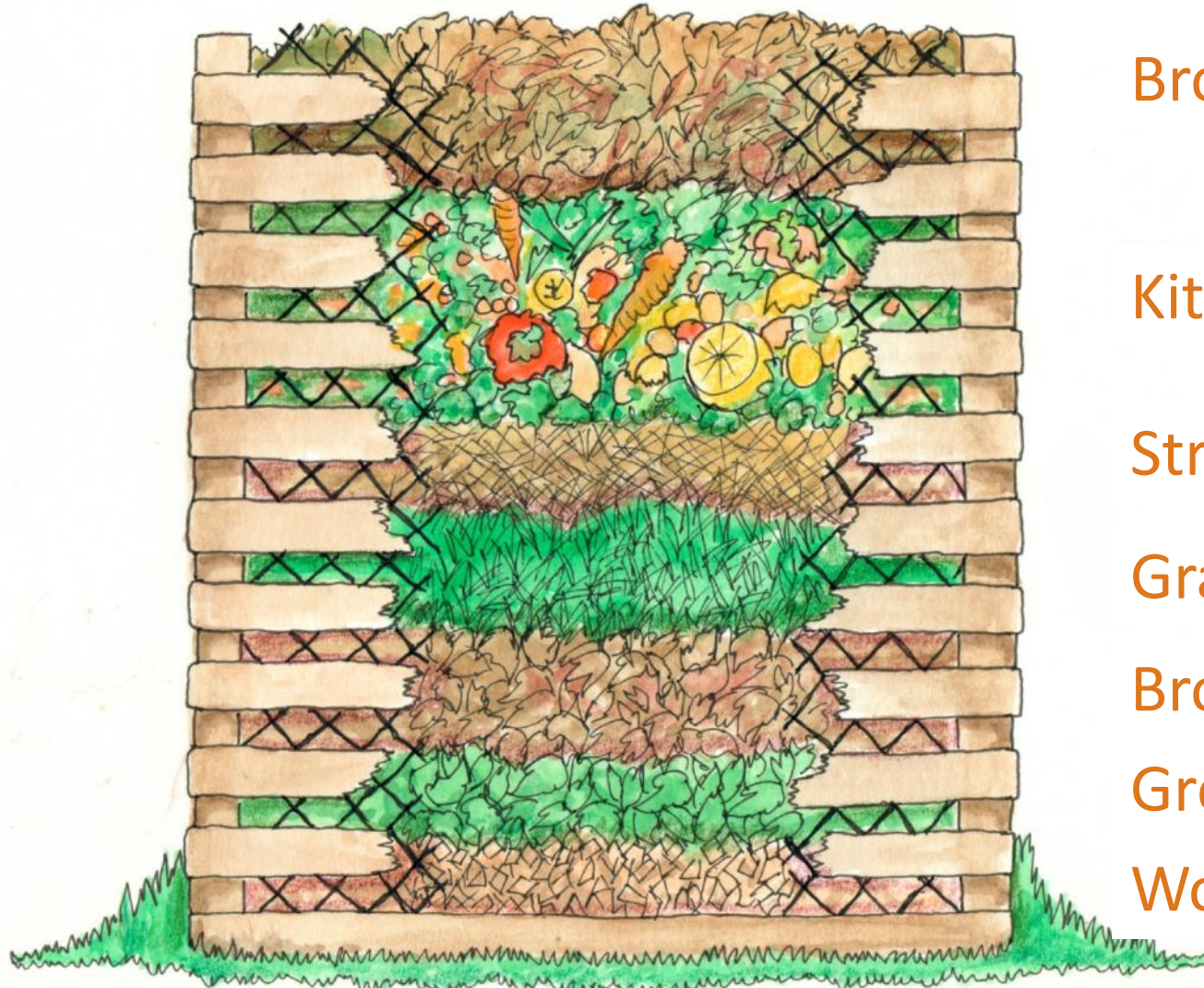
> Printed booklet: Tugel, A.J., A.M. Lewandowski, and D. Happe-vonArb, eds. 2000. Soil Biology Primer. Ankeny, IA: Soil and Water Conservation Society.



How to Protect and Encourage a Healthy Soil Food Web

- Limit soil disturbance.
- Restore overly compacted soils.
- Regularly apply compost or organic mulch.
- Avoid pesticide use that may harm soil biota.
- Plant a diverse garden.
- **Grasscycle:** *Use a lawn mower that returns mulched lawn clippings to the soil.*
- Allow plant materials to decompose in the garden.

Strategy: Convert Greenwaste into Compost



Brown leaves

Kitchen scraps

Straw

Grass clippings

Brown leaves

Green leaves

Wood chips



Example Compost Bins





Vermicomposting

- Make a worm bin.
- Drill holes.
- Add bedding material.
- Add earthworms.
Note: non native
- Add food waste.
- Cover bin.
- Harvest.





Maintaining Soil Fertility





Strategy: Use Local-made, Natural Mulches

- Use local-made mulch.
- Conserves water.
- Suppresses weeds.
- Insulates roots.
- Prevents compaction.
- Prevents erosion.
- Adds organic matter.





Example: Local-made, Organic Mulches





How to Apply Mulch

- Remove all weeds.
- Spread about 3 inches deep.
- Pull back from plant base.
- Avoid mulching seedlings.
- Reapply as needed.





Strategy : Use Green Manure Cover Crops





Appropriate Fertilizer Use

- **Conduct a soil test first.**
- **Use only when needed.**
- **Choose renewable, natural fertilizers.**
- **Select single nutrient fertilizers.**





Appropriate Fertilizer Use

- **Add only the amount recommended.**
- **Apply only to the soil.**
- **Avoid areas near streams or drainage ways.**





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