Life Beneath Your Feet

Soil isn’t just dirt. It’s a complex environment that is home to all kinds of microorganisms. Did you know there are millions and millions of organisms that make soil their home?

WHERE DO SOIL ORGANISMS LIVE?

The organisms of the food web are not uniformly distributed through the soil. Each species and group exists where they can find appropriate space, nutrients, and moisture. They occur wherever organic matter occurs – mostly in the top few inches of soil (O horizon), although microbes have been found as deep as 10 miles (16 km) in oil wells.

Favorite habitats for soil microbes

Around roots. This is called the rhizosphere. Organisms use the sloughed-off plant cells and the proteins and sugars released by roots.

In litter. Fungi are common decomposers of plant litter because litter has large amounts of complex, hard-to-decompose carbon. Bacteria are abundant in the green litter of younger plants which is higher in nitrogen and simpler carbon compounds. Bacteria and fungi are able to access a larger surface area of plant residue after shredder organisms such as earthworms, leaf-eating insects, millipedes, and other arthropods break up the litter into smaller chunks.

On humus. Humus is the “leftovers” after bacteria, fungi, arthropods and worms have had their fill of plant litter. Fungi are common here because they can make some of the enzymes needed to degrade the hard-to-digest compounds in humus.

On the surface of soil aggregates. Many aggregates (“clumps”) are actually the fecal pellets of earthworms and other invertebrates. Biological activity, in particular that of aerobic bacteria and fungi, is greater near the surfaces of soil aggregates where they can get lots of oxygen.

In spaces between soil aggregates. Those arthropods and nematodes that cannot burrow through soil move in the pores between soil aggregates. Organisms that are sensitive to drying out, such as protozoa and many nematodes, live in water-filled pores.

Did you know?

The reason soil smells “earthy” is because of bacteria called ACTINOMYCETES. These helpful bacteria produce a number of antibiotics that we use.

Credits: Jennifer DeBruyn and Andrea Ludwig

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Where do soil organisms live?

Label the diagram with favorite habitats for soil organisms. (HINT—read the first page of this handout!)
ACTIVITY: Who lives in my soil?

You will be using a Berlese Funnel to collect organisms in soils.

Preparation: Berlese Funnel Set Up

If you don’t have a funnel, use scissors and tape to cut a manilla folder into a half circle and fold this into a cone shaped funnel using tape to hold it together.

Place the funnel inside the ring stand and the strainer inside the funnel at the bottom.

Place a jar half full of water or ethanol or isopropanol under your funnel setup.

Place the light on top of the ring stand so that it will illuminate, but not touch the funnel.

Collect approximately 1-2 cups of soil and leaf litter. Try to find two different samples to compare (e.g. forest floor, meadow, farmer’s field, roadside ditch)

Place the soil and leaf litter into the strainer, being careful not to let it fall through to the alcohol.

Turn the light on and make sure it is not touching the funnel. It should be about 10-15 cm from the funnel.

Allow the litter/soil to dry slowly under the light (1-3 days). Then remove the funnel carefully.

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You can also do this with a 2 L pop bottle!
**ACTIVITY: Who lives in my soil?**

**Day of observation:**
- Pour the contents of the jar into a petri dish for observation.
- Use magnifying glasses and dissecting microscopes to observe. Use forceps to move organisms around.
- What sorts of living things do you see?
- Use the pictures in this handout to identify some of the organisms in your soils.

Draw a picture of and make observations about three of them. Try to identify them! Use pictures, a field guide, or the online key at [http://www.insectidentification.org/insect-key.asp](http://www.insectidentification.org/insect-key.asp)

<table>
<thead>
<tr>
<th>Organism #1</th>
<th>Organism #2</th>
<th>Organism #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of soil sample did I come from?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sketch a picture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What color am I?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many legs do I have?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do you think I move?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHAT AM I???</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Check it out!**
Explore soil microfauna with Terry Tollefson [http://www.youtube.com/watch?v=VuHznlr8af](http://www.youtube.com/watch?v=VuHznlr8af)

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How many?

If you look at the surface layer of soil, you may only see one bird or squirrel. But if you look closely, you’ll find millions and millions of other organisms!

Did you know?

In a single teaspoon of soil, we can find more organisms than there are people on earth!
**Official Name: Tardigrades**

**Size:** 0.3—0.5 mm  
**Movement:** Crawl around on 8 stubby legs  
**Habitat:** Almost everywhere on earth, but particularly lichens and mosses, sediments, beaches, soil  
**Diet:** Moss, algae, bacteria  
**Claim to fame:** Capable of cryptobiosis (reversible state of suspended animation): They can “die” then come back to life! Using this adaptation, they can survive extreme conditions, including temperature (as low as -450°F, and as high as 304°F), dehydration to 1% of their moisture, high doses of radiation, even the vacuum of outer space!

**Learn more about Tardigrades and their adventures in outer space here:** [http://www.youtube.com/watch?v=6H0E77TdYnY](http://www.youtube.com/watch?v=6H0E77TdYnY)

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**Official Name: Rotifers**

**Size:** 0.2—0.5 mm  
**Habitat:** Common in freshwater and moist soil or leaf litter  
**Feeding:** Rotifers have a complete digestive tract. They feed using a ring of cilia around their mouth which move rapidly – they look just like a wheel. They feed on organic matter and unicellular algae  
**Movement:** Their body is telescopic, and they move by expanding and contracting. They have a “foot” and “toe” opposite the mouth, which they use to anchor themselves while feeding  
**Claim to fame:** One of the first organisms discovered by pioneer microscopist Antony van Leeuwenhoek

**See a rotifer in action here:** [http://www.youtube.com/watch?v=PALgTXQOqQo](http://www.youtube.com/watch?v=PALgTXQOqQo)
**SOIL MITES**

**Official name:** Oribatid mites (Arthropods, Arachnids)

**Relatives:** Ticks, spiders

**# of legs:** 8

**Diet:** Leaf litter, fungi, algae, springtails, worms

**Feeding:** “Shredders” Decomposers of dead organic material. They use chewing mouthparts to cut leaves and scrape away rinds.

**Habitat:** Soil mites can’t burrow, so they use tunnels made by other animals.

**Claim to fame:** Mites are the “first responders” of decomposers: they chew leaf litter into smaller pieces, making it more available to worms and bacteria and fungi.

![Soil Mite](image)

**Official name:** Collembola (Arthropods, Hexapods)

**Size:** 1-5mm

**# of legs:** 6

**Diet:** Leaf litter, decaying plant matter, fungi and bacteria

**Habitat:** Any place that is damp. Springtails hate to dry out!

**Claim to fame:** Springtails get their name because they have an forked tail-like organ called a furcula below their abdomen that helps them “spring” away from predators.

![Springtail](image)

**SPRINGTAILS**

![Springtail](image)

**Did you know?** A springtail can jump up to 20 times its body length in a single leap!
NEMATODES

Also known as: Roundworms

**Size:** Nematodes have a wide range of sizes and lifestyles. Range in size from 0.05—1 mm

**Habitat:** Just about everywhere!

**Feeding:**
- Bacterial-feeders
- Fungal-feeders
- Root (plant pathogens)
- Predatory (eat other nematodes and protozoa)
- Omnivores

Mouth parts of a bacteria-feeding nematode

A predatory nematode consumes a smaller nematode. 
*Credit: Kathy Merrifield*

A fungal-feeding nematode with a distinct stylet for piercing hyphae.

Claim to fame: Some are parasites, and others feed on the parasites. Some cause plant diseases, and some help prevent plant diseases!

Size: 1 inch to 2 yards

Diversity: >7000 species identified

Feeding: Decomposers of dead organic material

Habitats: Most temperate soils, some tropical soils

§ Epigeic species live in surface plant litter and are adapted to variable moisture conditions

§ Endogeic species live in the upper soil layers and feed on soil and organic matter; do not make permanent burrows

§ Anecic species (e.g. “night crawlers”) inhabit permanent burrows that can extend several meters.

Claim to fame: Earthworms play a key role in soil’s structure—they mix organic matter into soil and excrete pellets (casts) that help with soil aggregation.

EARTHWORMS

Juvenile and adult earthworms

*Pontoscolex corethrurus*

Photo credit: Tufetsky

Earthworm borrow filled with organic material

Photo credit: Eriunas, DCF

Check it out!

There are many types of earthworms

http://youtu.be/qS8zyGlkN2c