

Illustrations by Taina Litwak

## The Soil Is

## ALIVE!

The ground beneath your feet is constantly changing and full of **living creatures**.

By Mary Hoff

IT'S A SUNNY SUMMER DAY. When you step outside, you're surrounded by signs of life: leaf-filled trees, glowing green grass, scampering squirrels, swooping birds, buzzing bees. But that's not all! If you look down, you might see another super-important part of nature: the soil beneath your feet. Soil is the root of all life. And it's far from "just dirt." Soil is a rich and varied substance, with an amazing past, a very important present, and a future that depends on us. Let's take a look!

*A soil rotifer and a soil mite, seen here at an enlarged scale, are among the microscopic animals that live in and nourish soil.*

## Layered by Time

Soil varies as you dig down. That's because as time passes and things get added, moved, and taken away, layers form. The layers of a soil are called *horizons*.

### Fun Fact

Most living things on Earth live in the soil.

\* **DECOMPOSING MATTER**—mostly formerly living things such as plants and animals

\* **TOPSOIL**—mainly minerals, but also some formerly living things

\* **SAND AND SILT**—often found in forests and in older soils

\* **SUBSOIL**—minerals that filtered down

\* **PARENT MATERIAL**—weathered rocks

## Not Just



Soil plays an important role in our life and in the life of all living things. It gives plants what they need to grow. It helps recycle waste and dead things into materials that can support new life. It holds and cleanses water. It forms a surface for our houses, highways, and us. And it provides a home for millions of living things.

Scoop up a handful of soil and hold it close to your face. What does it feel like? What does it smell like? What does it look like?

Soil is a mix of minerals, organic matter (formerly living things), air, and water. In Minnesota, rocks and other materials carried by glaciers 11,000 to 14,000 years ago form the basis for our soils. But a lot has happened since then. Water, wind, and roots have pulverized the rocks. Wind, rain, people, and other living things have added more ingredients, mixed things up, broken things down, and moved things around.

Gravity has moved soil particles down slopes. You can do a lot in 11,000 years!

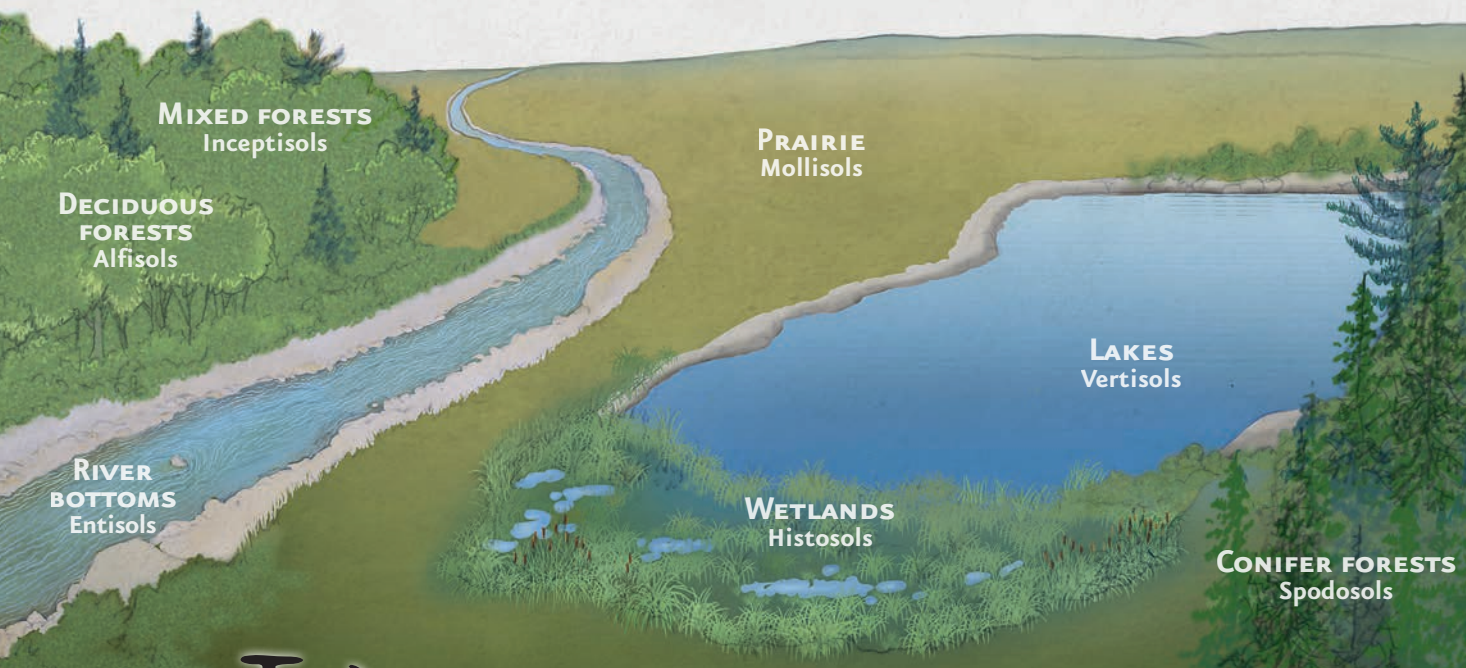
Because soil ingredients vary from place to place, the texture, color, and structure of soil does, too. A soil might feel coarse like sand, soft like silt, or sticky like clay. Depending on the rocks and minerals that make it up, it might be black, red, white,

### Fun Fact

Soil porosity refers to the space between soil particles, which are filled with various amounts of water and air.

brown, or orange. It might hold lots of food for plants or be like an empty pantry. The particles might be loose, with lots of space for air and water in between, or they might be packed so tightly together that you need a hammer to break them apart.

❖ **CATEGORIES OF SOIL** are determined by where they formed. Landscapes change over time, so places may look different now than they did when the soil formed.



# Soil TYPES

Just as we can group living things into categories—mammals, birds, insects, and so on—scientists group different kinds of soil into categories, called *orders*.

All of the soils in the world fall into 12 orders. Minnesota is home to seven orders:

**ALFISOLS** form in forests. They have lots of nutrients. They often are gray or brown and stay moist in summer.

**ENTISOLS** form in river bottoms. Their parent material is mainly sand.

**HISTOSOLS** form from dead plants in wetlands. They are mainly found in

northern Minnesota and are sometimes called *peat* or *muck*. They are good for growing sod and vegetables. **INCEPTISOLS** form in forests that contain both conifer and deciduous trees. You might find them in the parts of Minnesota that were once

pine forests and are now largely aspen.

**MOLLISOLS** form in prairies. The top layer is dark and full of nutrients for plants.

**SPODOSOLS** form under conifers. They are white on top and red underneath. They are not good for growing crops.

**VERTISOLS** form under lakes as sediments settle to the bottom. They are dark on the top layer with a gray layer underneath. Farmers grow sugar beets, sunflowers, and small grains in these soils.



## Meet Our State Soil

You might know that Minnesota has a state bird, a state fish, and a state mammal. But did you know we also have a state soil? It's called Lester. (See Minnesota Profile, May–June 2013.)

Lester is found in central Minnesota. It began its life as rocks and pebbles carried by a glacier from north of what is now Lake Winnipeg in Canada some 12,000 years ago. As the glacier moved south, it deposited gravel, sand, and other materials along its way. After it melted, a few plants began to grow in the open space it left behind. When those plants died, they left behind organic material that broke down and provided nutrients to more plants. Gradually forests and prairies took over. As the surface of the land changed, the soil beneath it did, too. Water and roots broke up the rocks and pebbles. Water dissolved some of the minerals and carried them downward. More organic material accumulated in the upper parts. The layers that make up Lester today gradually took shape.

Lester has traits of both Mollisols and Alfisols. It is great for growing crops such as corn, soybeans, and alfalfa. The food you had for breakfast today just might have had its start in Lester soil!



# A Living THING

At first glance, soil might seem really ... dead. But healthy soil is teeming with life.

If you've ever seen a hole in your yard or places where it looks like a creature bumped up the surface from below, you've seen evidence of some of soil's larger inhabitants—moles, woodchucks, turtles, and toads. And if you've dug a hole yourself, you've probably seen earthworms, insects, and other creatures that live in the soil.

Each living thing in soil has a “job” to do that helps keep the soil ecosystem healthy. From making tiny tunnels through the soil that allow water to trickle through, to breaking down dead things, to capturing the sun's energy, to building up new life by nourishing each other, life forms of all sizes are a vital part of healthy soil.

Smaller than the eye can see are microbes such as bacteria, viruses, algae, fungi, and protozoa. These organisms form the foundation of life in the soil. Some break up ma-

terials produced by plants and animals into chemical building blocks other living things can use to grow. Some help plants obtain the nutrients they need. Some capture the sun's energy. Some serve as food for each other and for larger forms of life. Some give the soil its soft texture and earthy fragrance.

Tiny but visible are invertebrates such as mites, ants, spiders, centipedes, and worms called nematodes. Some of these animals eat mainly dead things. Others eat living plants or animals. Yet others thrive mainly on fungi or bacteria.

Even more visible are earthworms and larger insects. These creatures create small tunnels through the soil and mix it up. This allows air and water to filter through and helps keep the soil healthy.

Toads, moles, and other bigger animals live at least part of their lives in the soil as well. The soil protects them from cold and predators.

## Microscopic Soil Workers

Some of the smallest living things in soil have big jobs. Here are three tiny but mighty soil friends:

**RHIZOBIA.** Some bacteria that live in soils get along so well with plants that the bacteria actually live inside the root cells of the plants. The bacteria, called *rhizobia*, trap nitrogen from the air and share it with the plant, which needs nitrogen to grow. The plant in turn feeds the bacteria sugars they need for energy.

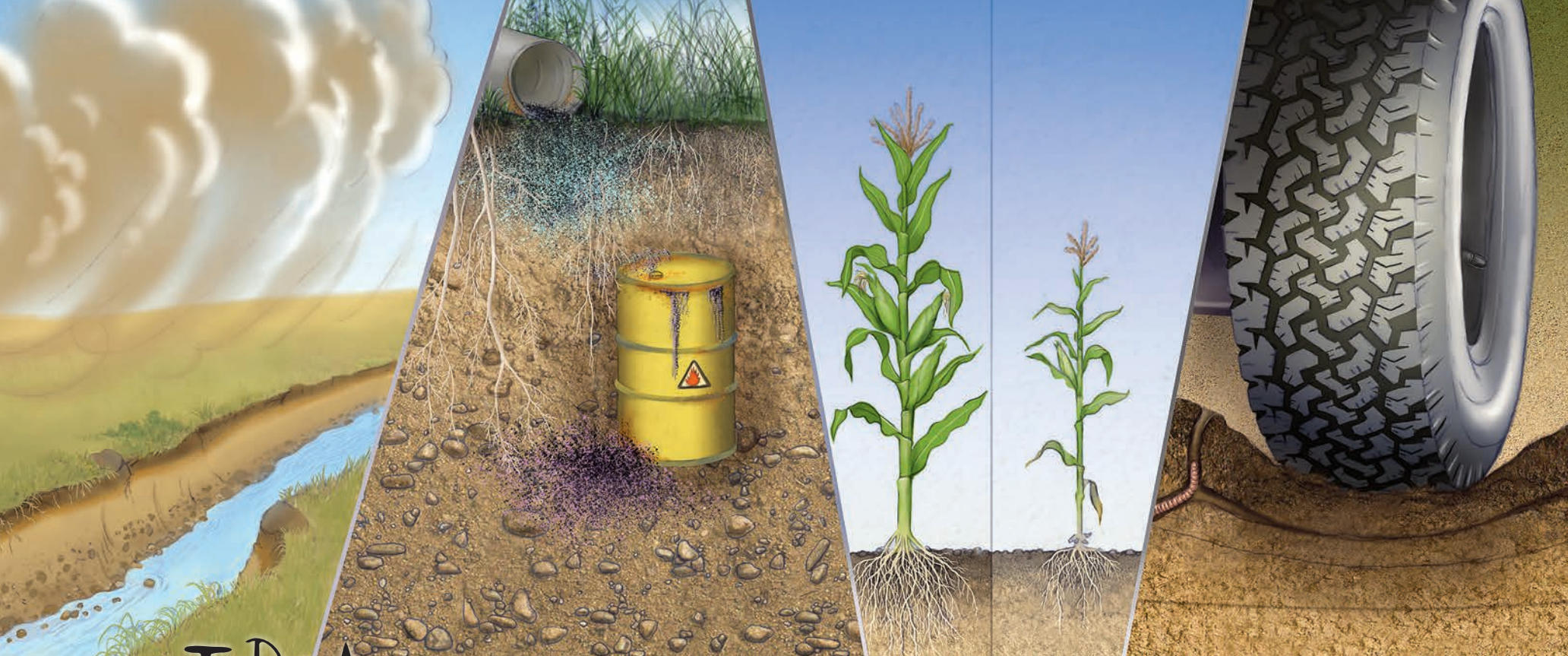


**NEMATODES.** *Nematodes*, also known as *roundworms*, are much tinier than a grain of rice. A single spoonful of soil might be home to hundreds of nematodes. They eat bacteria and fungi found around them in the soil and provide food for other living things, including plants.



**PROTOZOA.** These one-celled animals come in three kinds. *Ciliates* have tiny hairs all over their body that they wiggle to move about. *Flagellates* have one or more long tails that propel them. *Amoebas* ooze out “fake feet” known as *pseudopods* and use them to pull themselves around. Protozoa eat dead things, bacteria, fungi, and sometimes each other. They help keep nutrients available for other living things and bacteria from becoming too abundant.





# Soil THREATS

Because soil is largely out of sight, it's easy to assume that we don't need to take care of it. But we do! Many things we do can harm soil if we're not careful.

**EROSION.** It's natural for wind and water to move soil from place to place. But when people remove plants from the soil's surface to grow crops or harvest trees or build buildings, wind and water can quickly strip large amounts of soil from an area and send it downwind or downstream to harm other places.

**POLLUTION.** Sometimes people deliberately dump chemicals into the soil to get rid of them. Sometimes people accidentally contaminate soil with

pollutants. And sometimes soil is polluted by chemicals as a side effect of things we do on purpose, such as spreading anti-icing chemicals on highways in winter. These practices can kill soil life and make the soil unsuitable for growing plants. The chemicals can also seep down through the soil and contaminate groundwater we use for drinking and watering crops.

**NUTRIENT LOSS.** When we grow plants in soil but then remove them rather than letting them decompose, the soil may lose the nutrients needed to support more plant life.

**COMPACTION.** Heavy things such as trucks and cars can damage soil by squishing all of the spaces between particles. Plant roots and microbes use those spaces to grow and to get to nutrients, air, and water.

### Fun Fact

If we don't protect them from erosion, farm fields can lose 2 tons of soil per acre (an area the size of a football field) in a single year.



## BE a Soil Saver!

You can take actions that will help soil stay healthy and in place. Here are a few ideas:

- ✱ If you dig a garden, cover the soil with mulch to keep it from washing or blowing away.

- ✱ Encourage your family to buy food that is produced on farms that take care of their soil.

- ✱ Don't waste food. Soils work hard to produce the food we eat. When you throw food away, you are throwing away that hard work!

- ✱ Don't dump wastewater or other chemicals onto the ground.

- ✱ Share what you've learned about soil with other people so they will want to take care of it, too.

**TEACHERS RESOURCES.** Find a Teachers Guide and other resources for this and other Young Naturalists stories at [mndnr.gov/young\\_naturalists](http://mndnr.gov/young_naturalists).



## Make Your Own SOIL

Did you know you can make your own soil using grass clippings, fallen leaves, and scraps from your kitchen? Here's how:

1. Get permission to use an outdoor space about as big as a hula hoop. If you can, put a small fence around it.
2. Gather dead grass clippings and fallen leaves from outdoor spaces and put them in a pile about 6 inches high.
3. Add vegetable and fruit peelings, eggshells, and other scraps from the kitchen—but not meat or dairy products.

4. Add more outdoor plant materials on top, along with a shovelful of soil to introduce decomposers.

5. Once or twice a week, mix things up with a shovel or pitchfork. Keep adding new layers as materials become available. Bury kitchen scraps in the middle when you add them.

Gradually the plant materials will turn into a rich, dark soil called *compost*. You can use the compost to grow new vegetables or other plants. (V)