

Genre Informational Text

Essential Questions

How are different creatures connected together in natural cycles? How are you connected to those cycles?

A Handful of Dirt

by Raymond Bial

Soil is everywhere. In the country, farmers plow the soil of their sprawling fields. In the city, people spade garden patches in their backyards. The sprawling prairies grow in the soil, as do deeply rooted forests with their high canopies of branches overhead. Even the drifting sands of the deserts hold enough soil to sustain cacti and succulents. The grass and trees in yards and neighborhood parks are rooted in soil. Your house or apartment is built upon the soil, as are sidewalks and streets. Soil has settled at the bottoms of lakes, rivers, and oceans, and in the crevices of all but the highest mountain peaks. There is soil everywhere, both in far-off places and right under your feet.

Soil can be found all over the Earth; on the forest floor (top left); in the hot desert (top right); beneath the tall prairie grass (bottom left); under flowing rivers (bottom right).





Waves persistently crashing on the shores of this lake have worn most of the stones on the beach into sand.

Without soil there would be no life on Earth. We eat vegetables and fruit, as well as animals that feed on the grasses and grains grown in the soil. We make clothes from cotton, wool, and many other products that trace their roots back to the soil. Soil is as essential as the elements of water and air and as the energy of the sun.

Soil is made up of organic and inorganic—living and nonliving—ingredients. The inorganic minerals found in soil—clay, silt, and sand—began as rocks that have been worn down by wind and water over thousands of years. Rocks break apart when water collects in their cracks, then freezes and expands. Streams and rivers also wear down rocks, just as the ocean waves over time grind large stones into grains of sand on the beach.

Soil is also made up of organic materials that were once alive. If you pick up a handful of soil, you will be holding invisible bits of rotted leaves and grass and fragments of dead insects. The grasses and wildflowers of the prairies feed on the remains of plants that have died, just as the forest floor is covered with dead leaves that become humus—a dark, fragrant substance that feeds the trees reaching high into the sky. Earthworms, as well as bacteria and other small creatures, munch on this plant and animal matter and turn it into vital soil ingredients. Humus helps to stick crumbs of soil together, almost like glue, and enables it to hold water like a sponge.



Enriched with bits of leaves and other plant matter, this humus provides most of the nutrients needed by flowers, vegetables, and trees.



Silently falling from the trees, autumn leaves collect on the forest floor and gradually turn into humus.

Soil may not seem to be alive, but, amazingly, most of the wild creatures of the world live in the soil. These living things range in size from microscopic bacteria that are invisible to the naked eye to wriggly earthworms up to six inches long, as well as snakes and burrowing mammals that spend at least part of their lives underground. They are more abundant and varied than the species of the tropical rain forests and the coral reefs of the South Seas combined. A single acre of land may provide food and shelter for a million ants, two hundred thousand mites, and four thousand worms.

Beneath the surface, millions of microscopic critters called microorganisms battle for supremacy in their miniature world, gobbling up plant debris, animal remains, and each other! The tiniest of these living things, bacteria and protozoa, energetically devour any organic matter that touches the soil—fallen autumn leaves and roots dying underground—as well as the flesh of dead animals. Their action releases the nutrients, or food, that is then drawn up by the roots of living plants. Without these microorganisms, the soil would be unable to grow anything.

Amazingly, earthworms, like this night crawler, eat soil as they burrow through underground passages.





Often appearing as an eerie mass, fungi devour organic matter reducing chunks of rotting wood to humus.

Many people think of soil as unclean. Soil is popularly called “dirt,” from the Old English word *drit*, meaning manure. When playing in the yard, you may get “dirty” and your clothes may become “soiled.” However, through decomposition, bacteria break down diseases and other deadly substances present in dead animals so they are no longer harmful.

Fungi, including mushrooms, also decompose just about any dead organic materials, returning their nutrients to the earth. Mushrooms come in many shapes and sizes. Some are quite lovely, and others are downright ugly. Some are delicious, but many are deadly. Those with bright colors or white gills are pure poison; others, like the stinkhorn, emit foul odors. It’s best to stay away from mushrooms, except those at the grocery store.



Popping up in the woods, mushrooms are the most familiar of the fungi. They work quietly in the shade, making soils fertile for new generations of plants.



Centipedes, long and flat, ably slither under rocks and fallen leaves to seize their unlucky victims. Then, with nasty pincers, they shoot a dose of deadly poison.

These glistening red worms are feasting on kitchen scraps, which they will transform into compost in a matter of days.

Many different kinds of worms live in the soil, including earthworms, wire worms, and nematodes. The most numerous of these squiggly organisms are the strange creatures called nematodes, which feed on bacteria. There may be a million nematodes in a single acre of land. Also called threadworms and roundworms, these eel-shaped, colorless worms are often too small to be seen except through a microscope.

Earthworms constantly burrow through the soil. Their vast networks of tunnels make excellent channels for air and water, as well as other small creatures. As many as 1,600 earthworms may live in a square meter of soil. Earthworms eat enormous amounts of leaves and other organic material—all the leaves falling to the forest floor may be devoured within a single year. With several pounds of soil passing through each of their wiggly bodies every year, they excrete waste called “castings” that further enrich the soil.

Lubricated with slime, snails and slugs glide over plants and graze with teeth located on their undersides. Although some of these slowpokes riddle the leaves of farm crops and garden vegetables, most snails and slugs prefer to dine on dead plants.

Like tiny cattle, crickets, millipedes, sow bugs, and other tiny “grazers” nibble leaves and grasses, breaking them down into the ingredients for fertile soil. Busy ants also recycle nutrients as they tunnel and bring food underground.

Like a science fiction thriller, the surface of the soil is the battleground for the most vicious, bloodthirsty creatures on Earth. Roaming the leaf litter and mulch, as well as the leaves and stems of green plants, these ruthless, efficient predators capture and kill their prey in their razor-sharp jaws and pincers. This rogues’ gallery includes praying mantises, ladybugs, and centipedes, all of which feed on the small creatures that make soil. These backyard assassins are everywhere, but their slaughter is hardly noticed in their small “eat or be eaten” world, except that many useful plants are spared from the ravenous appetites of the crickets and aphids upon which they prey.

Moist and sticky, a plump slug cruises over a dead leaf, one of its favorite foods.



Scuttling under the leaf litter, a sow bug not much larger than a grain of rice scavenges on dead plants.



These insects in turn are gobbled up by the reptiles, including snakes and lizards, and mammals, such as moles, gophers, and prairie dogs, that make their homes in the earth. Moles plow along, just beneath the surface, gobbling up worms, grubs, and roots—they rarely appear above ground in the light of day. Ground squirrels, gophers, and prairie dogs tunnel deep into the ground, churning up tons of subsoil, especially in sandy and gravelly land, because they prefer dry places. These burrowing animals mix plant material and their droppings into the soil.

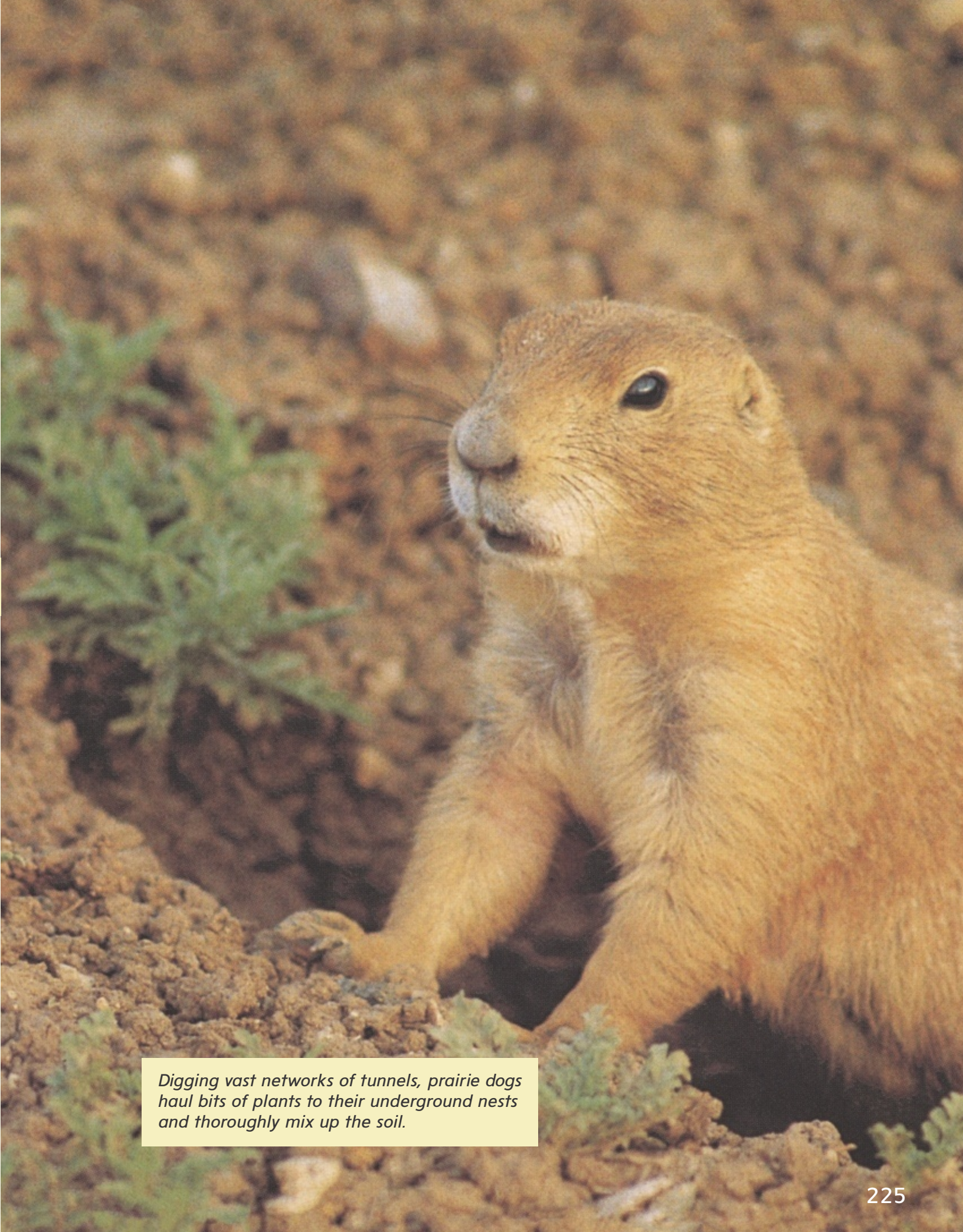
Larger, grazing animals, such as cattle and sheep, fertilize the soil with manure, which is chockful of nutrients. They also nibble grasses, leaving bite-sized bits on the ground to be whittled down further by insects and microorganisms.



This garter snake feeds primarily on insects and worms living in or near the soil.

As they graze on a slope on the northern plains, these cattle not only feed on grass but also help to fertilize the soil with their manure.





Digging vast networks of tunnels, prairie dogs haul bits of plants to their underground nests and thoroughly mix up the soil.



Gardeners know the value of compost, which they apply in large amounts to their beds of flowers and vegetables.

A garden or a field is only as good as its soil. The best soil allows air, water, and nutrients to reach the roots easily. One of the best ways to enrich soil is to apply home-grown compost—plants just love the dark, crumbly humus. Compost is made naturally in forests and grasslands from dead leaves, roots, and stems, but you can make your own compost in your backyard.

To decay properly, the compost pile needs the right amounts of carbon and nitrogen. Carbon-rich materials, such as leaves raked in the autumn, are known as “browns.” Nitrogen-rich materials, such as fresh grass clippings, vegetable and fruit scraps from your kitchen, and weeds pulled from the garden, are called “greens.” Compost piles with a mixture of browns and greens in a ratio of about twenty-five to one decompose quickly and yield the richest compost.

To make your own compost, find a shady spot in the yard and alternate layers of fallen leaves (browns) and grass clippings or weeds (greens), along with a little soil or fresh compost, in a pile at least three feet high and wide.

The soil or compost will supply hungry microorganisms that will get right to work on the fresh organic materials. Spray the pile with a garden hose, until it is sponge damp, and make sure it stays moist but not soggy. To keep everything mixed up, you can turn the pile with a garden fork every week or so. Or you can simply leave the heap alone. The compost is finished when most of the mixture is dark and crumbly. The process may take from a month to a year or more, depending on whether you turn the pile or not, but you'll end up with a mound of rich, fragrant compost.

The cycle of life, death, and decay in the soil continues to this very moment. Every second of every day soil is being made, just as it was millions of years ago. And if you make more soil, you'll be helping to create a better world for all of us. However, every second of every day soil is also being lost—to wind, water, and the growth of cities where the soil is buried under asphalt or cement. The next time you play in your backyard or the neighborhood park, think of the soil beneath your feet. It may not seem to be worth very much, but remember, soil is as precious as the wind in your face and the sun warming your shoulders.

Mixed together in the right amounts, greens and browns quickly decompose to make excellent compost.



You will answer the comprehension questions on these pages as a class.

Text Connections

1. Why would there be no life on Earth without soil?
2. What can a single acre of land contain, according to the text?
3. Why is it “best to stay away from mushrooms” in the wild?
4. Think about farming and irrigation information in “Monsoons” and what “A Handful of Dirt” says about inorganic minerals in soil. How does irrigation help bring those nutrients to the soil?
5. What are the benefits of making compost yourself versus purchasing fertilizer in a store?
6. Based on “A Handful of Dirt,” explain why people should be concerned about areas with eroding soil.

Did You Know?

A spoonful of rich, healthy soil has more microorganisms than there are people on the planet!



Write

Compose an ad telling people about the benefits and wonders of dirt.

Look Closer

Keys to Comprehension

1. Why does the author describe soil's surface as a "battleground"? Quote details from the text to support your answer.
2. Describe how details in "A Handful of Dirt" support two main ideas about the role of soil.
3. Explain the relationships between different types of decomposers. Quote details from the text to support your answer.

Writer's Craft

4. What is humus, and why is it important to soil?
5. Compare and contrast how "A Handful of Dirt" and "Salmon Creek" each show that death in nature supports new life.

Concept Development

6. Use information from both "A Handful of Dirt" and "A Year on Bowie Farm" to explain how to create, take care of, and use a compost pile.



Read this Science Connection. You will answer the questions as a class.

Text Feature

Captions explain what is happening in a photograph or illustration. Sometimes they give more information about the topic.

Do Plants “Eat” Meat?

You may know that many plants are able to make their own food using sunlight, water, carbon dioxide, and chlorophyll. A nutrient called nitrogen is an important part of chlorophyll. Would it surprise you to find out that many plants’ nitrogen sources make those plants indirectly meat-eaters?

For years, scientists have known that special soil fungi can partner with plants and trees. These fungi are a type of endophyte. An endophyte can live within plant cells without hurting the plant. When plants and endophytes work together, they form a *symbiotic relationship*. Also known as *symbiosis*, a symbiotic relationship is when two organisms help each other survive. Endophytic soil fungi enter a plant’s roots and help give the plant nutrients like nitrogen. In return, the plant gives the fungi things they need, such as carbon, sugars, and water.

Scientists only recently discovered, however, that some of these fungi prey on insects and then pass those insects’ nutrients to trees and other plants. Many endophytic fungi infect small insects in or near the soil. As the insects decay, they become food for the fungi. Scientists wondered if the nitrogen from the insects was ending up inside the nearby plants. By doing some tests with radioactive materials, scientists confirmed that this was true. It is almost as if the trees are emitting a ruthless net of fungi to “catch” insect prey.

So the next time you think about how plants make their own food, remember that some plants are getting some surprising help. These plants are not so different from carnivorous plants like Venus flytraps—they just let fungi do the decomposing first.



Decomposition is vital for a healthy ecosystem. When organic matter is decomposed, important nutrients are returned to the soil.

1. What is an endophyte?
2. Why is the relationship between a plant and endophytic fungi an example of symbiosis?
3. Imagine that an insect feeds on a plant's leaves. Create a basic model that describes how those nutrients could return to the plant through decomposition.



Go Digital

Research the connection between trees and salmon, including the link between the numbers of salmon and the amount of nitrogen in tree rings. How do the fish enrich the soil?