the Giving Grove

CLASSROOM LEARNING ACTIVITES FOR ELEMENTARY STUDENTS

N UTRITION FROM TREES

E NVIRONMENTAL BENEFITS OF TREES

S OIL BIOLOGY FOR GROWING HEALTHY TREES

T REE BIOLOGY FOR MAINTAINING HEALTHY TREES

Curriculum provided by Kansas City Community Gardens
and sponsored by EPA Region 7

300 WEST 39TH STREET, KANSAS CITY, MISSOURI 64111
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ELEMENTARY TABLE OF CONTENTS

SECTION ONE: SOIL BIOLOGY

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LET'S GET DIRTY

Lesson Objective: The Learner will explore the components of soil, discuss how soil is formed, and compare/contrast various soil samples.

Key Questions: How is soil formed? What is soil composed of? How do soils differ from each other in color, texture, and composition?

Background Information:

Have you ever been playing outside and someone reminds you to wipe your feet before you come in the house? Next time this happens, really look at what is on your shoes. While it may look like just dirt, it is actually soil, which is something vital or necessary for human life. Soil is a lot of materials mixed together, including dirt, minerals, animal material, and plant material. Soil is needed for growing plants, and those plants are consumed by animals and humans. There are different types of soils, and some are better for growing plants than others. All soil is made up of minerals and organic matter. The proportion of each determines the texture of the soil. There are 3 basic categories of particles that exist in soils:

Sand is the largest particle found in soil. When you rub it, it feels rough and gritty. Sand does not have many nutrients, but it dries quickly after rainfall, and it is good for drainage, which means it lets water flow through it easily.

Silt is the medium-sized particle found in soil. Silt feels smooth and powdery when dry, and it feels slippery when wet. Silt can be packed down into a crust that makes it harder for water and air to pass through it.

Clay is the smallest particle found in soil. Clay feels smooth and hard as stone when dry, and it feels sticky when wet. While clay can hold many nutrients, it does not allow much air or water to pass through. Too much clay can make the soil heavy and not good for growing plants.

If you cannot make a ball out of it, it is mostly sand. If it forms a loose ball but crumbles when squeezed it is mostly silt. If it forms a packed ball and can be reshaped into a snake, it is mostly clay.

Materials:

Soil samples | Large sealable baggies | Shovels or trowels | Science journal

Several books on soil | Magnifying glasses | Materials for Soil Painting (see below)

Learning Activity:

- Engage the students by taking them outside to different places on the school grounds to see how soil is different and is made up of different material.
- Have students dig soil from under bushes, under trees, and on open ground and put the soil into large baggies. Fill soil bags about 3/4 full.
- Allow students to examine the different materials that are in each soil sample to see that soil is a mixture and might have different purposes.
- Discuss the following questions: What do you notice about the sample? What do you think is in the soil? How do you think the soil is formed? What do you think causes the different colors? Which soil has the most rocks? Which soil has the most bits of dead plants and animals? Which soil is darkest, and which keeps its shape longest when you stick your thumb in it?
- Discuss the process of soil formation with the class.
- Provide books about soil that are appropriate for students' reading levels.
- Have students generate vocabulary cards in their science journals with their own definitions, pictures, and a sentence with select terms.
- Different soils vary in color and texture. Invite students to bring in a small amount of soil from their yards or from places around their communities. Make sure they label where they got the soil. Have them compare and contrast the soil. Why might one soil be darker than the other? What might make one soil reddish in color? Where in the community might you find drier soil or sand? Have students discuss and write down their ideas.

- Have students create soil paintings. They can use glue or vegetable shortening (lard) and their soil samples to create landscapes, abstract paintings, or even portraits.

  Separate soil samples into different colors. Using an old spoon, mash the dirt up in a bowl or tray so that it is nice and smooth (keep the colors separate). Add a spoonful of vegetable shortening to the dirt. Add more dirt if the mixture is too light in color. Add more shortening if the mixture is too dry. Once all the prehistoric paint is mixed up, tape some mural paper (or wrapping paper – fancy side down) on the wall or table. Using old paintbrushes or toothbrushes, start to paint! If you are feeling really adventurous, you can go outside and find a big rock or boulder to paint on. Add some tempera paint to the soil for a touch of color.
  (https://kinderart.com/art-lessons/painting/make-your-own-cave-paint/)

  Materials needed: small bags, spoons, paper plates, vegetable shortening/lard, old toothbrushes or stiff-bristle paint brushes, masking tape, soil samples, tempera paint (optional)

- Extension: Bring in different kinds of soil for your students. If possible get topsoil, clay soil, and sandy soil (or even sand). You can get these soils from a nursery or gardening store. Have students plant seeds in each kind of soil and observe how they grow. Which soil is best for plants? Which soil is worst? If possible, try experimenting with different seeds such as grasses, flowers, and vegetables. Different plants grow best in different kinds of soil.

Additional Resources

https://www.soils4kids.org/about | https://www.education.com

Children's books: https://www.barnesandnoble.com/blog/kids/8-books-to-get-kids-digging-in-the-dirt/

NAME: _____

LET'S GET DIRTY

MY SOIL LOOKS/FEELS LIKE

WITH A MAGNIFYING GLASS

DESCRIBING WORDS:

DESCRIBING WORDS:

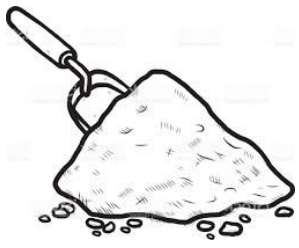
MY FRIEND'S SOIL LOOKS/FEELS LIKE

DESCRIBING WORDS:

DESCRIBING WORDS:

DESCRIBING WORDS:

HOW IS MY SOIL THE SAME OR DIFFERENT THAN MY FRIEND'S SOIL?



SOIL LAYERS

Lesson Objective: The Learner will describe the layers of soil and how they form.

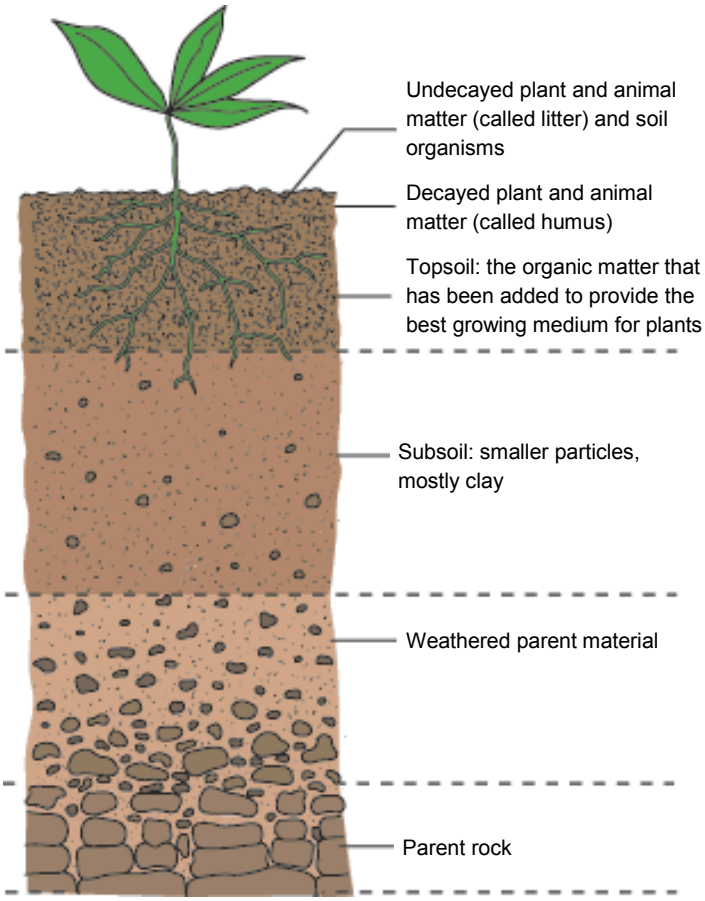
Key Questions: What are the 5 layers of soil? What does each layer look like?

Background Information:

Soil covers much of the land on Earth. It is made up of minerals (rock, sand, clay, silt), air, water, and organic material (matter from dead plants and animals). Soil provides an environment for plants (roots anchor in soil), a source of food for plants, and a home for many animals.

A scientist who studies soil is called a ***pedologist***. There are many different types of soils, and each one has unique characteristics, like color, texture, structure, and mineral content. The depth of the soil also varies. The kind of soil in an area helps determines what type of plants can grow. Soil is formed slowly as rock (the parent material) erodes into tiny pieces near the Earth's surface. Organic matter decays and mixes with inorganic material (rock particles, minerals and water) to form soil.

Soil is made up of distinct horizontal layers; these layers are called horizons. They range from rich, organic upper layers (humus and topsoil) to underlying rocky layers (subsoil, regolith and bedrock).



Organic litter (***humus***): The top, organic layer of soil, made up mostly of leaf litter and humus (decomposed organic matter).

Topsoil: The next layer is called topsoil. Seeds germinate and plant roots grow in this dark-colored layer. It is made up of humus (decomposed organic matter) mixed with mineral particles.

Subsoil: The next layer is called the subsoil. It contains clay and mineral deposits (like iron, aluminum oxides, and calcium carbonate) that it receives from layers above it when mineralized water drips from the soil above.

Parent Material : The layer (or rock fragments) consists of slightly broken-up bedrock. Plant roots do not penetrate into this layer; very little organic material is found in this layer.

Bedrock: The final layer is the unweathered rock (bedrock) layer that is beneath all the other layers.

Materials:

To create the paper model:

- Dark brown, light brown, grey, and green construction paper
- Crayons of different colors
- Scissors and glue

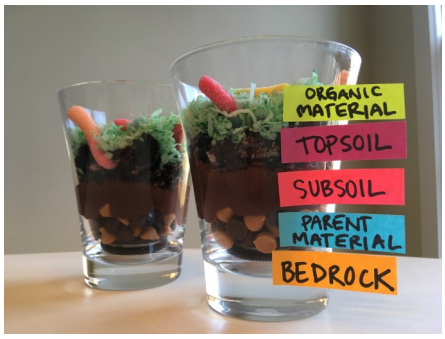
To create the edible profile:

- Clear plastic cups/spoons
- Bedrock: 2-3 vanilla wafers (or sugar/sandie cookie, graham cracker, vanilla oreo)
- Parent Material: Butterscotch Morsels (or crush up any of the bedrock ingredients)
- Subsoil: Honey Nut Cheerios, slightly crushed (or chocolate coated candies, other crunchy cereal)
- Topsoil: Chocolate pudding (or crushed oreo cookies)
- Humus: Sprinkles (or shredded coconut w/green food coloring—add some gummy worms too!)

Learning Activity:

- Students will make a paper model of the 5 main layers of soil.
- Give students dark brown construction paper that will be their back-ground and will not get cut at all.
- Start at the bottom by cutting some bedrock out of grey construction paper and gluing it to the bottom of the dark brown paper.
- Then add Parent Material (weathered rock fragments). As you go through each part, discuss how the bedrock breaks apart more and more the closer you get to the subsoil and the topsoil. Why does this happen?
- Add subsoil by changing the color of the background by coloring with a crayon and adding some sparkling minerals (glittery crayons!).
- Finish the model with topsoil, using white crayons to make roots and green paper to make grass and flowers on top. You may even add a worm and an insect or two!

- For extra fun, have students create an "EDIBLE SOIL PROFILE". Each student will need a clear plastic cup. Provide students with a variety of edible materials (be sure to check for food allergies before this activity). Start creating the soil profile by layering sections from the bottom to the top.



Additional Resources

https://www.soils4kids.org/about

https://www.enchantedlearning.com/geology/soil/

https://betterlesson.com/lesson/637412/the-layers-of-soil

NAME: _____

SHOW ME YOUR SOIL

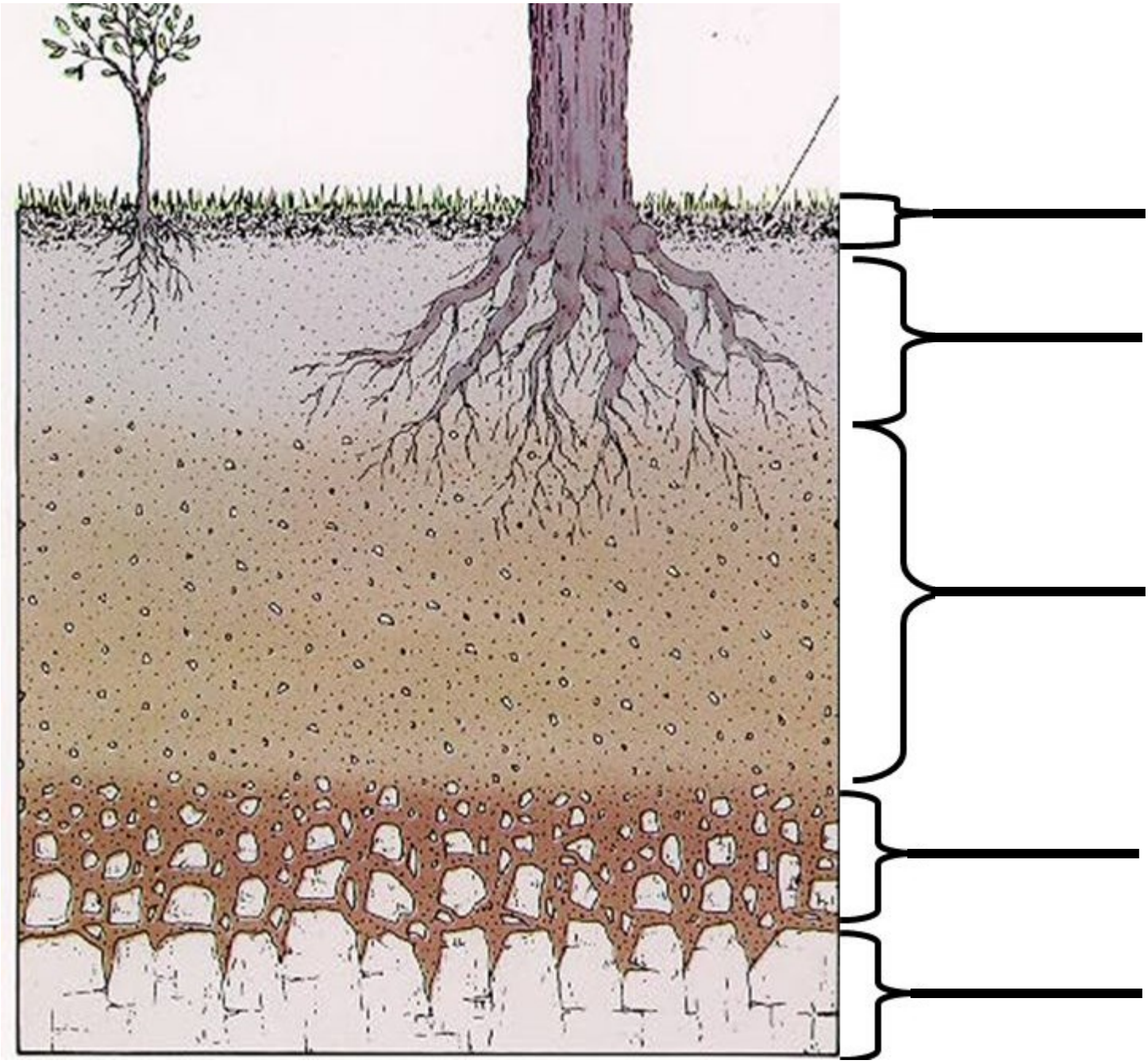
Use the Word Bank to label each soil layer:

PARENT MATERIAL **HUMUS** **TOPSOIL** **BEDROCK** **SUBSOIL**

Something new I learned today about soil: _____

_____

_____



SOIL IS ALIVE

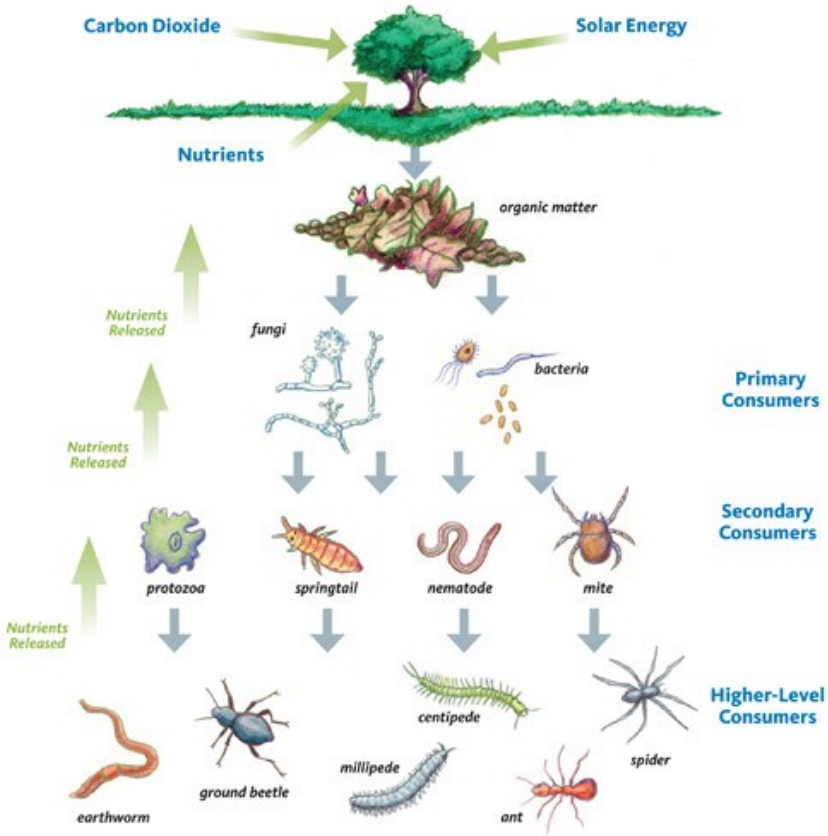
Lesson Objective: The Learner will define the term “soil food web”, describe living creatures in the soil, and observe relationships by comparing and contrasting soil samples.

Key Questions: What is living in the soil? How do the living organisms interact with the soil and each other? What would happen if one (some) of the living organisms disappeared?

Background Information:

Soil is rarely devoid of life. Soil which supports plant life is teeming with many soil organisms, the majority of which are too small to see. Some examples of soil organisms are fungi, bacteria, nematodes, diatoms (algae), earthworms, ants, centipedes, millipedes, beetles, snails, and slugs. All these soil creatures and more make up the soil community. Most fungi and bacteria are supported by relationships with plant roots, so they stay close to plants. Any creatures that live on fungi and bacteria also stay close to the roots. Other larger herbivores, like beetles, ants, centipedes, and termites, feed closer to the surface where more plant debris is located. By virtue of where the food is located, most soil creatures live within a few inches of soil closest to their food sources.

This community of organisms is deeply involved in the soil food web. It’s basically a recycling program, where plant and animal residues are broken down by a chain of soil consumers (nematodes, bacteria, fungi, mites, earthworms, etc), who are then consumed by birds and other mammals, cycling carbon and essential nutrients.



Examples of Soil Community Creatures

Ants: Ants are known for their highly organized underground colonies and nests. Colonies can occupy a wide area of land. Some ants consume other soil creatures like centipedes, spiders, and mites, others prefer a vegetarian diet, and others live on animal and plant debris. The building of underground tunnels and nests can improve the soil’s capacity to hold air and water, and cause changes in soil pH.

Termites: Termites are less involved in soil processes than ants, but there has been more research done on them. They can be found in many locations, but are most common in grasslands and tropical forests (both humid and arid). Their main contribution to the health of soil is through churning - bringing lower soil layers to the surface while taking surface layers deeper. The surface layers contain plant residues, which the termites use for food. This mixing of soil layers affects how the soil is formed and the overall health of the soil community.

Nematodes: The nematode is a unique soil creature, highly diverse in its feeding habits and size. These non-segmented worms are found in almost all soil types, but most are too small to see without some sort of magnification. They usually feed on fungi and bacteria, but some are plant parasites that attack plant roots. Still others are cannibalistic. As nematodes digest a bacterial population, a lot of nitrogen is released, increasing the amount of that valuable nutrient available to plants. However, those nematodes that feed on plants create puncture wounds that can quickly lead to infection by fungal and bacterial cultures. Nematodes move mainly by swimming, so they are most often found in wet, sandy soils.

Slugs and snails: Slugs and snails do not directly contribute to the health of the soil, but are still members of the soil community. Both feed on plant roots and tender new leaves and stems, although most snails don't do significant damage. During cold winters, these creatures hibernate in the sheltered soil layers, but in warmer areas they are active all year long.

Centipedes and Millipedes: These soil organisms also feed on plant roots. They are most common in moist soils that are high in organic matter, like forest soils. They spend the winter in the subsoil (below the surface), but the majority of their time is spent near plant roots and near the surface in plant debris.

Spiders: While we usually think of spiders as living in webs, there are quite a number of spiders that live and hunt on the ground. Found in all sorts of climates, they are commonly located in leaf and bark litter on the soil surface, although some construct very specialized dens in the upper layers of the soil. Ground spiders are usually very neutral in color to blend in with their surroundings. These dens serve as traps to catch other soil creatures, the spider's main food source. There are more than 200 species.

Earwigs: A common soil pest, the earwig devours the flowers and foliage of many garden and greenhouse plants. Like many other soil creatures, earwigs spend the winter in the subsoil. They do not directly contribute to the health of the soil except for adding their organic residues.

Beetles: The dung beetle is the most influential soil contributor in the beetle family. The female beetle creates dung balls to house her eggs; the nutrients from these are not added to the soil right away but are conserved for later. This prevents nutrification, or overloading water with more nutrients than the ecosystem needs.

Toads and Frogs: Contrary to popular belief, toads and frogs are not really different, taxonomically speaking. They use the litter layer (leaves, sticks and other organic residues) and sometimes the subsoil to live, digging burrows for nests. Their main purpose in the soil food web is recycling organic matter.

Earthworms: Worms may be the most important contributors to soil health, as well as deeply involved in the recycling of organic matter for nutrients. Earthworms break down organic debris and expel waste material called casts or castings, which are high in nutrients and beneficial bacteria. Plants use these nutrients to maintain health and growth, while the bacteria help to stabilize and improve the structure of the soil. These casts can be seen with the naked eye and appear as small globular clumps, generally located on the soil surface in plant litter where the worms reside.

Materials:

Small shovel(s) or trowel(s) 1-liter plastic freezer bags Plastic jars

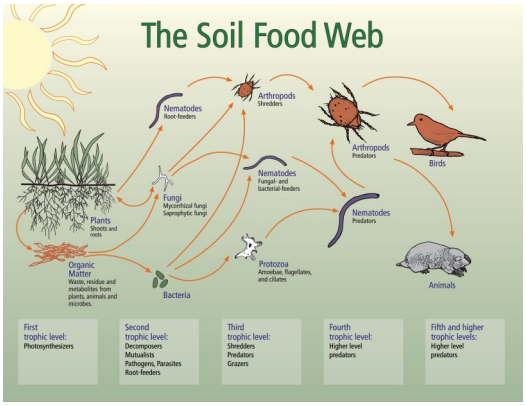
Magnifying glasses (microscope) Science Journals "Soil is Alive" Activity Sheets

Samples of soil from different areas (geographically and by elevation)—fill soil bags about 3/4 full

Color Diagrams of a Soil Community (Soil Food Web)

Learning Activity:

- Do a survey walk. Take note of locations that the students would be interested in taking samples from. Be sure to have a variety of locations. Suggestions: Garden or flower bed, Wooded area, Near a parking lot, Near a sidewalk, Turf (grassy area).
- Have a table in the classroom ready for observing soils. If students will be drying soil, you'll need a place where soils can be left for several days.
- Have students draw a map of the school grounds. Digging soil at each area, have students:
  - ⇒ Observe and Describe location and vegetation
  - ⇒ Write about location and vegetation in journals
  - ⇒ Use trowel or shovel to collect several clumps of soil and place soil in freezer bags
- Place soil samples on table in classroom. Divide students into groups and give one soil sample bag per group.
- Students observe characteristics of the soil which may include: Gravel, Rocks, Sand, Earthworms, Ants, Other soil creatures, Color, Moisture, Texture. Use magnifying glasses. If available, use microscope slides to observe microscopic organisms.
- Use Activity Sheet to chart observations by location. Have students compare their soil sample with samples from other groups. Predict from chart which soils might be best for growing crops.
- Have diagrams available of what a soil community (soil food web) looks like. Use worksheet or science journal for students to draw/label a picture of a soil community.
- Use Activity Sheet or science journal for students to identify and write about various organisms that live in soil communities.



Additional Resources

Lesson adapted from

https://www.soils4kids.org/about

https://www.soils4teachers.org/lessons-and-activities

https://study.com/academy/lesson/soil-science-lesson-for-kids.html

https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/biology/?cid=nrcs142p2_053868

NAME: _____

SOIL IS ALIVE

Use the chart to record your findings and observations from the soil samples you collected.

	SOIL FROM: (PLAYGROUND)	SOIL FROM:	SOIL FROM:	SOIL FROM:
SOIL TEXTURE	**STICKY**			
SOIL COLOR	**REDDISH BROWN**			
LIVING CREATURES	**WORMS, SPIDER**			
MOISTURE CONTENT	**NOT VERY WET**			

We've talked about some very small things that live in soil. Many larger creatures also make their homes in soil. One example is the toad. Can you think of three animals that live in the soil and what kind of homes they build in it?

1. _____ Kind of home: _____

2. _____ Kind of home: _____

3. _____ Kind of home: _____

Draw and **Label** a soil community. Include at least two very small organisms that live below the soil, two that live above the soil, and two plants (include their roots). Try to create a soil community similar to what is found near your school or home.

Above ground

Below ground

NAME: _____

SOIL IS ALIVE

WHAT'S LIVING IN MY SOIL?

Have you ever dug in the soil and seen little creatures moving around? Soil is full of living things. You probably recognize earthworms when you see them, but what else lives in there?

Many creatures and organisms are large enough to see with your eyes (like worms, centipedes, beetles, etc.).

Some are too small to see without magnification (like nematodes, fungus, bacteria). They are called **micro-organisms**.

Use the hints we've given you to identify the soil organisms in the pictures below. You'll find the **slug, nematode, earwig, toad, ant, centipede, spider, earthworm, and beetles**.

1. 

This one is a micro-organism

2. 

3. 

4. 

5. 

6. 

7. 

8. 

9. 

1. ___ ___ ___ ___ ___ **O** ___ ___

2. ___ ___ **R** ___ ___ ___

3. ___ ___ ___ **G**

4. ___ ___ **A** ___

5. ___ **N** ___

6. ___ ___ ___ ___ **I** ___ ___ ___ ___

7. ___ ___ ___ ___ ___ ___ **S**

8. ___ ___ ___ ___ ___ ___ ___ ___ **M**

9. **S** ___ ___ ___ ___ ___

Can you name some other organisms that live in soil communities? _____

_____

NAME: _____

SOIL IS ALIVE

MY SOIL ORGANISM

Pick one of the soil organisms you placed in your soil community drawing.

Write a paragraph about the organism. What does it do? What is its role in the community?

Be sure to include the following:

Name the organism. Describe how it looks. Describe what it does and how that helps the soil community. Give at least one supporting detail for your answer (How can we tell it is busy doing its job?)

SOIL & PLANTS NEED EACH OTHER

Lesson Objective: The Learner will investigate the relationship between plants and soil, describe components of healthy soil, and conduct composting and erosion experiments.

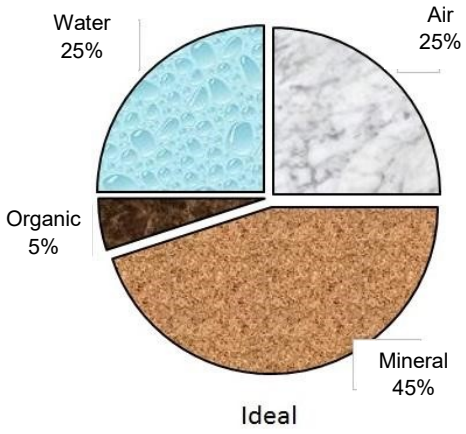
Key Questions: Why is healthy soil important? Why do plants need soil? Why does soil need plants? How do plants and soil depend on each other?

Background Information:

Why is healthy soil important? All animals living on land need plants to survive. Without healthy soil, we can't grow the food we need to survive. Any seasoned gardener will stress the importance of good soil. In addition to anchoring roots, soil provides life-sustaining water and nutrients. Plants in poor soils will struggle to grow, even if optimal water and light are available. In contrast, plants in good soils will grow to their fullest potential and experience fewer problems with insects and disease.

Mother Nature has a pretty smart strategy for keeping the planet healthy. Soil is teeming with life, including microorganisms like bacteria and fungi (billions in a single teaspoon!) and larger animals such as worms and beetles. When plants and animals die, they break down into nutrient rich compounds. Many of these underground inhabitants feed on remains of plants and animals, breaking down their tissues. In the process, they create pore space and release nutrients that plants need and the cycle begins again. These compounds keep the soil healthy and fertile. This natural process also ensures that the Earth doesn't become polluted with the remains of dead animals and plants.

Pore space -- the arrangement of soil particles in relationship to each other -- is an important component of soil structure. In an optimal situation about 50 percent of the volume of the soil would be pore space, with half of that filled with water and half filled with air. The other 50 percent would be sand, silt, clay, and organic matter. Roots need air as much as they need water; plants can actually suffocate or drown if they are completely submerged in water for extended periods of time.



Not only is soil important to plants, plants are also important to soil formation. Without plants, the earth would be barren, its surface unprotected from the effects of sun, wind, and rain, and its soil composition too poor to sustain life. Plant roots help to prevent erosion, and when plants die, they become the raw material for worms, insects, and microbes to build the nutrient-rich humus that supports robust food webs and promotes good soil structure. Fallen leaves, grasses, weeds and sticks help prevent soil erosion. Wind and water can wash the soil away, but these natural mulches help keep the soil in place. Farmers and gardeners have learned that they can have healthier farms and gardens if they use this approach too.

Healthy soil is dark and rich. Water drains out of it, but not too quickly. Healthy soil has a lot of organic matter, such as old leaves, manure and worm castings in it. Manure – or animal waste – makes a nutrient rich fertilizer for plants. Dig it into the soil and watch those plants grow. Fresh manures smell bad and they can burn plants. Manure should be composted first. Composting is a great way to keep food and garden scraps out of the trash can. Spread these composted scraps on your garden to build healthy soil.

Materials:

Small shovel(s) or trowel(s) 1-liter plastic freezer bags Soil samples

Organic materials (vegetable scraps, plant clippings, old leaves). Science journal

Learning Activity:

- As a class, discuss whether and how soil is important for plants.
  - ⇒ *What do you think soil does for plants?* (Provides a place to anchor roots, nutrients, water, air.)
  - ⇒ *Have you ever seen plants growing without soil*? *Where?* Explain that some plants, including certain aquatic and parasitic plants, have particular adaptations that allow them to meet their basic needs without soil.
- Delve deeper into the plant-soil relationship. Ask, *Other than mineral particles, what is an important part of soil?* Share the background information about microorganisms -- fungi, bacteria, and other decomposers -- and discuss the role they play.
- Find out what your students know or assume about the plant-soil relationship.
  - ⇒ *Plants need soil, but does soil need plants? Why?* Record all answers and supporting reasoning; then visit the schoolyard or a nearby park to make observations.
  - ⇒ Have teams investigate the soil in different areas (e.g., garden beds, lawns, weedy patches, woods, a compacted area along the edge of a driveway or sidewalk) and record their observations in their journals. Make a second chart, summarizing these findings and take a vote. Ask, *Who thinks soil needs plants?*
- We can help build healthy soil by recycling food scraps to create COMPOST. Have the class create “Compost Bags”. Collect some soil from your schoolyard. Put it in a large zippered plastic bag along with some organic materials (vegetable scraps, plant clippings, old leaves). For comparison, add these same organic materials to a second bag, but do not add soil. Moisten the contents of the "compost bags”, seal them, punch a few air holes in them, and leave them in a warm part of the classroom for a week or two, while the class observes what happens. Then ask, *Are the contents changing? How? What do you think might be causing this change? Where have you seen examples of once-living things changing and decomposing outdoors?* (Rotting logs, moldy garbage, compost piles.) *Did some materials seem to decompose more quickly than others?*

  - ⇒ In what ways do you think plants depend on soil? Based on your observations, can you imagine how soil might depend on plants or animals? In what ways do animals, including humans, depend on soil?
  - ⇒ Why do you think materials might break down quickly in soil? What do you think might happen to once-living things that decompose in soil? How might these once-living things help to support life?

Additional Resources

Lesson adapted from https://kidsgardening.org/lesson-plans-the-plant-soil-relationship/

https://www.soils4kids.org/about https://easyscienceforkids.com/all-about-healthy-soil/#

https://www.lifeisagarden.co.za/soil-erosion-experiment/

Extension:

Erosion Experiment 1:

Materials: 2 trays of soil, ryegrass seeds (or other plants), watering can, tray for runoff

- Conduct a simple simulation to introduce students to the concept of erosion.
- Fill two trays with soil. Leave one tray unplanted and then plant a fast growing seeds such as ryegrass in the second.
- Wait two weeks as the grass grows. Then set the two pans up side by side, propping one end up about two inches at one end to create a slope.
- Set up a collecting basin below the pan for runoff. Holding a watering can a foot above the trays, sprinkle “rain” for a minute or two.
- If necessary, help students make connections between the simulation and what can happen outdoors; then discuss the techniques farmers and gardeners use to reduce or prevent erosion. (Mulching, terracing, cover crops, adding organic matter to improve a soil's water absorption.)

Erosion Experiment 2:

Materials: 1 x piece of ply wood (30cm x 30cm x 2cm thick), 6 empty 2 liter bottles, Wood glue, Scissors and Stanley knife, String, Soil from the garden and compost, 4 Seedlings of flowers or grass, Mulch (bark chips, dead leaves and sticks), Water, Hole puncher

- Prepare three of the coke bottles by cutting a rectangular hole roughly 7cm x 25cm along the side of the bottle.
- Stick the bottles to the wood with the wood glue making sure that the necks of the three bottles protrude a little over the edge of the board.

- Fill the first bottle with plain garden soil and the other two with a soil and compost mixture. Press down firmly to compact it.
- Leave the first bottle as is. Cover the top of the soil in the second bottle with your mulch (bark chips, dead leaves and sticks etc). Plant your seedlings in the third bottle. Make sure you plant them tightly together and press down firmly to compact the soil.
- Cut the other three bottles in half, horizontally and keep the bottom halves. Make two small holes opposite each other, nearest the cut side of the bottle. Cut three pieces of string, roughly 25cm long and insert each end into the holes. Tie a knot on the ends to secure them. This will form a “bucket” to collect the water. Hang them over the necks of each of the three bottles on the board.
- Slowly pour equal amounts of water into each of the bottles. Pour the water in at the end furthest from the neck of the bottle.
- Take note of the color of the water collecting in the cups! The water in the first cup is really dirty, the water from the second and third cups are much cleaner which shows that both mulch as well as the root structure of plants assist in preventing soil erosion.

KEEP THE SOIL CLEAN

Lesson Objective: The Learner will investigate the positive and negative ways that humans impact soil health.

Key Questions: How do humans hurt the soil? How can humans help soil to be healthy? What is your personal responsibility in keeping the land healthy?

Background Information:

Soil helps sustain life on Earth—including your life. You already know that soil supports the growth of plants, which in turn supply food for animals. Therefore, soil provides you with nearly all the food you eat. But that's not all. Many other items you use, such as cotton clothing and medicines, come from plants. Lumber in your home comes from trees. Even the oxygen you breathe comes from plants. Besides supporting the growth of plants, soil plays other life sustaining roles. Soil helps purify, or clean, water as it drains through the ground and into rivers, lakes, and oceans. Decomposers in soil also help recycle nutrients by breaking down the remains of plants and animals, releasing nutrients that living plants use to grow. In addition, soil provides a home for a variety of living things, from tiny one-celled organisms to small mammals.

When soil is polluted, the entire ecosystem suffers.

⇒ **food shortages**: Soil pollution reduces the amount of nutrients in the soil, making it difficult for farmers to grow enough food to meet demand. Americans and people around the world rely on "America's Breadbasket" for grains, produce, and other products to survive. Contaminated soil could lead to massive food shortages.
⇒ **toxic atmosphere**: Polluted soil cannot produce the nutrients that plants and trees need to survive. Plants and trees remove carbon dioxide from the air, leaving behind the clean, oxygenated air we need to breathe. If contaminated soil reduces the number of plants and trees, carbon dioxide in the air could rise to toxic levels.
⇒ **mass extinctions**: Contaminated soil cannot produce the nutrients that plants need to survive, so the animals that depend on the plants for food will starve.
⇒ **water contamination**: Rainwater that drains across contaminated soil before arriving in lakes and streams could contaminate drinking water.

What causes soil to become contaminated?

◊ Soil contamination comes from pesticides, lead paint, factory pollution, unwise farming practices, and waste. Remember—pollution is often caused by people!
◊ Waste: The United States produces 230 million tons of personal, commercial, and agricultural waste each year. Landfills are unable to keep up with the demand, leading to contamination of soil and water supplies.
◊ Deforestation: Trees are nature's filter. They remove air pollutants and drive the air-recycling process that produces clean oxygen. Deforestation also leads to soil erosion and landslides, and disrupts the composting cycle that nourishes the soil for other organisms. Tropical rain forests are home to 50 to 90 percent of all organisms on earth, including 90 percent of all primates. 50 million organisms can survive only in the rain-forest ecosystem. Rain forests are the source of 25 percent of all medicines.

How can you help to keep the land healthy?

- Wise waste management:
  - ⇒ **Composting**: In nature, fallen plants and animals decompose naturally. Composted waste is gradually processed and cleaned by soil, providing fresh nutrients for plants and animals.
  - ⇒ **Preventing waste**: When people make a commitment to using durable, reusable items and purchasing products with less packaging, they are reducing the amount of waste they produce.
  - ⇒ **Incineration or burning waste**: Used wisely, incineration can produce steam, which is processed as electricity.
  - ⇒ **Recycling**: Using recycled materials reduces the amount of greenhouse gases and pollutants that are put into the environment by traditional manufacturing plants. Recycling also conserves fossil fuels, saves energy, and reduces waste.
- Pesticide-free farming: Encourage farmers to "go organic" and use pesticide-free fertilizers to keep contaminants out of the soil.
- Prevent erosion: Plant a windbreak of trees or bushes around fields to reduce the chance that wind will blow the topsoil away into your water supply. Planting trees at river banks and stream banks helps prevent erosion of the banks into the water bodies.

Materials:

Science journals Handouts “Keep the Soil Clean” and “Protecting the Land”

Access to research materials on the positive/negative ways humans impact soil

Materials to create persuasive presentations

Learning Activity:

- Look outside for evidence of ways that people have affected the soil. Make a list of all the things that you can see or think of. Use your list to make a two-column table with the headings “Activity” and “Effects.” Use the handout “Keep the Soil Clean”.
- Have students Think-Pair-Share: Do you think you have a personal responsibility to help keep our local environment healthy? If not, whose responsibility is it? Engage students in a lively discussion about the importance of caring for the environment. Discuss whether a healthy environment is the responsibility of individuals, governments, private businesses, nonprofit organizations, or everyone on earth. Ask if students consider themselves to be "polluters," and remind them that cars, home heating/cooling systems, waste, and even hairspray puts foreign particles (pollutants) into the air.

- Ask: Do you think our local environment is healthy? What parts of our environment do you think we could study to try to find the answer? (Clues to the health of an environment can be found in its air, water, plant and animal ecosystems, and soil. Highlight the fact that although all of these factors are very important to a healthy planet, **soil pollution heavily influences the health of every other part of the environment.**)
- Healthy soil affects every other part of the environment. Ask: What are different ways that people can pollute the soil? Have students list ways that contaminated land and soil affect plants, animals, and humans. Here are some ways that people pollute the soil:

⇒ **Deforestation and erosion:** When forests are cleared for development and to meet the demand for wood supply, the soil is loosened in the process. Without the protection of the trees, the land becomes barren over time and starts to erode.

⇒ **Agricultural chemicals:** Part of the farming process often involves the use of harmful pesticides and insecticides to protect crops. However, the chemicals can cause the land to become barren. The once-fertile soil is then more susceptible to environmental elements, such as the wind.

⇒ **Industrialization:** The Industrial Revolution may have resulted in significant positive changes to the economy and society, but it also led to significant pollution of the land. Through unsafe disposal practices for chemicals used in manufacturing, poor regulation, and the overwhelming number of industries and factories that are polluting the land daily, industrialization has become one of the main contributors to the pollution problem.

⇒ **Mining:** The mining process can lead to the creation of large open spaces beneath the surface of the earth. This can result in the land caving in, which compromises the integrity of the land. Mining also results in harmful chemicals, such as uranium, being disturbed and released into the environment.

⇒ **Landfills:** The garbage found at landfills is filled with toxins that eventually seep into the earth. During rains, the toxins are washed into other areas and the pollution is spread. As the population grows, the amount of garbage filling landfills also grows.

⇒ **Human sewage:** Untreated human waste can produce toxic gases that can seep into the ground. As with air pollution, the soil quality is negatively impacted, and land nearby can be contaminated. In addition to this, the probability of human illnesses occurring increases.

- Separate students into groups. Explain that each group is going to present a persuasive argument. Students will choose a topic, conduct an investigation to discover the facts, and then inspire others to act.
- Instruct each group to choose a specific human action that could lead to soil contamination. Each group should then decide what it thinks the primary effect of that action will be (i.e. human actions like poor waste management, deforestation, and the use of pesticides can lead to effects such as soil erosion, animal and plant extinction, and food shortages).
- Distribute a copy of the "Protecting the Land" student reproducible. Student teams should use this reproducible to help guide their research.
- Provide class time for students to research and present their findings.
- Take a class poll to find out which group had the most compelling argument for action! Discuss what was most persuasive about each presentation.

Additional Resources

http://www.scholastic.com/browse/article.jsp?id=3747551

https://www.soils4teachers.org/human-soil-interactions/

https://www.classzone.com/science_book/mls_grade7_FL/248_252.pdf

NAME: _____

KEEP THE SOIL CLEAN

Healthy soil affects every other part of the environment. What are some things that people do to hurt the soil?

THINGS PEOPLE DO (ACTIVITY)	HOW IT HARMS THE SOIL (EFFECTS)
Farmers clear trees and plow up the soil to plant crops.	Without its natural plant cover, the soil is more exposed to rain and wind and is therefore more likely to get washed or blown away.

Draw a picture of something you can do to help the soil

NAME: _____

PROTECTING THE LAND

Healthy soil affects every other part of the environment. With your group, brainstorm ways that humans can hurt the soil. Choose one of these problems to research and create a presentation for the class on what you have learned.

Get to the Root of This Problem!

1. Use available research materials to investigate ways that people can hurt the soil.
2. Choose one topic to focus on (i.e. what happens when farmers use pesticides? What happens to the soil when most of the trees are cut down?).
3. How does this hurt the soil? Can we do anything to change it?
4. Create a group presentation to share your findings. Be creative! Your presentation can include visual aids, songs/skits, audience participation, etc.
5. Be very persuasive! Back up your argument with facts to convince others that they should take action.

One way that people can hurt the soil:

_____

_____

_____

This is what happens to the soil:

_____

_____

_____

This is how we can take action:

_____

_____

_____

One thing I learned from another group's presentation:

_____

_____

_____