Soil Tent Activities and Implementation Guide

**Purpose:** Encourage the sciences in elementary schools and integration with the arts through an interactive traveling Soil Tent.

**Contact:**
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NH GLOBE Team
Leitzel Center at the University of New Hampshire
UNH/PARTNER YOUTH PROGRAM EXPECTATIONS
AT THE SITE OF THE EXTERNAL PARTNER

Protection of Minors Policy & Procedures
The University of New Hampshire is committed to providing a safe and welcoming environment for minors who participate in University programs and activities that occur on and off campus. The University adopted a Policy and Procedures for the Protection of Minors in 2014 (updated in 2017). The policy and procedures seek to protect minor participants (under the age of 18) and to provide guidance to University faculty, staff, volunteers and students who provide programming to minors.

UNH faculty, staff, students, and volunteers working with youth are expected to be familiar with and follow the Protection of Minors policy and procedures. Below are key aspects of the policy and the responsibilities/expectations for the external partner and UNH.

External Partner Expectations:
- The hosting partner will ensure that adequate supervision is provided for the number of participants.
- The partner is responsible for maintaining supervision of the students at all times.
- Participant travel and transportation is typically the responsibility of the hosting group. If UNH is providing transportation, UNH travel protocols will be followed.
- The partner will have emergency procedures in place and will be responsible for executing the plan and communicating with parents/guardians in an emergency. UNH personnel will follow the lead of the partner staff.

UNH Faculty, Staff, Volunteer and Student (UNH staff) Expectations:
- UNH staff will not be alone with a minor student.
- UNH staff will not establish a relationship with a minor outside the program.
- UNH staff will not communicate with participating minors through any means, including social media, unless there is parent permission and another adult is included in all interactions.
- UNH follows State law regarding mandatory reporting for suspicion of child abuse and neglect.
Earth Around Us: Soil Tent Implementation Guide

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# Soil Tent Activities and Implementation Guide

**Purpose:** Encourage the sciences in elementary schools and integration with the arts through an interactive traveling Soil Tent.

**Overview:** Students will engage in research about soils, soil layers and profiles, and soils in different habitats and then *(optional)* work with an artist or their art teacher to create soil-inspired art.

<table>
<thead>
<tr>
<th>Grade Level: K-4</th>
<th>Contact: Haley Wicklein (<a href="mailto:haley.wicklein@unh.edu">haley.wicklein@unh.edu</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Tent Website:</strong> groundbeneathourfeet.weebly.com</td>
<td><strong>Elementary GLOBE Soils Website:</strong> <a href="http://www.globe.gov/web/elementary-globe/overview/soils">www.globe.gov/web/elementary-globe/overview/soils</a></td>
</tr>
<tr>
<td><strong>Soil Tent Activity Flow Chart:</strong> <a href="https://tinyurl.com/SoilTentFlow">https://tinyurl.com/SoilTentFlow</a></td>
<td><strong>Optional:</strong> Become a GLOBE Trained Teacher: GLOBE Pedosphere (Soil) Protocol eTraining: <a href="https://tinyurl.com/GetTrainedSoil">https://tinyurl.com/GetTrainedSoil</a> <em>(recommended: Soil Characterization)</em></td>
</tr>
</tbody>
</table>

## Standards supported by Soil Tent Activities

<table>
<thead>
<tr>
<th>NGSS</th>
<th><strong>Disciplinary Core Ideas</strong></th>
<th><strong>Crosscutting Concepts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• ESS2.A Earth Materials and Systems</td>
<td>1. Patterns</td>
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<tr>
<td></td>
<td>• ESS2.E Biogeology</td>
<td>3. Scale, Proportion, and Quantity</td>
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<tr>
<td></td>
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<td>6. Structure and Function</td>
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<td></td>
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<td>7. Stability and Change</td>
</tr>
</tbody>
</table>

**Science and Engineering Practices**

1. Asking Questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

<table>
<thead>
<tr>
<th>CCSS</th>
<th><strong>ELA</strong></th>
<th><strong>MATH</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• R.4 Interpret words and phrases as they are used in a text</td>
<td>• MD A.1-A.4 Measurement and Data</td>
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<tr>
<td></td>
<td>• R.7 Integrate and evaluate content presented in diverse media and formats</td>
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</tr>
<tr>
<td></td>
<td>• R.10 Read and comprehend complex literary and informational texts</td>
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</table>

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*The Soil Tent was funded by a 2016 Youth Engagement grant from USDA Forest Service, Eastern Region/Northern Research Station*
**Background**


**NH State Soil is the “Marlow”**:  

**Why are NH and VT soils so different?**  

**NH Fish and Game has a great soil resource for kids**  

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**Soil Tent Activity Sequence**

The sequence involves soil learning activities and a visit from the soil tent. Optional additions include soil art with an art teacher, an artist residency or visit with a soil scientist. Schools may need to arrange these on their own. *When to complete each part and the resources needed are outlined in the clickable boxes in the Soil Tent Flowchart ([https://tinyurl.com/SoilTentFlow](https://tinyurl.com/SoilTentFlow)).*  
*NOTE: An adult from the school or organization must be present with students at all times*

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**Materials Provided in the Soil Tent Kit**

- Soil Tent: pop-up tent with mural panels of soils in three different habitats
- ‘The Scoop on Soils’ GLOBE Storybooks
- Soil samples of sand, silt, and clay
- Soil Auger
- Soil Corer
- Small Shovel
- Glad containers
- GLOBE soil color books
- Screens with three mesh sizes
- Rulers and magnifying lenses
- Carpet tape
- “Dirt on Soil” binder – extra soil activities and content resources
Soil Tent Activity Flowchart

Use this flowchart as a menu to help you decide the best way to use the Soil Tent materials at your school/organization. Clickable links lead to implementation guides with materials needed, NGSS and CCSS correlations. Each activity has modifications for weather, class size, number of adults/chaperones.

Pre Tent Visit
Student Activities
(40-90 min)

- 'The Scoop on Soils' Book
- Soils Brainstorm
- All About Soil Student Presentation
- Soil is Living Video

Tent Visit

Tent Set-up and Care Guide

Soil Exploration Activity (45-90 minutes)
- Options for indoors and outdoors
- Options if there is not a space for students to dig their own soil cores

Soil Texture Activity (15 minutes) + Sand, Silt, and Clay Activity (30 minutes) + Make a Mini Soil Profile (30 minutes)

Post Tent Visit

Collaborate with an art teacher
Go further with Extension Activities in the classroom

- Soil Mural Art
- Go Further: Science experiments and activities
Pre-Tent Visit
## Pre Soil Tent Visit Student Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Materials Needed</th>
<th>Time</th>
<th>NGSS, CCSS Standards supported by the activity</th>
</tr>
</thead>
</table>
| Read ‘The Scoop on Soils’ GLOBE Storybook - can be read by the teacher, or students can read it independently. | 'The Scoop on Soils' book: available on the GLOBE website as a PDF and eBook, 4 copies come with Soil Tent kit | 20-30 minutes | DCI ESS2.A  
Science practice 8: Obtaining, Evaluating, and Communicating Information  
CCSS.ELA R.4 Interpret words and phrases as they are used in a text  
CCSS.ELA R.7 Integrate and evaluate content presented in diverse media and formats  
CCSS.ELA R.10 Read and comprehend complex literary and informational texts independently and proficiently |
| We All Need Soil Brainstorm – What makes up soil? Who lives in soil? Group brainstorm and class discussion to generate ideas about what they may find in the soil. | • Whiteboard or Chart Paper  
• Markers  
• Background and Teacher Guide: GLOBE We All Need Soil Teachers Guide and Student | 20-30 minutes | DCI ESS2.A |

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**The Soil Tent was funded by a 2016 Youth Engagement grant from USDA Forest Service, Eastern Region/Northern Research Station**
<table>
<thead>
<tr>
<th>Activities</th>
<th>DCI ESS2.A</th>
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<tbody>
<tr>
<td><strong>OPTIONAL</strong></td>
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<tr>
<td><strong>All About Soil Student Presentation</strong> - Learn about what makes up soil, soil profiles and who lived in the soil. Students make observations about how soil looks in different habitats.</td>
<td><strong>Student Soil Powerpoint Presentation</strong> (teacher notes are included)</td>
</tr>
<tr>
<td></td>
<td>[FOREST SOIL PROFILE]</td>
</tr>
<tr>
<td><strong>‘Soils Are Living!’ video</strong> - short video describes the living things that are found in soil. <em>From the Soil Science Society of America.</em></td>
<td><strong>Video link</strong> (<a href="https://youtu.be/Qas9tPQKd8w">https://youtu.be/Qas9tPQKd8w</a>)</td>
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</table>
Dirt is what is under your fingernails, soil is what is under your feet!

The Soil Tent was funded by a 2016 Youth Engagement grant from USDA Forest Service, Eastern Region/Northern Research Station
What is soil made of?

- 5% Organic Material
- 45% Minerals
- Sand, Silt & Clay
- 25% Air
- 25% Water
Sand, Silt, and Clay

- **Silt**: 0.002 to 0.05 mm diameter
- **Sand**: 0.05 to 2 mm diameter
- **Clay**: < 0.002 diameter
A **soil profile** shows what the layers in the soil look like if you were to make a slice through the ground.
The soil profiles in different habitats have different characteristics. Let’s take a look at three New Hampshire habitats— the forest, wetland, and meadow. What differences can you see in the soil?
Remember to think about:

1) **Texture**- how it feels.
   Is it mostly sand, silt or clay?

2) **Color**- be descriptive!

3) What else is in the soil? Roots, rocks, etc.
FOREST SOIL PROFILE
WETLAND SOIL PROFILE
MEADOW
SOIL
PROFILE
What characteristics did you notice for each habitat?

FOREST

WETLAND

MEADOW
The critters and plants that live in and on the soil are also very important! They...

**Move soil between soil layers**

**Help break down organic matter to add nutrients to soil**

**Hold the soil in place to prevent erosion**
WHO LIVES IN THE SOIL?

Watch this video to learn more about soil organisms!

Click for link!
Tent Visit: Set Up, Activities
Tent Set-up and Care Guide

Soil Tent Set-up

*This can be done by one person, but it is easier to have at least two*

1. Remove the tent from its case and store the case in a dry, safe location.
2. Stand the tent vertically and gently pull the outer frame legs until the canopy is extended.
3. Lock each of the corner sliders into place by pushing the slider upwards until it clicks into place.
4. Pull the corners of the Tent canopy down to cover each upper corner.
5. Attach mural panels (stored in separate bins) to the cross bars. These attach with velcro straps. It is MUCH easier to do this step before the legs are extended to their full height.
6. Adjust the frame legs by raising each leg and slowly sliding the inner leg into place until it clicks. This may need to be done in a few steps to reach full height.
7. See this YouTube tutorial for a visual demonstration of a similar tent (https://youtu.be/HL951E0XqeA).

Tent Care

The Soil Tent should be taken down over the weekend and in the case of rain or extreme weather (wind, etc.). If the Soil Tent is being left up overnight, please lower the legs to their shortest setting and buffer the tent against wind (i.e. near trees or a building).

Please do not pack the Tent or panels up if it is still wet.

Materials Care

After using the soil tent materials, please clean them to the best of your ability and re-pack them into the bin they came from. Bin labels include all of the items and number of each item found in each bin.
Soil Exploration Activities

Overview
Students will engage in exploration of soils, soil layers and profiles, and soils in different habitats.

Time
This activity needs at least 45 minutes but can use more!

Student Outcomes

**NGSS**
ESS2.A Earth Materials and Systems  
ESS2.E Biogeology  
PS1.A Structure and Properties of Matter  
Cross Cutting Concept 4 Systems and System Models  
Cross Cutting Concept 6 Structure and Function  
Science Practice 1. Asking Questions  
Science Practice 7. Engaging in Argument from Evidence

**Common Core**
MD.A.1-A.4 Measurement and Data

Materials

- Soil Tent  
- Soil Auger  
- Soil Corer  
- Small Shovel  
- Glad containers  
- GLOBE soil color books  
- Rulers  
- Meter Sticks  
- Magnifying lenses  
- Screens with three mesh sizes (optional)  
- Microscope (optional, not provided)  
- Gutter sections, bins, or roasting pans (to hold soil cores, especially if inside)  
- Science notebook (not provided) or printed [Soil Investigation Sheet](#)  
- Pencil (not provided)  
- Colored pencils or crayons (not provided)  
- Clipboards or writing surface (if outside, not provided)  
- Paper to cover surfaces (if inside)
Preparation

1. Locate a safe place for students to dig soil cores. Depending on the size of the group, you may need to set up multiple ‘stations’ where they can dig. It is ideal if they can work in groups of 3-4 students. NOTE: If there is not a space for students to dig, that is OKAY! - see the Adaptations section.
2. Pre-dig one soil core.
3. Organize the exploration materials so each group of 3-4 students has a soil color book, magnifying glasses, magnifying boxes, rulers, and (optional) strainers.

Teacher Notes

**Soil vs. Dirt:** An important note that comes up in most discussions of soil with students: Soil is different from dirt. Soil is the Earth material composed of mineral and organic material, air, and water that serves as a medium for plant growth and other uses. Dirt is simply soil that is out of place. For example, when you track soil into your house on your shoes, soil becomes unwanted and is called dirt. Otherwise, it is called soil because it is an important resource we need and it has an important job to do. In order to show respect for our natural environment, we call it soil and not dirt!

**Soil Profiles and Horizons:** The face of a soil, or the way it looks if you cut a section of it out of the ground, is called a **soil profile or soil core**. Every soil profile is made up of layers called **soil horizons**. Soil horizons can be as thin as a few millimeters or thicker than a meter. Soil profiles and their horizons change as you move across a landscape, and also change as you move downward deeper into the soil at one location. In fact, soil samples taken at the surface may have entirely different characteristics and appearances from soil dug deeper in the soil profile. One common reason soil horizons are different as you dig deeper is because of mixing of organic material in the upper horizons and weathering and leaching in the lower horizons. Erosion, deposition, and other processes might also affect the way a soil profile looks at a particular location.

What To Do and How To Do It

1. Tell students that they will be investigating the soil around their school or location. Tell them “I am wondering what the soil will be like here at our school. Can you make a prediction about what the soil might look like, feel like, or what we might find in the soil?”

2. Show them a pre-dug soil core. Ask them what they notice about it (guide them to notice the different colors and layers they see). Tell them that the layers in the soil are called “soil horizons”. What do they think the top horizon is made out of? If they are having trouble guessing, ask them to look around on the surface of the soil - what do they...
notice? This top layer is called the ‘**organic layer**’ made up of organic materials that are starting to decompose (i.e. things that were once living - leaves, bark, grass, twigs). What you find next is going to depend on your local environment, but there will likely be **topsoil** (a mix of organic material and minerals from the parent material), **subsoil** (mostly weathered rocks and mineral), and **parent material** (geologic material from which soil horizons form). More information on soil horizons can be found here: https://www.soils4teachers.org/soil-horizons/. No matter what you find, ask students *why they think the different soil layers are different colors.* Color change has to do with the minerals found in the soil, how much organic matter is in each layer, and the environment (much more on soil colors here: https://tinyurl.com/SoilColor).

3. Depending on student interest, topics you want to cover, and/or how long students can engage in conversation, you could include discussion on (see further information on each topic here in the *Soils Background Info Sheet*):
   a. **Why is soil important?** *(connection with agriculture, Earth and human activity, interdependent relationships in ecosystems)*
   b. **What is soil made up of?** *(connection with living vs. nonliving, structure and property of matter)*
   c. **How is soil formed?** *(connection with weathering, erosion, landforms, history)*
   d. **What lives in soil?** *(connection with life science, interdependent relationships in ecosystems)*

4. Tell students they are going to be able to dig their own soil cores. Introduce the tools they will use to dig, and the exploration tools. This period is most successful if students are split into student teams of 3-4, and rotate through each coring tool. If your school/organization has a microscope, it is also great to include a microscope station. Encourage students to make detailed observations, and to pay attention to the different colors and textures they notice in the soil layers.

5. This open-ended exploration time can include sketching and recording observations in a science notebook or on the Soil Investigation Sheet.

6. If you have more than 45 minutes for each student group, you can repeat this process at another location (this is especially interesting if you are able to get to another habitat) and/or include other activities such as **exploring soil texture, sand silt, and clay and making a mini soil profile.**

7. With the last 10-15 minutes of time, have students clean up their area and join you at the Soil Tent for a wrap up. **For notes on how to use the soil murals for wrap up, see the end of this document.**
Adaptations

Not every location will have a space where students can dig outside (due to weather or location limitations), and this is OKAY and students will still get hands-on exploration time with soil! There are a few options for this scenario. One is to have pre-dug soil samples from another location set up (inside or outside) in gutter sections or other large containers (roasting pans work well). It is good to have some samples for observations so they can really notice, measure, and sketch the layers, and some samples that they can disturb to feel the texture and look for organic materials, rocks, critters, etc. If not kept covered, these samples will dry out after a few days and it will be much harder to see the different layers.

Another option is to have large chunks of intact soil in bins, and students can practice using the soil coring tools in the bin to pull out their own soil samples.

If there is space to dig, but the weather is not cooperating, the soil tent could be set up over a digging station, and students could dig their own soil cores to bring inside for investigation as described above.

Other considerations

After students are done with the soil programming, any holes made should be filled in to the best of your ability.

What’s next?

More Soil Tent Activities There are other activities that can be done in conjunction, before, or after the soil exploration. This includes determining texture, exploring samples of sand, silt, and clay, and creating a mini soil profile. All activities can be done indoors or outdoors. The mini soil profile should be done after the students have explored their local soil. Texture and Sand Silt and Clay can be done at any time. The guide to these activities can be found in Soil Tent Activities: Sand, Silt, and Clay, Mini Soil Profile, Determining Soil Texture.

Go Further with extension activities and experiments. The guide to these activities can be found in Soil Tent Activities: Go Further.

Soil Art. We highly recommend including soil art as a part of this experience. Students can work with a classroom teacher, art teacher, or volunteer to complete soil art projects. Instructions on how to make soil murals (like the ones in the Tent) as well as other soil art ideas can be found in Soil Art Murals.
Using the Soil Tent Murals for wrap-up and systems thinking discussions

Soil mural panels from the Soil Tent. They represent soils from a wetland (left), a forest (center), and a meadow (right).

This worked well as a wrap-up to the soil exploration, but could also be done in small groups during the soil exploration time.

1. Tell students to imagine that they are shrinking down and will be going underground to explore what different types of soil in NH look like.
2. Lead students into the tent and give them a minute to take in the murals. Tell them that the murals were created by elementary students in NH. If they will be working on a similar project with their art teacher, this is a great time to get them excited!
3. Use the following questions (or more that you come up with) to engage students in a discussion of soil types. Encourage them to wonder and ask questions, and remind them that scientists make careful and detailed observations!
   a. Can someone point out where the surface of the soil is?
   b. Each of the three murals shows a different habitat, look carefully at each one. Can you find any clues as to which habitat they are?
   c. What differences do you notice in the soils between the different habitats?
   d. Why do you think soils look different in these three habitats?
   e. Which soil mural looks the most like the soil you explored today?
   f. The plants look different in each habitat. Do you think the soil determines what plants can grow? Do you think the plants determine how the soil can develop?
   g. Include any other general wrap up questions here as well. E.g., was there anything that surprised you during the soil investigation? What did you notice about the texture of the soils? Color of the soils?
Outdoor Soil Investigation

Soil location (What habitat? What does it look like near the soil pit?):

___________________________________________________________

Soil layers:
Draw the layers you notice in the soil. How deep is each layer? Label your drawing with measurements in centimeters (cm).

The top of the soil core is 0 cm.

The bottom of the soil core is ________ cm.
**Soil Observations**

Record what you notice about each layer in the soil!

<table>
<thead>
<tr>
<th>Soil Layer</th>
<th>Texture (sand/gritty, silt/smooth or clay/sticky?)</th>
<th>What is in the soil? (do you see rocks, insects, plants?)</th>
<th>Soil Color (Use colored pencils and the color books!)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (top)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
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<td>B</td>
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<tr>
<td>C</td>
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</table>
# Soil Tent Activities: Sand Silt and Clay, Mini Soil Profile, Determining Soil Texture

*All Activities can be done inside or outside.*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Materials Needed</th>
<th>Time</th>
<th>NGSS, CCSS Standards supported by the activity</th>
</tr>
</thead>
</table>
| **Sand, Silt, and Clay Exploration** - Students rotate through stations to make predictions about the properties of various soil samples and examine several types of soils, recording their observations. Instructions are in the [GLOBE Teacher Guide](#) (pages 2 and 3). | • Samples of sand, silt, and clay (provided)  
• Printed Sand Silt and Clay cards (provided)  
• Magnifying lenses (provided)  
• Pencil and drawing tools  
• [Getting to Know Soils Activity Sheet 1](#) printed for each student  
• Paper to cover workspaces if inside | 30 minutes | DCI ESS2.A  
Science Practice 1 Asking Questions  
Science Practice 8 Obtaining, Communicating, and Evaluating Information  
Crosscutting Concept 1 Patterns  
CCSS.ELA W.2 Write informative/explanatory texts  
CCSS.ELA W.4 Produce clear and coherent writing |
**Create a Mini Soil Profile** - Students make a mini soil profile with soil samples from the soil pit. Simple instructions on how to assemble the mini soil profile can be found on the NRCS Website.

- On their card, have students write their name and the habitat the soil came from (i.e. Forest, Meadow, Wetland).
- Depending on the age of students, have them label the depth of each soil horizon (layer)

*An NRCS activity.*

<table>
<thead>
<tr>
<th>Equipment &amp; Instructions</th>
<th>Time</th>
<th>DCI/PS</th>
<th>Science Practice/Crosscutting Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Profile Cards, printed on heavy paper and cut&lt;br&gt;Carpet Tape (provided)&lt;br&gt;Soil Sample from different layers in soil pit (plastic containers provided)&lt;br&gt;Ruler (optional)&lt;br&gt;Paper to cover workspaces if inside</td>
<td>30 minutes</td>
<td>DCI PS1.A Structure and Properties of Matter&lt;br&gt;Science Practice 2 Developing and Using Models</td>
<td></td>
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</tbody>
</table>

**Determining Soil Texture Activity** - Students determine if their soil is mostly made of sand, silt, or clay. Simple instructions can be found on Page 6 of Wild Times Journal for Kids (from NH Fish and Game).

- A handful of soil<br>Water<br>Rules (provided)<br>Paper to cover workspaces if inside

15 minutes  | Science Practice 4 Analyzing and Interpreting Data<br>Crosscutting Concept 6 Structure and Function
TESTING SOIL TEXTURE

You will need: a handful of soil, water and a tape measure or ruler.

1. Get a handful of soil from a garden or schoolyard.

2. Wet the soil gradually and work it in your hand until it forms a ball. Keep working the ball of soil until it doesn’t change any more.

3. Now, slowly squeeze the soil out between your thumb and your forefinger – pushing away from your body. Watch carefully to see if the soil sticks together and if a “ribbon” forms...

- If the soil won’t form any sort of ribbon at all and is very hard to form into a ball, then the soil texture is SANDY. Grains of sand will stick to your fingers.

- If you can make a ribbon about an inch long before it breaks off, and the ball of mud feels spongy, but you can’t feel any sand grains, then you can describe your soil as SILT.

- If the ball of mud feels like very smooth playdough, and you can make a long ribbon of two inches or more, then it is a CLAY soil.
A Soil Profile

Background
If you look in a soil pit or on a roadside cut, you will see various layers in the soil. These layers are called soil horizons. The arrangement of these horizons in a soil is known as a soil profile. Soil scientists, who are also called pedologists, observe and describe soil profiles and soil horizons to classify and interpret the soil for various uses.

Soil horizons differ in a number of easily seen soil properties such as color, texture, structure, and thickness. Other properties are less visible. Properties, such as chemical and mineral content, consistence, and reaction require special laboratory tests. All these properties are used to define types of soil horizons.

Soil scientists use the capital letters O, A, B, C, and E to identify the master horizons, and lowercase letters for distinctions of these horizons. Most soils have three major horizons -- the surface horizon (A), the subsoil (B), and the substratum (C). Some soils have an organic horizon (O) on the surface, but this horizon can also be buried. The master horizon, E, is used for subsurface horizons that have a significant loss of minerals (eluviation). Hard bedrock, which is not soil, uses the letter R.

Project
1. Print the soil profile cards onto cardstock paper or draw your own design on a 3" x 5" note card. (The following files will print 6 cards per page.)
   - Soil Profile Cards (DOC; 340 KB)
   - Soil Profile Cards (PDF; 115 KB)
2. Cut the cards apart.
3. Attach a short strip of carpet tape to the card. Rolls of double-sided tape come in various widths. One-inch tape is adequate.
4. Pull back the tape at the top to expose some of the sticky tape and place soil from the surface horizon to represent the depth of this soil.
5. Pull back the tape for each additional layer one at a time following the same procedure.

6. Properly dispose of the remaining tape piece.

7. The card can now be placed in an envelope to protect it.

8. You might also collect a little surface vegetation to keep with your soil type for learning about plant-soil relations.

You can demonstrate erosion severity by altering the depth of the A horizon or display various types for soils found in different locations.

Displays can be made of several soils on a drawing of a hill slope or other landscape by using the tape on a larger card or poster.

Have fun with soils!
Go Further: Extension Activities
## Soil Tent Activities: Go Further with Extension Activities and Experiments

<table>
<thead>
<tr>
<th>Activity</th>
<th>Materials Needed</th>
<th>Time</th>
<th>NGSS, CCSS Standards supported by the activity</th>
</tr>
</thead>
</table>
| **Getting to Know Soil Part 2: Soil Profile Activity** - Students explore the properties and make-up of soils through a simple experiment. Instructions are in the [GLOBE Teacher Guide](page 4). | ![Image](soil_sample) *Soil Sample*  
• 16 oz or larger clear jar (one per group)  
• Pencil and/or drawing tools  
• [Getting to Know Soils Activity Sheet 2](page 4) printed for each student  
• Paper to cover workspaces if inside | 30 minutes | DCI ESS2.A  
Science Practice 1 Asking Questions  
Science Practice 8 Obtaining, Communicating, and Evaluating Information  
Crosscutting Concept 1 Patterns  
CCSS.ELA W.2 Write informative/explanatory texts  
CCSS.ELA W.4 Produce clear and coherent writing  
CCSS.ELA W.7 Conduct short as well as more sustained research projects  
MD A.1-A.4 Measurement and Data |
| **We All Need Soil Part 2** - This is a great activity with a beautiful literacy connection! Students create soil connection sentences about how living things use soil. Instructions are in the [GLOBE Teacher Guide](pages 3-4) | ![Image](activity_cards) *Whiteboard/chart paper and markers*  
• Activity Cards from the [We All Need Soil Activity Cards Sheets 1-6](page 4) (one set of cards for each group) | 30 minutes | DCI ESS-2A: Earth Materials and Systems  
DCI LS-1C: Organization for Matter and Energy Flow in Organisms  
Science Practice 2 Developing and Using Models  
Crosscutting Concept 2 Cause and Effect |
### Water and Soil Investigation
- A simple experiment to determine how much water different soil types can hold.
- Instructions, full material list, and student investigation sheet found in the Teacher Guide: [https://tinyurl.com/WaterAndSoil](https://tinyurl.com/WaterAndSoil).
- (Modified from a Project SEE activity.)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshop printed</td>
<td>(1 per student)</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Soil sample from two different habitats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dixie cups</td>
<td>(1 per group, half labeled &quot;A&quot;, half labeled &quot;B&quot;)</td>
<td></td>
</tr>
<tr>
<td>Coffee filters</td>
<td>(1 per group)</td>
<td></td>
</tr>
<tr>
<td>Beakers or cups</td>
<td>(1 per group)</td>
<td></td>
</tr>
<tr>
<td>Graduated cylinder</td>
<td>(1 per group)</td>
<td></td>
</tr>
<tr>
<td>Funnels</td>
<td>(1 per group)</td>
<td></td>
</tr>
<tr>
<td>Paper towels</td>
<td>(1 per group)</td>
<td></td>
</tr>
<tr>
<td>Sponge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Crosscutting Concept 5 Energy and Matter**

- CCSS.ELA W.2 Write informative/explanatory texts.
- DCI PS1.A Structure and Properties of Matter
- Science Practice 1 Asking Questions
- Science Practice 3 Planning and Carrying out Investigations
- Science Practice 4 Analyzing and Interpreting Data
- Science Practice 5 Using Mathematical and Computational Thinking
- Science Practice 7 Engaging in argument from evidence
- Science Practice 8 Obtaining, evaluating, and communicating information
- CCSS.ELA W.2 Write informative/explanatory texts
- CCSS.ELA W.4 Produce clear and coherent writing
- CCSS.ELA W.7 Conduct short as well as more sustained research projects
- MD A.1-A.4 Measurement and Data
<table>
<thead>
<tr>
<th>Activity</th>
<th>Materials needed</th>
<th>Time</th>
<th>Science Practices</th>
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<tbody>
<tr>
<td><strong>Just Passing Through</strong></td>
<td>Materials needed are outlined in the</td>
<td></td>
<td>DCI PS1.A Structure and Properties of Matter</td>
</tr>
<tr>
<td>[Beginner Version] - A GLOBE</td>
<td>Teacher Guide</td>
<td></td>
<td>Science Practice 1 Asking Questions</td>
</tr>
<tr>
<td>activity that is similar to the</td>
<td></td>
<td></td>
<td>Science Practice 3 Planning and Carrying out Investigations</td>
</tr>
<tr>
<td>Water and Soil Investigation</td>
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<td></td>
<td>Science Practice 4 Analyzing and Interpreting Data</td>
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<tr>
<td>above, students time the flow of</td>
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<td>Science Practice 5 Using Mathematical and Computational Thinking</td>
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<tr>
<td>water through different soils.</td>
<td></td>
<td></td>
<td>Science Practice 7 Engaging in argument from evidence</td>
</tr>
<tr>
<td>Instructions and student report</td>
<td></td>
<td></td>
<td>Science Practice 8 Obtaining, evaluating, and communicating information</td>
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<tr>
<td>are in the Teacher Guide.</td>
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<td></td>
<td>CCSS.ELA W.2 Write informative/explanatory texts</td>
</tr>
<tr>
<td>*A version of the activity for</td>
<td></td>
<td></td>
<td>CCSS.ELA W.4 Produce clear and coherent writing</td>
</tr>
<tr>
<td>older students can be found here*</td>
<td></td>
<td></td>
<td>CCSS.ELA W.7 Conduct short as well as more sustained research projects</td>
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<td></td>
<td></td>
<td></td>
<td>MD A.1-A.4 Measurement and Data</td>
</tr>
<tr>
<td><strong>The World’s Apple -</strong></td>
<td>• Instruction sheet</td>
<td>15 minutes</td>
<td></td>
</tr>
<tr>
<td>Demonstration with an apple</td>
<td>• Apple (1 or enough for whole class)</td>
<td></td>
<td>Science Practice 1 Asking Questions</td>
</tr>
<tr>
<td>showing how much of the world’s</td>
<td>• Knife (set of plastic knives if</td>
<td></td>
<td>Science Practice 3 Planning and Carrying out Investigations</td>
</tr>
<tr>
<td>surface is capable of producing</td>
<td>necessary)</td>
<td></td>
<td>Science Practice 4 Analyzing and Interpreting Data</td>
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<tr>
<td>food. Can be done as a teacher</td>
<td></td>
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<td>Science Practice 5 Using Mathematical and Computational</td>
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<td>demo or as a class. Great</td>
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<td>MD A.1-A.4 Measurement and Data</td>
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<tr>
<td>agriculture. An NRCS activity.</td>
<td>students are participating)</td>
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</tbody>
</table>
Purpose
To develop an understanding of how water flows through different soils and how it is transformed when it flows through these soils.

Overview
Students time the flow of water through different soils and observe the amount of water held in these soils. They will also observe the filtering ability of soils by noting the clarity of the water before and after it passes through the soil.

Student Outcomes
Students will be able to identify the physical and chemical changes that occur as water passes through soil.

Science Concepts
Earth and Space Science
- Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.
- The surface of Earth changes.
- Soils consist of minerals (less than 2 mm), organic material, air and water.
- Water circulates through soil changing the properties of both the soil and the water.

Scientific Inquiry Abilities
- Identify answerable questions.
- Design and conduct an investigation.
- Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.
- Develop descriptions and explanations, predictions and models using evidence.
- Communicate procedures and explanations.

Time
One class period

Level
Beginning

Materials and Tools
(for each team of 3-4 students)
- Clear 2 liter bottle
- Three 500 mL beakers* or similar size clear containers marked off in cm to pour and catch water
- Soil sample (Bring in 1.2 L samples of different types of soil from around the school or from home. Possibilities include top soil (A horizons), subsoils (B horizons), potting soil, sand, soils that are compacted, soils with grass growing on top, soils with clearly different textures, colors, or structures)
- Fine window screen or other fine mesh that does not absorb or react with water (1 mm or less mesh size)
- Water
- Clock or timer

Note: Smaller containers may be used if desired as long as the soil container sits firmly on the water catchment container. Reduce the amounts of soil and water - but remember that it is important for all students to start with the same amount.

*You can use 1- and 2-liter bottles and beakers (either 400 or 250 mL) or you can cut bottles to act as beakers. See the Just Passing Through Learning Activity at: http://www.globe.gov/web/soil/documents.

For more advanced students:
- pH paper, pen, or meter

Prerequisites
None
Background
What happens to water when it passes through soil depends on many things such as the size of soil particles (texture and particle size distribution), how the particles are arranged (structure), how tightly they are packed (bulk density), and the attraction between the soil particles and the water. Some types of soil let water flow in quickly, and then hold the water inside the soil like a sponge. This might give plants a better chance of using some of that water. Other types of soil may let the water go completely through in just a few seconds. Still other soils may keep the water from getting in at all. None of these soil types is better than the other - they are simply good for different reasons. Which soil property would you look for if you wanted to plant a garden? Build a driveway or a playground? What happens if the soil is full of water and a heavy rain falls on it? How can you change the way your soil holds water? What happens to the soil when organic matter is added, when plants are growing on top of it, when it is compacted, or when it is plowed?

Preparation
- Discuss some of the general characteristics of soils or do Why We Study Soil or Soil in My Backyard learning activities or the Soil Characterization Protocols.
- Bring in samples of different types of soil from school or from home.
- Remove the labels and lids and cut off the bottoms of the clear plastic 2 L bottles.
- Place a circle of screen inside the bottle so that it covers the cap opening.
- Pour 3-4 cm of sand onto the screen. The sand will keep the screen from becoming clogged.
- Place the bottle, mesh side down, on a beaker or clear container.
- Pour 1.2 L of soil into the bottle over the sand.
- Copy the Work Sheets for each student

What To Do and How To Do It
Class Investigation
1. Choose a soil (a sandy soil works best) to use for demonstration and place 1.2 L of the soil into the 2 liter bottle.
2. Have students look closely at the soil. What do students notice: Color? Plant matter? Does it feel light or heavy? Is it granular (like cookie crumbs) or blocky (clumpy)? Record their observations about the soil on the board.
3. Pour 300 mL of water into a 500 mL beaker or other clear container for pouring. Have students notice the clarity of the water.
4. Use a black marker to draw a line showing the height of the water in the pouring container. Have students count the cm lines to reach the top of the water. Record this number on the board.
5. Ask the students “What will happen when you pour the water onto this soil?” Ask students to explain why they think the soil and water will behave this way when water is poured onto it. Some possible questions to ask are:
   - Will the water run out through the bottom of the bottle?
• Will all of it run out? How much will run out? Make a mark on the pouring container with a red pen to show how much of the water students think will flow out.

• How fast will the water pass through the soil? Older students may time with a clock or stopwatch. Younger students can time by marking the minutes off on a timer (like in the Work Sheets) as the teacher times.

• What will the water look like when it comes out the bottom? Clear? Murky? Very Dirty?

6. Record the class ‘hypotheses’ on the board.

7. Pour the water onto the soil and begin timing. Ask students to describe what is happening as you pour the water:
• Is all the water staying on top?
• Where is it going?
• Do you see air bubbles at the top of the water?
• Does the water coming out of the soil look the same as the water going in?
• Does the soil look different where the water has gone?

8. Record the class observations on the board. Also record how long it takes for the water to pass through the soil.

9. Ask students to compare their hypotheses and the results of the experiment.

10. Once the water has stopped dripping from the bottom of the bottle, remove the soil bottle and hold up the beaker of water which has passed through the soil. Ask students:
• Is this the same amount of water that we started with? How can we tell if it is the same amount?
• Pour the water back into the original container. Compare the amount left with the black line on the container. How much water is missing? How could we measure how much is missing?
• Compare the water level to the red line on the container. Is there more or less water left than we thought there would be? How could we measure the difference? Why did you think there would be more or less?

• What happened to the water that is missing?
• Is the water more or less clear than before it passed through the soil? Why?

11. Keep the water that was poured through for comparison.

12. Using the bottle of saturated soil, ask students what will happen if you pour another 300 mL of water into the soil. Record the class hypotheses on the board.
• Will the same amount, more, or less water stay in the soil this time?
• Will it move through faster or slower or at the same speed?
• How clear will the water be? The same, more clear, or less clear than before?

13. Pour the water through the saturated soil, keep the time, observe the results, and compare with the hypotheses. Ask students:
• Did the water flow through faster than before? How do you know? Compare the two times.
• Did more of it flow through than before? How can we find out? Compare the amounts in the beakers.
• Is the water as clear as the first time? Compare the color of the water in the two beakers.
Group Investigation

Experimenting with different soils

Discussion
1. Review the properties of the various soil samples that were brought in.
2. Ask students if they think water would pass through all of the types of soils in the same amount of time and if all the soils would hold the same amount of water.
3. Discuss which soils they think might be different.
4. Provide each group of students with one of the various soils.

Observation and Hypotheses
1. Give each student the Look and Guess Work Sheet.
2. Ask the students to fill in the Color of their soil (in words or with a crayon).
3. Ask the students to circle the Structure which looks most like their soil.
4. Ask students to look for leaves or Organic matter in their soil. Circle YES if they find organic matter. Circle NO if they do not.
5. Time: Remind students of the observations which they made during the demonstration. Ask students to guess the amount of time it will take water to flow through their soil. Circle the time on the timer, then write the number in the blank.
6. Amount: Ask students to draw a RED line on the container showing the amount of water they think will flow through their soil.
7. Clarity: Ask students to put an X on the container which will look most like their water after it flows through their soil.

Experiment and Report
1. Explain that when you say ‘GO’ everyone will pour their water in together.
2. You will begin to time when the water is poured.
3. Have students fill in the Experiment and Report Work Sheet for their soil.

Have each group report on the results of their experiment to the class. Reports should include Questions, Hypotheses, Observations and Conclusions about the experiment. Students can use their Work Sheets to prepare their reports.

Further Investigations
1. Using distilled water, have students measure the pH of the water.
2. Predict whether the pH will be different after the water passes through the soil.
3. Pour the water through, then test the pH again.
4. Have students draw conclusions about the effect of soil on water pH.

Note: 1. Use this procedure to experiment with conductivity by measuring the conductivity of distilled water before passing it through the soil, then using saltwater and passing it through the soil. 2. Experiment with filtering by using very murky water and passing it through clean sand.

Ask students to perform the advanced version of the Just Passing Through Learning Activity.
Look and Guess

My soil is ___________ color

My soil looks granular blocky

My soil has leaves. YES NO

Time ________

How much water will come out? Make your line RED.

What will the water look like? (CIRCLE)
Experiment and Report

Time _______

How much water came out?

What did the water look like?

My Report
Unit Title: Water and Soil Experiment  
Time Frame: 45 minutes

Resources Required:
- Worksheets (1 per student)
- Two types of soil collected ahead of time by teachers (will need ~1 sandwich containers worth of each soil type - for example from a wetland and a forest)
- Dixie cups (1 per group, half labeled "A", half labeled "B")
- Coffee filters (1 per group)
- Beakers or cups (1 per group)
- Graduated cylinders or other water measuring device (1 per group)
- Funnels (1 per group)
- Paper towels (1 per group)
- Sponge (1 for demonstration)
- Team Jobs outline (1 for teacher)
- Water

Main Ideas and Goals:
Essential Questions:
- Why is soil important to a habitat?
- Would different soils with different textures let different amounts of water go through them?

Students will:
- Discuss the importance of soil in habitats (S:LS2:4:1.2).
- Examine closely different soil types and compare and contrast them (S:ESS1:2:6.2).
- Complete a group experiment and record data (S:SPS1:2:3.2).

Introduction/Instructions/Lecture:
Set up: Scoop soil into Dixie cups, one soil type in the cups labeled "A", the other type in the cups labeled "B". Pour out 100 mL water into 6 graduated cylinders.

Ask students why soil is important to a habitat. Where do plants get their water and food? Would different soils soak up different amounts? Discuss how wetland soils differ from desert soils in the amount of water they hold, and why that might be important for the plants and animals living there.
Activity:

Explain that the students will be conducting an experiment as small groups (4 students per team when possible). Each student will have a number and specific jobs to do, so the class will have to listen carefully for directions and not try to move ahead of the other groups. Demonstrate how they will use their tools so the students can see what their “laboratory” should look like and how to conduct the experiment. There are two types of soil (ex: from a wetland and a forest), so the students will not only be taking their own data but also comparing it to other groups.

When the students are back at their seats in designated teams, distribute worksheets and assign each student a number. Tell the students to write their number down on the top of their paper. Have students write in the Investigative question: "Which soil will hold more water: the __________ soil or the __________ soil?" Fill in the blanks with the locations where you collected the two soil types. Then have students write a hypothesis- "I predict that _____ soil will hold more water because ________".

Using the Team Jobs outline, instruct students to get the materials they will need for their experiment. Be sure to use the numbers you assigned them so everyone gets a job. Students should record what type of soil their group has (A or B), what color it is, its texture, and what its mostly made up of on their worksheet. Remind students to use descriptive language to describe color and texture.

To set up their “laboratory”, students will put their funnel into their beaker, their coffee filter into their funnel, and then their soil into their coffee filter. Next, students will get 100mL of water. Students will SLOWLY pour the water over the soil by taking turns; everyone pours the water. Warn students to wait if a puddle forms on top of their soil so they do not break their coffee filter. Have the students draw and label their experiment on the back of their worksheet as they wait for the water to seep through the filter.

After about 5 minutes, students will then put the funnel/soil onto a paper towel and pour what is left of the water into the graduated cylinder. Students will record how much water ran through on their worksheet. Each group will report their results for a class t-chart that you draw on the board.

Have students fill in the rest of their worksheet. Explain that having your hypothesis supported means that what they predicted is what happened in the experiment.

Wrap up:

Talk about saturation with the students. Bring out a sponge and use it to illustrate what you mean by the word saturation. Look at your class data, which soil was more like a sponge? (Go through the process of subtracting the number from 100mL to find how much water each soil held). Discuss why each group may have gotten different results. How does soil affect the type of plants that can survive in a habitat?
Soil and Water Lab Report

Investigative Question:

________________________________________________________________________

________________________________________________________________________

Hypothesis:

________________________________________________________________________

Procedure:
1) Get cup of soil.
2) Record soil observations.
3) Gather materials.
4) Set up experiment and pour soil into filter.
5) Slowly pour water onto the soil.
6) Wait 5 minutes.
7) Remove filter from cup.
8) Pour water into the graduated cylinder.
9) Measure how much water dripped out.

Soil Observations:
1. My soil type is A B .
2. The color of my soil is __________________________
3. My soil feels (texture) __________________________
4. Other observations: __________________________

Results:

I put _______milliliters of water into the soil.

I measured _______milliliters of water that dripped out of the soil.
Conclusions:

5. Did all of the water you put into the soil drip out of the soil?
   Circle one: YES  NO

6. What happened to the water that did not drip out?

________________________________________________________________________

________________________________________________________________________

7. Read your hypothesis. Was it supported? Explain your answer with evidence from the class chart.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Draw your experiment here. Don’t forget to label the parts!
**Activity Sheet**

**The World’s Apple**

On planet earth all living things depend on the soil: Plants, people, animals...even fish...rely on the soil for food. Only a small portion of our land is capable of producing food.

---

### Try this demonstration

<table>
<thead>
<tr>
<th>One</th>
<th>Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imagine the earth as an apple.</td>
<td>Cut it into 4 equal parts. Only one part is land—the rest is water.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Three</th>
<th>Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut the land section in half. One part is mountains, deserts, or it is covered with ice.</td>
<td>Cut the other livable area into fourths. Three of these are too rocky, wet, hot, infertile, or covered with roads and cities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Five</th>
<th>Six</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is now only 1/32 of a slice of apple remaining...</td>
<td>When this section is peeled it represents the topsoil on which the food is grown that must feed the people on the earth</td>
</tr>
</tbody>
</table>

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**Conservation Across America**

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Instructions to Educators for:

“The World’s Apple”

1. Have each student bring a clean apple to class.

2. The teacher should provide the following:
   
   a. a plastic knife (picnic ware) for each student

   b. paper towels

3. Let students cut their apples at the same time.

4. Following completion of exercise, let students eat their apple.

Note: This activity involves math (fractions), earth science, and also provides a healthy classroom snack with emphasis on eating a product of the earth.
Soil Art
Creating Your Own Soil Art Murals

*Process created by artist Julie Puttgen.*

For a detailed description of the process artist-in-residence Jule Puttgen used in developing the soil artwork and murals, please read her descriptions from the three schools she visited during development of the Soil Tent: [https://groundbeneathourfeet.weebly.com/school-soil-murals.html](https://groundbeneathourfeet.weebly.com/school-soil-murals.html).

**Materials:**

- tar paper (4' wide roll)
- oil pastels - a "classroom box" is ideal - you will go through a lot of these
- white oil pastels - it's a good idea to order more of these, because they show up beautifully against the black paper
- masking tape in 1/2", 3/4" 1", and 1.25" widths. you'll be drawing with this - so a variety of widths really helps
- yupo plastic "paper" for stencils
- scissors for stencils
- variety of sample-size latex house paint colors
- grommeting tool and brass grommets (if hanging murals this way)

**Time Needed:**

Depending on the age of the students and logistics of the school, this process could be completed in 3-4 50-minute periods.

**Process:**

These steps can be used to create large classroom murals and smaller individual murals. Julie had students create both sizes of these during the Soil Tent visit. Students can work concurrently on both the small individual and large team murals, using the same process and stencils for both. Julie recommended no more than 4-6 kids to a mural panel at any one time.

1. *(Optional)* Drawing with detail. Work together as a class to create a detailed image. From *Julie’s description* "I talked about how both scientists and artists work hard together to be as specific as possible about their observations, and invited the kids to do a remembering and drawing exercise on the whiteboard at the front of the room. *What does a grasshopper look like?* One kid would come to the board, and start the drawing. *How could we be more specific?* Kids would volunteer that the back legs were different than the others, etc. I encouraged kids to be drawing their own version of whatever we were tackling, while the group activity was taking place. Many of them did.”
2. Drawing with tape.
3. Fill in big areas of color.
4. Add details.
5. Cut stencils.
6. Paint stencils on. (*Optional* - using natural pigments with motivated teacher, parent volunteers, or ordering earth pigments as a powder)
7. Peel tape (not pictured)
8. Grommet upper edge if hanging (teacher job, not pictured)
9. Spontaneous ritual - Julie enjoyed giving students the space to problem solve how they would move their artwork when finished and how they would tell the story of their piece.
10. Storytelling - student groups share their artwork and tell the story of their piece using what they learned in the science phase, exploring soils, and in the art phase, making the mural.

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| STEP 10 | |
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Other Soil Art Ideas

**Soil Paint:** Have your students explore the various colors of soil for a classroom art project. Take different dried soil samples and grind them into a fine powder. Notice the colors and textures of the different soils. Pour acrylic paint into small paper cups and mix different soils into the cups. Experiment with different amounts of soil to see how it affects the color of the paint mix. Use a paintbrush to apply the soil paint to a piece of paper and have fun creating some artwork! Instructions on how to make your own soil paint can be found here: https://tinyurl.com/SoilPaint.

**Soil Crayons:** Another art project using soils is to make soil crayons (https://tinyurl.com/SoilCrayon). Compare the soil colors to the colors in the GLOBE Soil Color books (provided with the Soil Tent kit).

**Soil Colors:** Further explore soil color and texture. Use paint chips or crayons in earth tones to look at the colors of various soil samples.

**Soil Collage:** Go out and dig in a certain area to find treasures in the soil. Sort the items and glue them on a piece of cardboard. Also glue different types of soil on the collage. If the students find live animals in the soil, have them draw them on paper and glue the paper to the collage. Then have them return the critters to the spot where they were found.
Painting with Soil

Teaching Objective: "To have fun and to gain a deeper appreciation of soils - one of our most important natural resources."

Introduction: Soils are one of our most important natural resources. They also are important for the beauty the many soil colors add to our landscapes. Most of us overlook this natural beauty because we see it every day. Often these colors blend with vegetation, sky, water, etc. Soil colors serve as pigments in bricks, pottery and art work. The color and texture of soil painting is fascinating and a creative opportunity for all ages of students.

Materials:
- Soil (dried in air)
- Hammer/mallet
- Mortar and pestle (rubber-tipped)
- Paper cups (4 oz.)
- Pencils
- Ink pens (black, different tip sizes)
- Paint brushes (different kinds and sizes)
- Artist acrylic (clear gloss medium) (Elmer’s glue works too)
- Sponges and rags
- Water color paper
- Masking tape

Procedure:
Soils
1. Gather many colors of soil.
2. Place dried soil on a piece of paper and crush into pieces with hammer or mallet.
3. Place some of the crushed soil into a mortar. Use a rubber-tipped pestle to crush the soil into a fine powder. Repeat to crush all of the different colored soils.
4. Place some of the powdered soil in a paper cup. Wrap a knee high hose over the top 2 or 3 times. Turn cup upside down over a piece of paper and gently shake out finely powdered soil.
5. Place the different soils in paper cups - notice the colors and textures.

Artwork
1. Lightly sketch art work on water color paper with pencil. When satisfied with composition use ink for permanent lines.
2. With masking tape, carefully tape paper edges to table or board. This is done so that the artwork will dry flat.
3. Pour small amount of artist acrylic in small paper cups. Add small amounts of finely powdered soil. You may also want to add a few drops of water to the soil mix.
4. Experiment with depth of color and mixing the different soils.
5. Use different sizes and kinds of paint brushes, sponges and rags. Experiment and have fun.
6. Layering the colors. When your art work is dry, you may want to apply another layer of soil paint.
7. You may want to use a black ink pen to make finishing touches on your art work.

Activity Time: The estimated time is about 1 or 2 hours.
Courtesy of the USDA National Resources Conservation Service
Soil Painting: Resources for Educators

USDA Natural Resources Conservation Service: Soils

Soil Education

Ten Key Messages to Understanding Soils

Soil Science Society of America

K-12 soil Science Teacher Resources
https://www.soils4teachers.org/

State Soil Booklet

Soil Painting

Kirsten Kurtz, Artist and Soil Scientist, Cornell University Soil and Crop Sciences
https://soilpainting.com/

Standard Operating Procedure for Soil Painting

Soil Science Society of America: Paint with Soil!

NRCS: Painting with Soil
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054304

Time Lapse of Soil Painting at the 2019 New York State Fair
https://www.youtube.com/watch?time_continue=1&v=xq348KENKow

Susan Hoskins, sbh1@cornell.edu, 4-H Geospatial Science and Technology Program, 10/2019
Elementary GLOBE Teacher Guides
Getting To Know Soil

**Purpose**

- To help students ask questions and make observations about soil.
- To introduce students to the properties of soil and that soil is made of many different organic and inorganic components.

**Overview**

Students make predictions about the properties of various soil samples and examine several types of soils, recording their observations. In Part 2 of the activity, they will examine a soil sample in a jar.

**Student Outcomes**

After reading and/or listening to the Elementary GLOBE book *The Scoop On Soils* and completing this activity, students will know about soil’s different properties. Students will know that soils have different properties including texture, color, and size.

**Next Generation Science Standards**

- DCI ESS-2A: Earth Materials and Systems
- Science Practice 1 Asking Questions
- Science Practice 4 Analyzing and Interpreting Data
- Science Practice 8 Obtaining, Communicating, and Evaluating Information
- Crosscutting Concept 1 Patterns

**CCSS.ELA Anchor Standards**

- W.2 Write informative/explanatory texts...
- W.4 Produce clear and coherent writing...
- W.7 Conduct short as well as more sustained research projects...

**CCSS.MATH Content Standards**

- MD A.1-A.4 Measurement and Data

**Time**

- Part 1: One 30-minute class period
- Part 2: One 30-minute class period

**Level**

Elementary (Part 1 is appropriate for grades K-4; Part 2 is most appropriate for grades 2-4)

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**Materials**

**Part 1:**

- *Elementary GLOBE* storybook: *The Scoop on Soils*
- For each student group:
  - Soil samples (sand, silt, and clay) in resealable plastic bags
  - Tweezers
  - Toothpicks
  - Magnifying lenses
  - Markers, colored pencils, or crayons
  - *Getting to Know Soils Student Activity Sheet 1* (one per student)

**Part 2:**

- A soil sample from a site near your school
- 16 oz or larger clear jars with lids (one per group)
- Stapler, scissors, and pencils
- Markers, colored pencils, or crayons
- *Getting to Know Soils Student Activity Sheets 2 and 3* (one per student)
Preparation

- Read the Elementary GLOBE storybook The Scoop on Soils – either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.

- Collect soil samples of sand, silt and clay or purchase them from science education suppliers. You can reuse the samples but they tend to get hard after they dry out. Moisten them for reuse, or grind them (with a hammer or rolling pin or mortar and pestle) to get them back into a usable state.

- Put the different types of soil in clear, resealable plastic bags so the students can see the soil before touching it; this way they can make some predictions about the soil. In addition, print and laminate labels that say: “sand,” “silt,” and “clay.” Put the labels by the different samples so students know what type of soil they are observing.

- Cover the classroom workspaces with newspaper.

- Make copies of Getting to Know Soil Student Activity Sheets 1, 2, and 3.

- Note: Alternatively, you can collect soil samples from local areas and have the students discover how much sand, silt, and clay is in the soil you collected.

Teacher’s Notes

Soil is different from dirt. Soil is the Earth material composed of mineral and organic material, air, and water that serves as a medium for plant growth and other uses. Dirt is simply soil that is out of place. For example, when you track soil into your house on your shoes, soil becomes unwanted and is called dirt. Otherwise, it is called soil because it is an important resource we need and it has an important job to do. In order to show respect for our natural environment, we call it soil and not dirt!

Soil Composition

Soils are composed of four main components:

- Minerals of different sizes
- Organic materials from the remains of dead plants and animals
- Water that fills open pore spaces
- Air that fills open pore space

The use and function of a soil depends on the amount of each component. For example, a good soil for growing agricultural plants has about 45% minerals, 5% organic matter, 25% air, and 25% water. Plants that live in wetlands require more water and less air. Soils used as raw material for bricks need to be completely free of organic matter.

Five Soil Forming Factors

They are:

1. Parent Material: The material from which the soil is formed. Soil parent material can be bedrock, organic material, or loose soil material deposited by wind, water, glaciers, volcanoes, or material moving down a slope.
2. Climate: Heat, rain, ice, snow, wind, sunshine, and other environmental forces break down the parent material and affect how fast or slow soil processes go.
3. Organisms: All plants or animals living in or on the soil (including micro-organisms and humans!). The amount of water and nutrients plants need affects the way soil forms. Animals living in the soil affect decomposition of waste materials and how soil materials will be moved around in the soil profile. The dead remains of plants and animals become organic matter that enriches the soil. The way humans use soils affect soil formation.
4. Topography: The location of a soil on a landscape can affect how climate processes impact it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not.
5. Time: All of the above factors assert themselves over time, often hundreds or thousands of years.
The way the five soil-forming factors interact is always different from one place to another, so soils differ greatly from each other. Each section of soil on a landscape has its own unique characteristics. The face of a soil, or the way it looks if you cut a section of it out of the ground, is called a soil profile. Every soil profile is made up of layers called soil horizons. Soil horizons can be as thin as a few millimeters or thicker than a meter.

Soil profiles and their horizons change as you move across a landscape, and also change as you move downward deeper into the soil at one location. In fact, soil samples taken at the surface may have entirely different characteristics and appearances from soil dug deeper in the soil profile. One common reason soil horizons are different as you dig deeper is because of mixing of organic material in the upper horizons and weathering and leaching in the lower horizons. Erosion, deposition, and other processes might also affect the way a soil profile looks at a particular location.

Soil texture is the way soil feels when it is squeezed between the fingers or in the hand. The texture depends on the amount of sand, silt, or clay in the sample (particle size distribution), as well as other factors (how wet it is, how much organic matter is in the sample, the kind of clay, etc.). Clay is a mineral particle less than 0.002 mm in size that has a sticky and dense feel when moistened and rubbed between the fingers. Silt is a mineral particle between 0.002 and 0.05 mm in size that has a floury and smooth feel when moistened and rubbed between the fingers. Sand is a mineral particle between 0.05 and 2.0 mm in size that has a gritty feel when moistened and rubbed between the fingers. In Part 1 of this activity, students should be able to feel the difference between clay, silt, and sand.

See the soil section of the GLOBE Teacher’s Guide for more information on soil (www.globe.gov).

What To Do and How To Do It

Part 1:

1. Hold up the three bags of soil (sand, silt, clay) and ask the students what they think they might find out about the soil samples if they were to study each kind carefully. Note: make sure the students know that these samples only represent one kind of sand, silt, or clay soil. Samples collected in other locations might be different colors, but the grain size will be similar to the samples you have.

2. After developing a list of predictions about the soil on the board, distribute soil and various tools (strainer, magnifying lenses, etc.) and supplies (water, markers/crayons, etc.) to small groups of students. Make sure the students keep the different soil samples separate. One way to keep them separate is to have each soil type at a different station and have the students take turns visiting each soil station.

3. Have the groups of students spend time experimenting with the different soil samples. With each sample they should use their various senses - feeling the soil with their fingers, smelling the soil, making visual observations, etc.

4. After experimenting with the different soil types, have the students record their observations of each soil type on their Getting to Know Soil Student Activity Sheet 1. They can also include a smudge of each soil sample as a way to record the soil color.

5. Have the students share their observations with the class. Use chart paper to record those observations. Encourage the students to discuss the soil’s texture and color. Explain those terms if necessary. Refer back to the student’s initial questions about soil during this discussion. See if their questions have been answered yet. If not, you may want to do further investigations.
Part 2:

1. Explain that soils are usually a combination of clay, silt, and sand and that soils usually include organic matter - living and dead plants and animals. Tell students that in this part of the activity, they will look at soil from near their school.

2. Have each group of students put a sample of soil from near your school into a jar that is partially filled with water. Tell them to put a top on the jar, shake the jar, and then observe what happens after two minutes, ten minutes, and 24 hours. Have them record their observations on the Getting to Know Soil Student Activity Sheet 2. Note: usually organic materials float to the surface and the inorganic materials settle into layers of different sizes and colors (the organic layer will be at the top, then clay, silt, and sand). Also, mark the water level on the jar at the start and observe how it changes.

3. Give each student a copy of the Getting to Know Soil Student Activity Sheet 3 and invite them to discuss the various layers in the soil. Note: Not all soil will settle in layers in this order. This is just one example. You can modify the Getting to Know Soil Student Activity Sheet 3 to match the way your local soil sample settles in the jar of water.

4. Add to the discussion as needed to discuss the different features in the soil layers. Focus on the visible features you can see in the profile, including different layers, grain size, roots, rocks, etc.

5. Have the students color in the different layers on the Getting to Know Soil Student Activity Sheet 3. Matching colors with layers in the jar of soil. See the “Soil Crayons” activity in the Further Investigations section of this activity for an idea of how to make crayons out of soil; the students could use those crayons to color the horizons in this activity.

6. Have the students complete the words on Student Activity Sheet 3. Have them cut out both the profile and cover sheet and staple the cover sheet to the top. To review the layers, have the students read a word and lift the corresponding flap to check that they correctly identified the word.

7. If you would like to take this activity to a more advanced level, have the students write in more information and observations about each layer on the back of its flap. Older students can also write the whole word rather than filling in the blanks.

Adaptations for Younger and Older Students

Younger students can sing songs about soils. The following Web site has several songs about soils: soils.usda.gov/education/resources/k_12/songs/.

Older students can practice making measurements of soil grains. If a grain is larger than 2.0 mm then it is considered gravel. Place a handful of sandy soil and some rulers on a table and have students measure the larger grains to see if they are classified as soil or rocks. Also, do the Soil and My Backyard Learning Activity with older students. This can be found in the soil chapter of the GLOBE Teacher’s Guide (www.globe.gov). You can also introduce the concept of turbidity to older students. Shake a jar of soil and water and hold a small light behind the back of the jar. Use a timer and record how much time passes before the light can be observed.

Older students can also explore the mechanism that causes different soil components to sort when settling in water (density) and identify which soil components have higher and lower density.

Further Investigations

- **Soil Word Wall:** Generate a list of words students might use to describe soil. This list should include ways to describe soil’s color, texture, and structure. Also include words that apply to the different senses. Your students can help you generate the list. Keep the list up on the wall while you are doing the Elementary GLOBE
soil activities so students can refer to it; it will help them think of words to use on their student activity sheets.

• **Soil Art:** Have your students explore the various colors of soil for a classroom art project. Take different dried soil samples and grind them into a fine powder. Notice the colors and textures of the different soils. Pour acrylic paint into small paper cups and mix different soils into the cups. Experiment with different amounts of soil to see how it affects the color of the paint mix. Use a paintbrush to apply the soil paint to a piece of paper and have fun creating some artwork! Another art project using soils is to make soil crayons. Go to the following Web site for more information on this activity: nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054292. Compare the soil colors to the colors on the Munsel Color Chart.

• **Soil Colors:** Further explore soil color and texture. Use paint chips or crayons in earth tones to look at the colors of various soil samples. Older students can follow a “Texture By Feel” flowchart to explore the different textures found in soils. Wow! The Wonders of Wetlands by Environmental Concern, Inc. and The Watercourse has an activity called Do You Dig Wetland Soil? that provides more details for this activity.

• **“Making” Soil:** To do this, collect the various ingredients that make up soil: small rocks, leaves, roots, bark, twigs, dead insects, etc. Put these items in a sturdy plastic bag or a pillowcase. Add a little water to the mixture. Help the students safely use a hammer or mallet to try and crush the soil building materials. Discuss the forces in nature that act like these hammers (freeze/thaw, water erosion, wind etc). Once they have done this, pour the mixture onto a surface and compare it to a soil sample you collected outside. Discuss with the students that one ingredient you didn’t use was time – if this had been a natural soil forming process it would have taken many years in nature for soil to form out of those ingredients!

• **Experimenting with soil and water:** Have your students make comparisons between their observations of dry and wet soil. They can observe differences in texture, color, weight, etc.

• **Observe Soil:** Find a special place to dig up the soil and make observations. Use tools like magnifying lenses, rulers, and color charts. Have your students write and draw what they discover in their journals.

• **Soil Investigations:** Use the GLOBE Teacher’s Guide for more information (www.globe.gov). As an extension to Part 2 of this activity, take your students outside at your school and expose a soil profile to make observations based on what they have learned in the classroom.
My observations about types of soil

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<th>Sand</th>
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<td><strong>What I feel</strong></td>
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<td><strong>What I smell</strong></td>
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The soil in the jar looked like this after:

- 2 minutes
- 10 minutes
- 24 hours (1 day)
Directions:
1. Cut along the dotted lines.
2. Color the layers on the bottle with pictures the colors you see in your bottle.
3. Fill in the missing letters on the bottle with words.
4. Put the bottle with words on top of the bottle with pictures and staple them together on one side at the black marks.

Name ____________________
**Purpose**

- To help students learn about natural things commonly found in soil and how these things impact how the soil looks and feels.
- To introduce students to the concept of decomposition.

**Overview**

Students will make predictions about what they think they will find in a sample of soil. They will investigate the sample and sort out the various items they find. Next they will spend time outside observing one or more sites to see what they find in the soil. After recording and sharing their observations they will create their own stories about the things they found in the soil.

**Student Outcomes**

After reading and/or listening to the *Elementary GLOBE* book *The Scoop On Soils*, students will know about various things found in soil including rocks, critters, roots, and other organic material. They will also understand that animals and microorganisms aid in the decomposition process that contributes organic materials to soil.

**Next Generation Science Standards**

- DCI ESS-2A: Earth Materials and Systems
- Science Practice 1 Asking Questions
- Science Practice 4 Analyzing and Interpreting Data

**CCSS.ELA Anchor Standards**

- W.2 Write informative/explanatory texts...
- W.4 Produce clear and coherent writing...
- W.7 Conduct short as well as more sustained research projects...

**Time**

- Part 1: One 30-minute class period
- Part 2: One 30- to 45-minute class period

**Level**

Elementary (most appropriate for grades K-4)

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**Materials**

**Part 1:**

- *Elementary GLOBE* storybook: *The Scoop on Soils*

  For each student group:

  - A soil sample from a site near your school
  - Mesh wire strainers
  - Tweezers, toothpicks, eye droppers, magnifying lenses, rulers
  - Pencils
  - Markers, colored pencils, or crayons
  - Copies of the *Soil Treasure Hunt Student Activity Sheet 1* (one per student)

**Part 2:**

- Shovels or trowels
- Mesh wire strainers
- Tweezers, toothpicks, eye droppers, magnifying lenses, rulers
- Pencils
- Markers, colored pencils, or crayons
- Copies of the *Soil Treasure Hunt Student Activity Sheet 2* (one per student)
Preparation

• Read the Elementary GLOBE storybook *The Scoop on Soils* – either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.

• Collect soil samples near your school. The samples may contain some of these materials: rocks, sticks, leaves, seeds, roots, insects, worms, tree needles or leaves, and sand, silt, or clay. Students can also bring in samples from their homes, taking soil at the surface or deeper to demonstrate differences in soil properties. Note: caution students not to dig a hole without adult supervision.

• Cover the classroom workspaces with newspaper.

• Make copies of *Soil Treasure Hunt Student Activity Sheets*.

• Read about digging soil profiles in the soil chapter of the *GLOBE Teacher’s Guide* (www.globe.gov) to learn more about site selection and safety procedures.

Teacher’s Notes

Soil Composition
Soils are composed of four main components:

• Minerals of different sizes
• Organic materials from the remains of dead plants and animals
• Water that fills open pore spaces
• Air that fills open pore spaces

Five Soil Forming Factors
They are:

1. *Parent Material*: The material from which the soil is formed. Soil parent material can be bedrock, organic material, loose soil material deposited by wind, water, glaciers, volcanoes, or material moving down a slope.

2. *Climate*: Heat, rain, ice, snow, wind, sunshine, and other environmental forces break down the parent material and affect how fast or slow soil processes go.

3. *Organisms*: All plants or animals living in or on the soil (including micro-organisms and humans!). The amount of water and nutrients plants need affects the way soil forms. Animals living in the soil affect decomposition of waste materials and how soil materials will be moved around in the soil profile. The dead remains of plants and animals become organic matter that enriches the soil. The way humans use soils affect soil formation (i.e. agriculture, development, etc.).

4. *Topography*: The location of soil on a landscape can affect how climate processes impact it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not.

5. *Time*: All of the above factors assert themselves over time, often hundreds or thousands of years.

The way the five soil-forming factors interact is always different from one place to another, so soils differ greatly from each other. Each section of soil on a landscape has its own unique characteristics. The face of soil, or the way it looks if you cut a section of it out of the ground, is called a soil profile. Every soil profile is made up of layers called soil horizons. Soil horizons can be as thin as a few millimeters or thicker than a meter.

Soil profiles and their horizons change as you move across a landscape, and also change as you move downward deeper into the soil at one location. In fact, soil samples taken at the surface may have entirely different characteristics and appearances from soil dug deeper in the soil profile. Soil horizons are different as you dig deeper, mainly due to the mixing of organic material in the upper horizons and weathering and leaching in the lower horizons. Erosion, deposition, and other forms of disturbance might also affect the way a soil profile looks at a particular location.

See the soil chapter of the *GLOBE Teacher’s Guide* for more information on soil (www.globe.gov).
What To Do and How To Do It

Part 1:

1. Hold up a bag of soil, tell the students where you collected it and how deep you dug to collect the soil. Ask the students what they think they might find in the soil sample if they were to study it carefully. Tell the students that this soil is different from the sand/silt/clay samples you investigated in the *Getting to Know Soils* learning activity, emphasizing that it came from a natural place rather than a lab that separated the soil type from a natural sample.

2. After developing a list of predictions on the board, distribute a bag of soil and various tools (strainer, magnifying lenses, etc.) to small groups of students.

3. Have each student write a prediction and a question about soil on his or her *Soil Treasure Hunt Student Activity Sheet 1*. Younger students will need assistance with this step.

4. Give each group of students a bag of soil. Explain to the students that this sample has lots of the ingredients in it that make up soil. Have the students use their fingers and other tools to sort out the different things they find in the soil. They can put them in piles based on their categories (rocks, plant parts, animals, other things). Have each student record his or her observations on the *Soil Treasure Hunt Activity Sheet 1*.

5. If the students find living things in the soil such as insects and earthworms, have them draw what they found and then release them outside where the soil sample was collected.

6. Have the students share their observations with the class. Use chart paper to record their observations. They can share verbally and the teacher can record the observations, or students can write their observations on sticky notes and put them on the chart paper.

Part 2:

1. After reading the storybook, discuss how the GLOBE Kids find different things in soil from different places. Show students illustrations of journal pages from the book and remind students how the kids in the story recorded their observations of soils.

2. Take students outside and dig into the top layer of the soil. This may be the layer that has plant roots and critters in it or it may just be mineral soil if there is no vegetation growing on it.

3. Have the students take time investigating what they see in the soil. Ask them to look for “treasures” like rocks, critters, and plants.

4. Give each student a copy of the *Soil Treasure Hunt Student Activity Sheet 2* and have each student record his or her observations. They can rub the soil on the paper to show its color.

5. Take a photograph of the soil pit that the students can refer back to later.

6. Return to the classroom and discuss as a class what each student or group found outside in the soil.

7. Have the students write and illustrate a story from the perspective of one of the critters seen in the soil outside. Ask the students to include details about what tasks the critter has to do to survive, find a home, eat, etc. They should include details about what the soil is like, what things they find in the soil, etc. If no critters were found in the soil the students can write stories about rocks or plants.

8. The students can share the stories with the class. You can also display them in a classroom gallery or put them together in a book.

Adaptations for Younger and Older Students

Younger students can draw the illustrations and dictate their stories to an adult for Part 2 of this activity. Then compile the stories into a book for the class.
Further Investigations

• **Soil Word Wall:** Generate a list of words students might use to describe soil. This list should include ways to describe soil’s color, texture, and structure. Also include words that apply to the different senses. Your students can help you generate the list. Keep the list up on the wall while you are doing the *Elementary GLOBE* soil activities so students can refer to it; it will help them think of words to use on their student activity sheets.

• **Soil Profile:** Extend the time you spend outside looking at a soil profile by digging holes in different areas and comparing what the soil is like and what you find in the soil in the different locations. Example locations could be at the top or bottom of a hill, under a tree, in an open lawn, near a stream, in an area disturbed from construction, on a trodden path, in a wet spot, etc. Use the *GLOBE Teacher’s Guide* for more information (www.globe.gov).

• **Soil Collage:** Go out and dig in a certain area to find treasures in the soil. Sort the items and glue them on a piece of cardboard. Also glue different types of soil on the collage. If the students find live animals in the soil, have them draw them on paper and glue the paper to the collage. Then have them return the critters to the spot where they were found.

• **Soil: The Great Decomposer Learning Activity:** This can be found in the soil chapter of the *GLOBE Teacher’s Guide* (www.globe.gov).

• **Earthworms:** Fill a clear plastic or glass container with sand, potting soil, and dead leaves. Put earthworms in the container and cover the outside of the container with black construction paper. Water the container so it is moist but not soggy every 2-3 days. After 3 days, take the paper off the outside of the container and observe the differences in how the soil looks. Notice what the earthworms have done to change the soil. Cover the container again and keep checking every 2-3 days for changes.

• **Seeds:** Plant fast-growing seeds in clear plastic cups. Use soils with different properties (such as different colors, textures, structure, organic matter, rocks, etc.). Water the seeds and place them in a sunny window. As the plants grow, observe what happens in the soil. Can you see the roots? Does the presence of roots change how the soil looks?

• **Field Guide to “Soil Critters”:** Create a field guide to illustrate the critters your students might find in your local soil. Some common critters are earthworms, insects, spiders, centipedes, and millipedes. You can either put information about the critters on a bulletin board in the classroom or print up small guides the students can take outside to use as a reference when they are exploring in the soil.
My Soil Investigation!

My prediction or question about the soil is:

These are the things I found in the soil:
Outdoor Soil Investigation!

This is where I studied soil outside:  

Soil Color

(Rub a little soil above to show color.)

These are the things I found in the soil:
**Purpose**
- To introduce students to the importance of soil and help students understand how soil is used by living things.

**Overview**
Each student will explore three activities that promote understanding of and respect for soil. They will generate responses to the questions: “What makes up soil?” and “What lives in the soil?” and create their own soil connection sentences.

**Student Outcomes**
After completing this activity, students will understand the function of soil as it pertains to animals, plants, and humans.

**Next Generation Science Standards**
- DCI ESS-2A: Earth Materials and Systems
- DCI LS-1C: Organization for Matter and Energy Flow in Organisms
- Science Practice 2 Developing and Using Models
- Crosscutting Concept 2 Cause and Effect
- Crosscutting Concept 5 Energy and Matter

**CCSS.ELA Anchor Standards**
- W.2 Write informative/explanatory texts...

**Time**
- Part 1: One 30-minute class period
- Part 2: One 45- to 60-minute class period

**Level**
Elementary (most appropriate for grades K-4)

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**Materials**

**Part 1:**
- Elementary GLOBE storybook: The Scoop on Soils
- Chart paper
- Markers

**Part 2:**
- Chart Paper
- Markers
- Activity Cards from the We All Need Soil! Activity Cards Sheets 1-6 (one set of cards for each group of 2-4 students)
- Copies of We All Need Soil! Student Activity Sheet (one per student)
Preparation

- Read the Elementary GLOBE book *The Scoop on Soils* – either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.
- Make two charts with the titles “What makes up soil?” and “What lives in soil?” and place them on a bulletin board.
- Make one chart with the title “How Soil is Used by Living Things” and divide the chart into three sections with the headings: “Plants,” “Animals,” and “Humans,” and place the chart on a bulletin board.
- Cut the activity cards and laminate if you wish. (You’ll need one set of cards for each group of 2-4 students.)

Teacher’s Notes

Soils are essential natural resources, yet they are often taken for granted. Most people do not realize soils are a living, breathing world, supporting nearly all terrestrial life. Soils vary greatly from one location to another as a result of many factors, including differences in climate, the parent material of soil, and the location of the soil on the landscape.

Soil forms very slowly and comprises only about 10 or 11% of Earth’s surface. It is composed of minerals of different sizes (sand, silt, and clay). How much water a soil will hold, how easily water passes through the soil, and what happens to the soil as it dries depends on the combination of these materials in a particular soil. Soil rich in clay may crack as it dries, as demonstrated by ground with huge cracks or the cracking at the top of a mud puddle when larger, heavier particles have settled to the bottom. Soil rich in sand may not hold together or be strong enough as a building material. Soil has been used as a building material for thousands of years, and is still one of our most important building materials. In dry regions houses built of adobe bricks last hundreds of years. Concrete and...
bricks are common everywhere. Whether you are making concrete or adobe blocks, it is essential to understand the importance of having the right elements in your soil mix.

Soil can be characterized by its structure, color, consistence, texture, and abundance of roots, rocks, and carbonates. These characteristics allow scientists to interpret how the ecosystem functions and make recommendations for soil use that have a minimal impact on the ecosystem. For example, soil characterization data can help determine whether a garden should be planted or a school should be built. Soil characterization data can help scientists predict the likelihood of flooding and drought. It can help them to determine the types of vegetation and land use best suited to a location.

What To Do and How To Do It

Part 1:
2. As a large group, have the students report their ideas and record their thoughts on the charts provided.
3. After all ideas have been recorded, review the students’ findings with the whole group.

Part 2:
1. Gather students into a large group and fill out the chart “How Soil is Used by Living Things.” As students report their ideas, record them on the chart. Complete each section (plants, animals, and humans) separately and compare them at the end of the session. Discuss with the students the connections between how each group uses soil to survive. Note: “Humans” are listed in a separate column than “Animals” - make sure students realize that humans are animals but are discussed separately because they often use soil in different ways than other animals do.
2. Lay all of the cards out in their groups so the students can see all of them. Review all of the cards with the students so they are familiar with the pictures and the vocabulary. Demonstrate the process that students will use to make soil connections, speaking out loud about the connection. Then collect a card from each pile. Place the items on a table or the floor and lay them out in a sequence that leads to the connection. See Figure 1 below.

GROUP 1 + GROUP 2 + SOIL = FOOD/HOME
(plants/animals) (action)
Rabbit + Dig + Soil = Burrow
“The rabbit digs in the soil to make a burrow for its home.”
OR
Seeds + Plant + Soil = Garden
“Seeds planted in the ground grow in the soil and become a garden.”

Figure 1: Soil connection samples.
3. Divide the class into 4-5 groups. Give each group a set of cards. Explain to the students that they are going to make “soil connections.” As a small group, they need to decide what their connection will be and gather all the materials to complete the connection. Have each group designate a runner to collect the materials.
4. After all of the small groups have arranged their connections, have them share their soil connection with the rest of the class. Then have the runners return the materials to the appropriate places and repeat the process to make a new connection. Continue this process as time allows.
5. Provide a copy of the recording sheet from the We All Need Soil! Student Activity Sheet for each student so the students can document their connections. The students will first illustrate the connection in the boxes under the appropriate boxes and then write the connection using words. Younger students can illustrate the connection and then dictate their thoughts to an adult.
6. See Figure 2 below for a list of potential soil connections. Students may come up with many other possibilities. Note that these connections focus on how animals and plants use soil and some of their needs (water, Sun, food chain) and the role of microbes in soil have been omitted.

| Rabbit + Dig + Soil = Burrow (Home) |
| Worm + Dig + Soil = Tunnels (Home) |
| Mole + Dig + Soil = Burrow (Home) |
| Seeds + Plant + Soil = Plants (Food) |
| Ants + Dig + Soil = Ant Colony (Home) |
| Prairie Dog + Dig + Soil = Burrow (Home) |
| Termites + Dig + Soil = Termite Nest (Home) |
| Chipmunk + Dig + Soil = Burrow (Home) |

Figure 2: List of soil connections.

7. Once students have completed making their soil connections, add in Humans as an additional part of the equation. Use the Human cards from Group 3. See Figure 3 below for an example.

| GROUP 3 + GROUP 2 + GROUP 1 + SOIL = FOOD/HOME |
| Human + Plant + Corn Kernels + Soil = Corn Crop (Food) |
| “A human takes corn kernels and plants them in soil to grow corn for food.” |
| Human + Mix + Water + Soil (Clay) = Bricks for House (Home) |
| “A human mixes water and clay (soil) to make bricks to use when building a home.” |

Figure 3: Human/Soil connections.

**Adaptations for Younger and Older Students**

(See the “Who Lives Where?” diagram below)

Younger students: Discuss with the students which animals live above the ground and which live below the ground. Next, have the students illustrate a scene with soil and a tree. Then they can draw or cut out and glue on animals that live above and below the ground.

Older students: Discuss with the students that animals live above the ground, on the ground, and below the ground. Next, have the students illustrate a scene with soil and a tree. Then they can draw or cut out and glue on animals that live above, on, and below the ground. Have students make connections to the types of animals that live in your local area.

After students have discussed what soil is made of and what lives in the soil, demonstrate Part 3 of the Why Study Soils? Learning Activity from the GLOBE website (www.globe.gov) (How much soil is there on Earth?) with your students.

**Further Investigations**

- **Soil Comparison:** Find out which kind of soil is best for growing plants. Gather the following materials: four clear plastic cups, potting soil, sand, soil from an outside garden site, and clay, large bean seeds, and water. Have students fill each cup three-fourths full with the four different types of soil. Plant 2-3 bean seeds in each cup. Instruct students to plant the seeds closer to the side of the cup for better viewing as the seeds grow. Add a measured amount of water to each cup. Allow time for the seeds to grow. Have students predict what they think will happen for each cup of soil on a chart and save the chart for a future discussion when the experiment is completed. Have students make their own recording sheet by drawing the four cups of soil and then record what happens in each cup.
We All Need Soil! Activity Cards Sheet 1

Teachers: Cut out the cards on all of the activity sheets and laminate if possible. Then use the cards for Part 2 of We All Need Soil! with your students.

Title Cards

Group 1
Plants, animals, and other things

Group 2
Actions

Group 3
Humans

Home/Food

Group 3

Human

Human

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Group 2 Cards

- Plant
- Mix
- Dig
- Dig
- Dig
- Dig
- Plant
- Mix
- Dig
- Dig
- Dig
- Dig
We All Need Soil! Activity Cards Sheet 5

Soil Cards

Soil

Soil

Soil

Soil

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Soil

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### We All Need Soil! Activity Cards Sheet 6

**+/- Cards**

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We All Need Soil! Student Activity Sheet

Draw the parts of the soil connection in the boxes.

Type of Home/Food

Soil

Item from Group 2 (Actions)

Item from Group 1 (Plants and Animals)

Write your soil connection in a sentence.

Name

Date
Soils Background
Soils Background (from Elementary GLOBE Soil Materials)

What is Soil Made of?
Soils are composed of four main components:
- Minerals of different sizes
- Organic materials from the remains of dead plants and animals
- Water that fills open pore spaces
- Air that fills open pore space

The use and function of a soil depends on the amount of each component. For example, a good soil for growing agricultural plants has about 45% minerals, 5% organic matter, 25% air, and 25% water. Plants that live in wetlands require more water and less air. Soils used as raw material for bricks need to be completely free of organic matter.

Why is Soil Important?
Soils are essential natural resources, yet they are often taken for granted. Most people do not realize soils are a living, breathing world, supporting nearly all terrestrial life.

Important functions of soil include:
- Providing the fertile medium in which we grow our food and fiber
- Producing and storing gasses such as carbon dioxide
- Storing heat and water
- Providing a home for billions of plants, animals and microorganisms
- Filtering water and wastes
- Providing the source material for construction, medicine, art, makeup, etc.
- Decomposing wastes
- Providing a snapshot of geologic, climatic, biological, and human history

In student language: Soil is useful in many ways. Plants and fungi such as mushrooms pull nutrients and water they need to grow out of soil. Animals like insects and rabbits build homes in soil. Nearly all the vegetables and fruits that we eat are grown in soil. We also use soil to grow the foods for farm animals like horses, sheep, and cows. Humans build gardens and parks in soil, and build houses, roads, and other buildings on soil.
How is Soil Formed?

Five factors affect how soil forms. The properties of a soil are due to five soil-forming factors. They are:

1. **Parent Material**: The unweathered material that the rock and mineral parts of soil comes from. Soil parent material often includes loose sand, silt, and rocks deposited by wind, water, glaciers, or rock and mudslides.

2. **Climate**: Heat, rain, ice, snow, wind, sunshine, and other environmental forces break down the parent material and affect the speed at which soil forms.

3. **Organisms**: All living things in or on the soil (including plants, animals, microorganisms, and fungi) affect the way soil forms. Their dead remains are the organic matter that enriches soils as it decomposes.

4. **Topography**: The location of soil on a landscape can affect how climate processes impact it. For example, on a steep hillside, it may be more challenging for thick soil to form than in a valley.

5. **Time**: It takes time for soil to form. Deposition of parent material can take thousands of years or might happen quickly during a large storm. The climate forces that break down the parent material take hundreds to thousands of years. Organisms can affect soil in minutes to days, and also over longer periods of time.

These soil-forming factors interact differently in different locations, so the soils that form vary, too. Each soil has its own unique characteristics, which is why it’s important to explore and describe soils. Every soil profile (a vertical look through the soil) is made up of layers called soil horizons. Soil profiles and their horizons change as you move across a landscape, and also change as you move downward deeper into the soil at one location. In fact, soil samples taken at the surface may have entirely different characteristics and appearances from soil that is deeper underground. One common reason soil horizons are different as you dig deeper is because of mixing of organic material in the upper horizons and weathering and leaching of rocks and minerals in the lower horizons. Erosion, deposition, and other forms of disturbance might also affect the way a soil profile looks at a particular location.

What Lives in Soil


Soil organisms come in all shapes and sizes—microscopic forms include varieties of bacteria, fungi, algae, and protozoa; macroscopic forms include insects, worms, and even burrowing mammals and reptiles. Students will be surprised to hear that there are many more living things in the soil than those they found while examining their samples. In fact, healthy soil is loaded with life.
**Microbial Consumers and Decomposers:** One gram of fertile soil can contain up to one billion bacteria. There are many different types of bacteria, and most of them have not even been discovered yet! Soil fungi are also large components of the soil that come in various sizes, shapes, and colors. Mushrooms have underground roots (mycelium) that absorb nutrients and water until they are ready to flower in the mushroom form.

**Soil Animals:** Soil animals are consumers and decomposers because they feed on organic matter and decomposition occurs in the digestive tract. Some animals feed on roots, and others feed on each other. Some examples include earthworms, nematodes, mites, millipedes, centipedes, springtails, and grubs. There are also many larger animals that make their homes in the soil, such as burrowing animals or reptiles.
Underground Layers

If we could travel from the surface of the ground to the bedrock, we would go through different layers. On the surface is the topsoil or humus. This is where plants and animals grow and also where the decomposers break down dead plants and animals. The second layer is the subsoil, where most of the soil nutrients are, with little organic material. This is the layer where deep-rooted plants seek water. The third layer is made up of just rocks and minerals. This layer is sometimes very large and deep – out of reach of any living or dead organisms. Finally we hit solid rock – the bedrock.

That’s not just dirt under your feet!

What’s the difference between soil and dirt? Dirt is what you find under your fingernails. Soil is what you find under your feet. Though often taken for granted, soil is one of our greatest natural resources. It is the outermost layer of our planet. Think of the layer of soil as a living and breathing world that supports life. Soil is much more than just rock and mineral particles. It includes living animals and plants, dead and decaying material, and spaces where air and water are found.

Soils vary greatly from one place to another. They are formed from a parent material, called “bedrock,” and are affected by climate, the organisms that live in them, topography and time. Believe it or not, there are more than 70,000 kinds of soil in the United States!
An astonishing number of animals live in the world right under our feet. The “litter” layer isn’t trash – it’s where the leaves that have recently fallen can be identified. Below the litter layer is the fermenting layer, where most of the leaves are rotting and broken into smaller pieces. Below this lies the dark brown or black humus, containing the remains of plants and animals that have completely rotted.

The leaf litter provides habitat for bacteria, fungi and tiny invertebrates (animals without backbones). Some of these animals, like earthworms, snails and millipedes, feed on the litter, breaking it up into smaller pieces. This makes it easier for other organisms, like bacteria and fungi, to break down the tiny litter pieces into chemicals and minerals like nitrogen, calcium and sulfur. Without this diverse community of invertebrates providing ecological services like nutrient cycling, the soil would soon be depleted of nutrients, and plants could not grow.

These tiny animals not only help create soil, they are food for other animals like salamanders, earthworms and insects, which in turn are eaten by birds and mammals. Let’s take a look at who lives in the soil...
Carrion or burying beetles cover small dead animals and then lay their eggs in them. The larvae then feed on the dead and decaying animal as they grow.

Earthworms are long and slender, capable of burrowing deep into the soil. They have no eyes and use the bristles on their skin to feel their way around underground. Their tunnels create passageways for water and air to move through the soil.

when click beetles are larvae, they are called wire worms and are found in rotting wood. As adults, they are called click beetles because of the sound they make when they flip over.

Voracious predators, centipedes are found in leaf litter and soil under rocks and logs. They have pincers just behind their heads, which they use to pierce their prey and inject it with poison.

mites are abundant and very small (less than 1 millimeter). They have short legs and un-segmented bodies. They eat decaying plant material and mold or other small soil organisms.
Several kinds of mammals have specially adapted limbs for digging in the soil. These burrowing mammals are referred to as “fossorial.” They spend most of their time underground and play an important part in a soil ecosystem. Through their tunneling efforts, they help add air to the soil, as well as moving the humus (organic matter) deeper into the soil and bringing subsoil material closer to the surface where the nutrients are more available to plant roots.

Eastern moles are active throughout the year. They dig tunnels just below the surface in order to feed on earthworms, insects and vegetable matter. Moles also dig burrows ten inches or more deep for living quarters in the winter and as runways to feeding areas.

Woodchucks are active among the ground in the spring and summer when they are feeding on green plants. Most of the year, woodchucks spend their time underground. They have extensive burrow systems, including places where they hibernate and others where they have their young.

Woodland voles spend time digging a tunnel system so they can forage for roots and tubers below ground. They also move along surface runways.

The short-tailed shrew is active day and night throughout the year. It digs its own tunnels, as well as using burrows dug by others. Earthworms, millipedes and insects are major prey, but the shrew’s poisonous bite also allows it to kill larger voles and mice.

As with other insects, beetles undergo complete metamorphosis, and many of their larvae are found in the soil where they feed on a variety of dead and living material.

FOSSORIAL MAMMALS

PHOTO CREDITS:
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WOODCHUCK - APRIL KING / WIKIPEDIA.ORG CC-SA 3.0
EASTERN MOLE - © MARCIN PAWINSKI / DREAMSTIME.COM
COMPOSITE DIAGRAM BY VICTOR YOUNG / NHFG
CLAY
Clay soil is made up of tiny mineral particles packed closely together, leaving little space for air and water.

SANDY
Sandy soil contains large, round particles with relatively large spaces between them. Sandy soils don’t hold water well and tend to lose nutrients quickly.

SILTY
Silty soil is in between clay and sand. It feels smooth and is slippery to the touch when wet.

LOAM
Loam is soil that is a fairly even mix of silt, clay and sand.
TESTING SOIL TEXTURE

You will need: a handful of soil, water and a tape measure or ruler.

1. Get a handful of soil from a garden or schoolyard.

2. Wet the soil gradually and work it in your hand until it forms a ball. Keep working the ball of soil until it doesn’t change any more.

3. Now, slowly squeeze the soil out between your thumb and your forefinger – pushing away from your body. Watch carefully to see if the soil sticks together and if a “ribbon” forms...
   - If the soil won’t form any sort of ribbon at all and is very hard to form into a ball, then the soil texture is SANDY. Grains of sand will stick to your fingers.
   - If you can make a ribbon about an inch long before it breaks off, and the ball of mud feels spongy, but you can’t feel any sand grains, then you can describe your soil as SILT.
   - If the ball of mud feels like very smooth playdough, and you can make a long ribbon of two inches or more, then it is a CLAY soil.