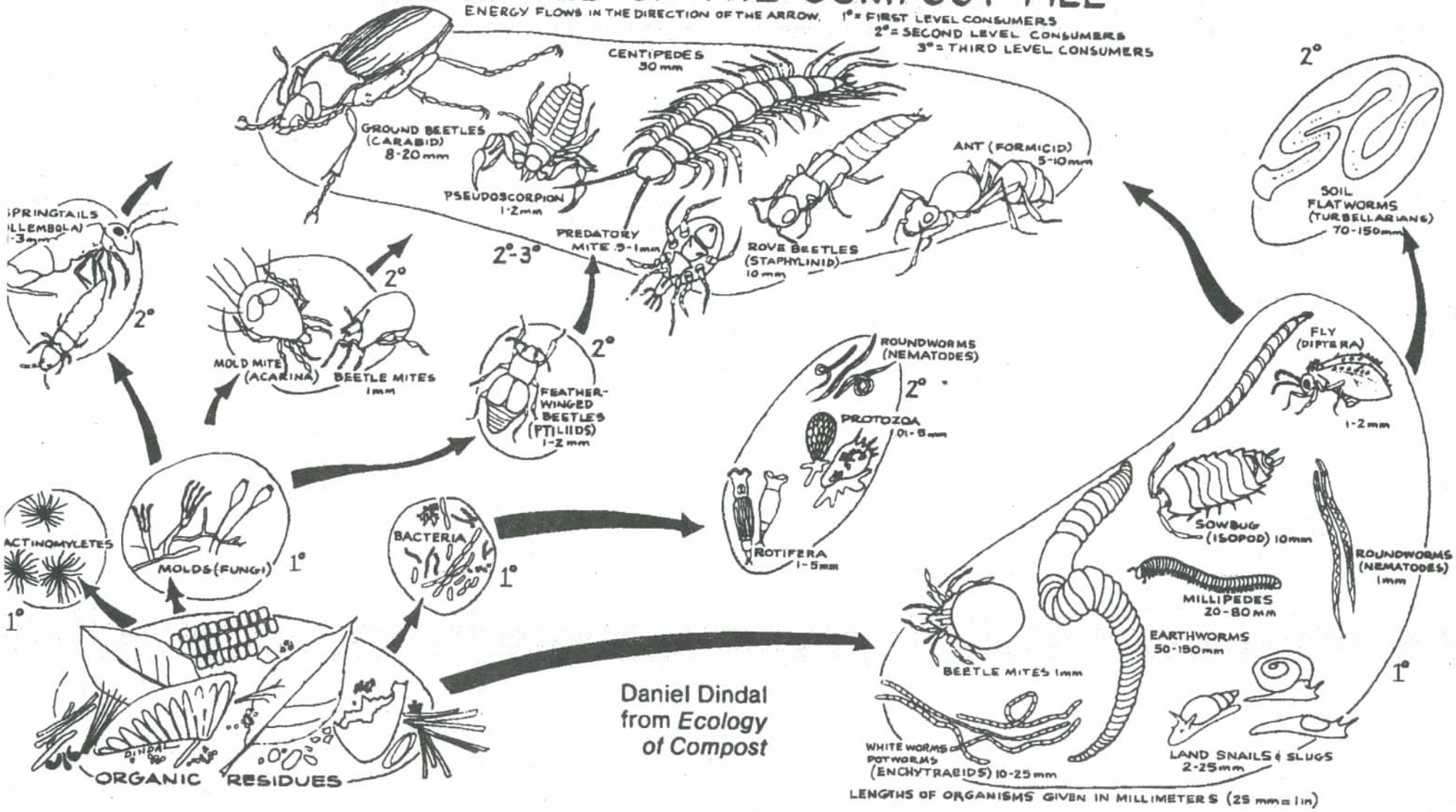
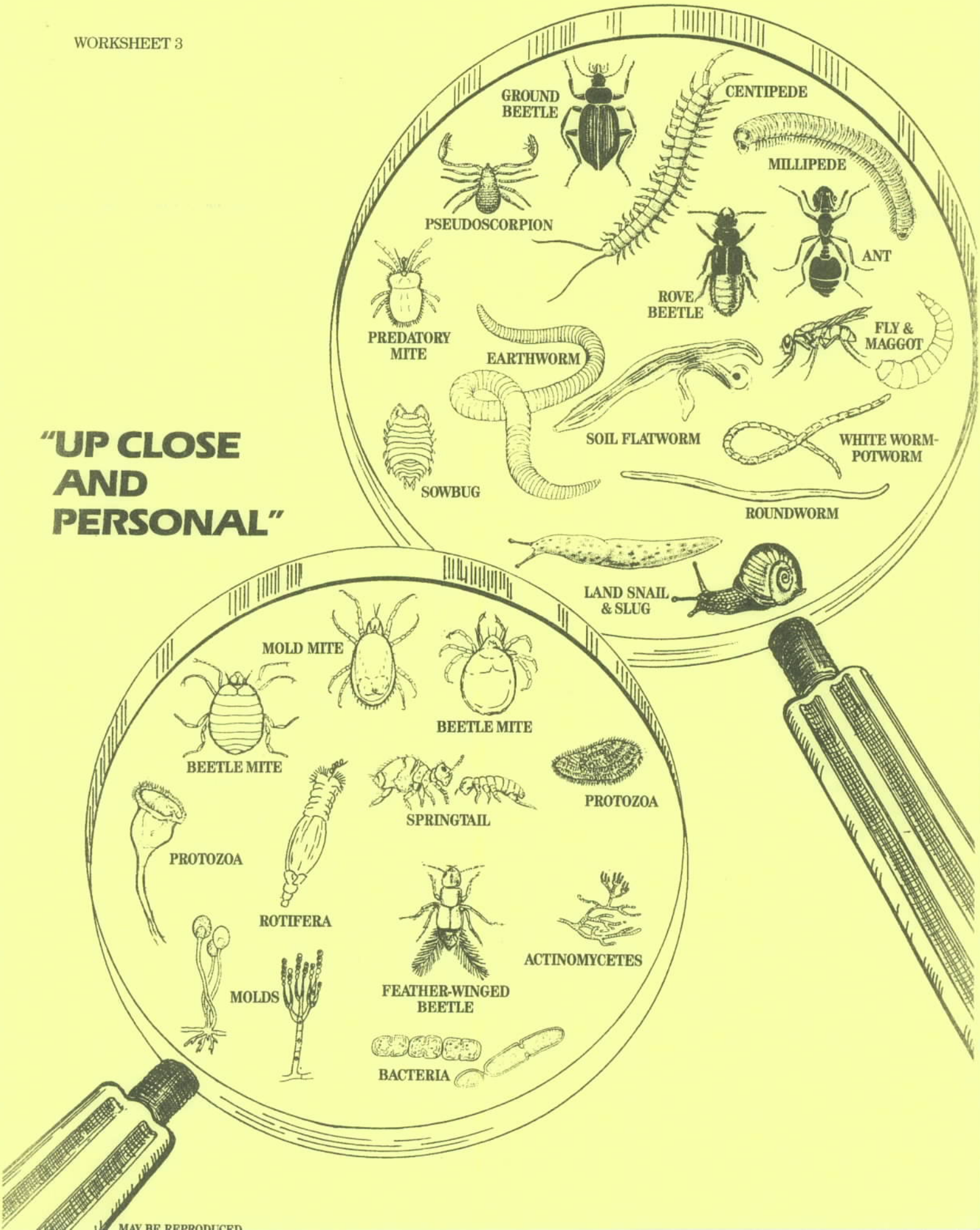
FOOD WEB OF THE COMPOST PILE



Daniel Dindal
from *Ecology of Compost*

WORKSHEET 3

"UP CLOSE AND PERSONAL"



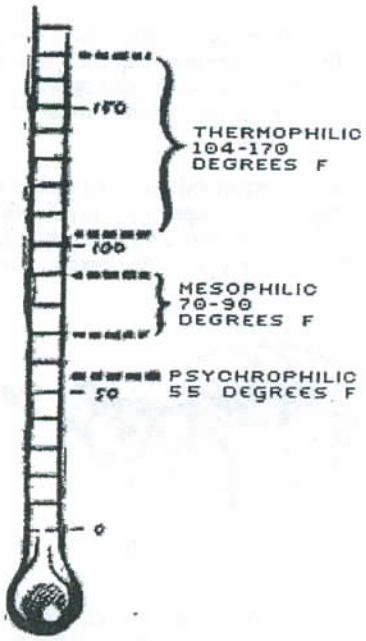
Microbes are a wide variety of organisms and are naturally present in all organic matter.

Primary Consumers are organisms that eat organic residues.

chemical decomposers—microorganisms

The most numerous organisms in a compost pile are **bacteria.** Although bacteria are too small to be seen individually, the effects of their work are easy to detect. Bacteria generate the heat associated with composting, and perform the primary breakdown of organic materials, setting the stage for larger decomposers to continue the job.

Bacteria don't have to be added to the compost pile. They inhabit virtually every surface and enter the pile on every single bit of organic matter. Initially their numbers may be modest, but given the proper conditions (proper moisture and aeration, a favorable balance of carbon and nitrogen, and lots of surface area to work on) bacteria can reproduce at a remarkable rate.



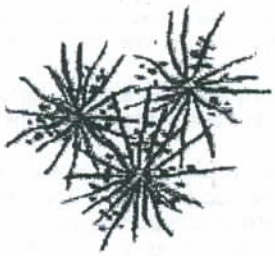
Many species of bacteria are at work in the compost pile. Each type thrives on special conditions and different types of organic materials. Even at temperatures below freezing, some bacteria can be at work on organic matter. These **psychrophilic** bacteria (a grouping of bacterial species that includes all those working in the lowest temperature range) do their best work at about 55°F, but they are able to carry on right down to 0°F. As these bacteria eat away at organic materials they give off a small amount of heat. If conditions are right for them to grow and reproduce rapidly, this heat will be sufficient to set the stage for the next group, the mesophylic bacteria, or middle temperature range bacteria.

Mesophilic bacteria thrive at temperatures from 70°F to 90°F, and just survive between 40°F to 70°F, and 90°F to 110°F. In many compost piles, these efficient mid-range bacteria do most of the work. However, given optimal conditions, they produce enough heat to kick in the real hot shots, the thermophilic, or heat-loving bacteria.

Thermophilic bacteria work fast, in a temperature range of 104°F to 170°F. In a matter of days they turn green, gold, and tan organic material into a uniform deep brown.

In all of this work, the bacteria are not alone—though at first they are the most active decomposers. Other microbes, fungi, and a host of invertebrates take part in the composting process. Some are active in the heating cycle, but most organisms prefer the cooler temperatures. They proliferate in cold compost piles and along the cooler outer edges of hot piles or when hot piles start to stabilize at lower temperatures.

Actinomycetes are a type of primary decomposer common in the early stages of the pile. Actinomycetes produce grayish, cobwebby growths throughout compost that give the pile a pleasing, earthy smell similar to a rotting log. They prefer woody materials and survive a wide range of temperatures and conditions.



actinomycetes

fungi

Fungi also perform primary decomposition in the compost pile. Fungi send out thin mycelial fibers like roots, far from their spore-forming reproductive structures. The most common of the reproductive structures are mushrooms, which sometimes pop up on a cool pile. Though fungi are major decomposers in the compost pile, fungal decomposition is not as efficient as bacterial decay. The growth of fungi, even more than that of bacteria, is greatly restricted by cold temperatures. Since they have no chlorophyll, fungi must obtain their food from plants and animals. Parasitic fungi exist on living plants or animals. Most fungi are saprophytic, living on decayed vegetable and animal remains.

Secondary Consumers are organisms that eat primary consumers.

physical decomposers—larger organisms

Besides the many types of bacteria and fungi, a multitude of larger organisms add diversity to the compost pile. Many of them feed on dead bacteria and their by-products as well as each other. The following is just a sampling of some of the more common organisms in this diverse group of physical decomposers:

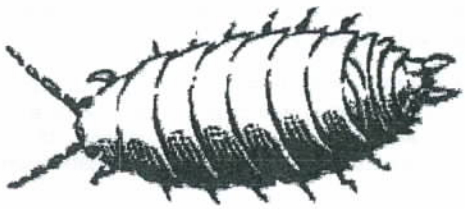
Nematodes, or roundworms, are the most abundant invertebrates in the soil. Typically less than one millimeter in length, they prey on bacteria, protozoa, fungal spores, and each other. Though there are pest forms of nematodes, most of those found in soil and compost are beneficial.

nematodes

mite

Fermentation mites, also called mold mites, are transparent-bodied creatures that feed primarily on yeast in fermenting masses or organic debris. Literally thousands of these individuals can develop into a seething mass over a fermenting surface. As a result, they often become pest species in fermenting industries, such as wineries and cheese factories. They are not pests in the compost pile.

springtail



sow bug

Springtails, or collembula, along with nematodes and mites, dominate in numbers among the soil invertebrates. They are a major factor in controlling fungi populations. They feed principally on fungi, but also on nematodes and small bits of organic detritus.

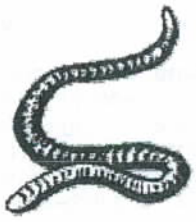
Wolf spiders are truly "wolves" of the soil and compost communities. They don't build webs, but run freely, hunting their prey. Depending on the size of the spider, their prey can include all sizes of arthropods— invertebrate animals with jointed legs and segmented bodies.

Centipedes are frequently found in soil and in compost communities. They prey on almost any type of soil invertebrate near their size or slightly larger.

Sow bugs feed on rotting woody materials and highly durable leaf tissues, such as the veins comprised of woody xylem tubes. Sow bugs that roll up like an armadillo are known as pill bugs or roly-polys.

Ground beetles have many representatives lurking through litter and soil spaces. Most of them feed on other organisms, but some feed on seeds and other vegetable matter.

Redworms play an important part in the break-down of organic materials and in forming finished compost. As worms process organic materials, they coat the material with a mucus film that binds small particles together into stable aggregates and helps to protect nutrients from being leached out by rain. These stable aggregates give soil a loose and well-draining structure.



redworm

Secondary Consumers - organisms that eat primary consumers. They include:

Protozoa are one-celled microscopic animals. They are found in water droplets in compost but play a relatively minor role in decomposition. Protozoa obtain their food from organic matter in the same way as bacteria do but also act as secondary consumers ingesting bacteria and fungi.

Nematodes or *roundworms* , are the most abundant invertebrates in the soil. Though there are pest forms of nematodes, most are beneficial. They prey on bacteria, protozoa, fungal spores and each other.

Mites are the second most common invertebrates found in compost. Some can be seen with the naked eye and others are microscopic. They have eight leg-like joint appendages. Some feed on yeast in fermenting materials, while others feed on nematodes, eggs, insect larvae and other mites.

Springtails are extremely numerous in compost. They are very small wingless insects and can be distinguished by their ability to jump when disturbed. They feed principally on fungi, although they also eat nematodes and small bits of organic detritus.

Tertiary Consumers are organisms that eat secondary consumers.

Centipedes are fast moving predators found mostly in the top few inches of the compost heap. They have formidable claws behind their head, which possess poison glands that paralyze small red worms, insect larvae, newly hatched earthworms, and spiders.

Draw an **energy pyramid** for compost organisms.

Names of organisms are required, additional drawings are optional

Soil Microorganisms

Microbes are a wide variety of organisms and are naturally present in all organic matter. This page will help you to learn more about the various organisms found in soil and compost.

Primary Consumers - get their energy from organic residue in soil or compost.

Bacteria

These 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 associated with composting. Bacteria are single-celled and structured as either rod-shaped bacilli, sphere-shaped cocci or a spiral-shaped spirilla. Bacteria don't have to be added to the compost. They are present virtually everywhere, and enter the pile on every single bit of organic matter. Many types of bacteria participate in the composting process, thriving at different temperatures and on different materials.

Psychrophiles are aerobic bacteria that thrive on low temperatures of approximately 55 degrees Fahrenheit and will slowly decompose compost even at 0 degrees Fahrenheit.

Mesophiles are most active at the 70-90 degrees Fahrenheit temperatures. Those aerobic bacteria do most of the work.

Thermophiles quickly raise the temperature in the pile to levels that kill most weed seeds.

Actinomycetes resemble fungi but actually are filmentous bacteria. Like other bacteria, they lack nuclei, but they grow multicellular filaments like fungi. In composting they play an important role in degrading complex organisms such as cellulose, lignin, chitin, and proteins. Their enzymes enable them to chemically break down tough woody materials. Actinomycetes form long, thread-like branched filaments that look like grey spider webs stretching throughout compost, and give the pile a pleasing earthy smell.

Fungi

These include molds and yeasts, which lack chlorophyll, the green pigment that allows most plants to convert sunlight into carbohydrate. Most fungi are classified as saprophytes because they obtain nutrients from dead plant matter. 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. Fungi species are numerous during both mesophilic and thermophilic phases of composting.

Invertebrates

Sow bugs are fat bodied crustaceans with delicate plate-like gills along the lower surface of their abdomens, which must be kept moist. They feed on woody materials and durable leaf tissues.

Earthworms play an important role in breaking down organic materials and stabilizing finished compost. They are constantly tunneling and feeding on dead plants and decaying insects during the daylight hours. Their tunneling aerates the compost and enables water, nutrients and oxygen to filter down. They coat organic materials with a mucus-like film that binds small particles together and protect nutrients from leaching.

Millipedes are slower and mory cylindrical than centipedes and have two pairs of appendages on each body segment. They feed mainly on decaying plant tissue but will eat insect carcasses and excrement.

Handout, continued

Natural Pest Control, Tricks and Traps!

- Hand picking insects and other pests off plants is often the easiest and best defense. If you don't like to touch them, a pair of rubber gloves are inexpensive at the hardware store.
- Plant a little extra for the bugs so they can share your bounty!
- A soapy water solution: 1 tablespoon of liquid dishwashing SOAP (not detergent) in 1 quart of water. Put in a spray bottle. Good for aphids and whiteflies. Rinse plant after it has set for an hour or more.
- Use a blender to prepare a mixture of 1 hot pepper, 2 cloves of garlic and 4 cups of water. This can be strained and sprayed on infested plants. It won't hurt the plant and will rinse off food before eating.
- A jar lid, saucer or other shallow container settled into the soil then filled with beer will attract and drown many pests, especially earwigs and slugs.
- A short section of old hose or a rolled up newspaper will attract nighttime marauders like earwigs. These can be collected and moved well away from the garden in the morning.
- A board laid on the soil with a little bit of crawl space is good for collecting snails and slugs. In the morning they can be gathered and carried far from the vegetable garden and released.
- Birds eat a lot of insects. Providing a bird bath may attract them. A bird house or two (placed where cats can't bother them) will encourage birds to stay and pick off insects for you.
- Lizards, frogs and toads are also great insect catchers. Make them feel welcome. If they have a favorite place in a pile of pots, on a pile of rocks, or in a water trough, let them claim it as home and don't disturb them.
- There are flowering plants called insectaries which attract beneficial insects to your garden. Ask your group leader where you can learn about these. Plant some!
- Nurseries sell ladybugs and sometimes praying mantis egg cases. These beneficial insects can be released into the garden to help control less welcome insects. It is fun and educational to see these insects, but be warned (before spending a lot of money on them) sometimes they just leave!

Getting and Keeping "Good" Insects in Your Garden

I. What role do "good" insects play?

food source
Predators of "bad bugs"
Parasites of "bad bugs"
Pollinators
Decomposers
Herbivores of weed plants

II. General Tips for Attracting Good Bugs

1. Include plants with lots of nectar-producing flowers also known as insectary plants. Many of the insects we consider "good" consume nectar and pollen when they are not eating bad bugs.

2. Choose plants with complementary flowering periods so that you have something flowering as much of the year as possible.

3. Do not eradicate "bad bugs" with insecticides unless your interest is in maximum unmarred yield on a single crop.

II. Easy-to-Grow Insectary Plants for the Sacramento Valley

Mint Family Plants
- peppermint
- oregano
- marjoram
- lemon balm
- basil that has gone to flower
- catnip
- sweet woodruff

Sunflower or Daisy Family Plants
- asters
- sunflowers
- Shasta daisies
- yarrow
- zinnias
- cosmos

Carrot Family Plants
- fennel
- carrots that have gone to flower
- cilantro
- toothpick weed

Native Buckwheat Genus (Eriogonum)
- California buckwheat
- St. Catherine's lace
- Santa Cruz Island buckwheat

californica
fasiculatum

Others
- buckwheat, annual (non-native)
- broccoli and related vegetables that have gone to flower
- coyote brush
- ceonothus sp.
- willow sp.