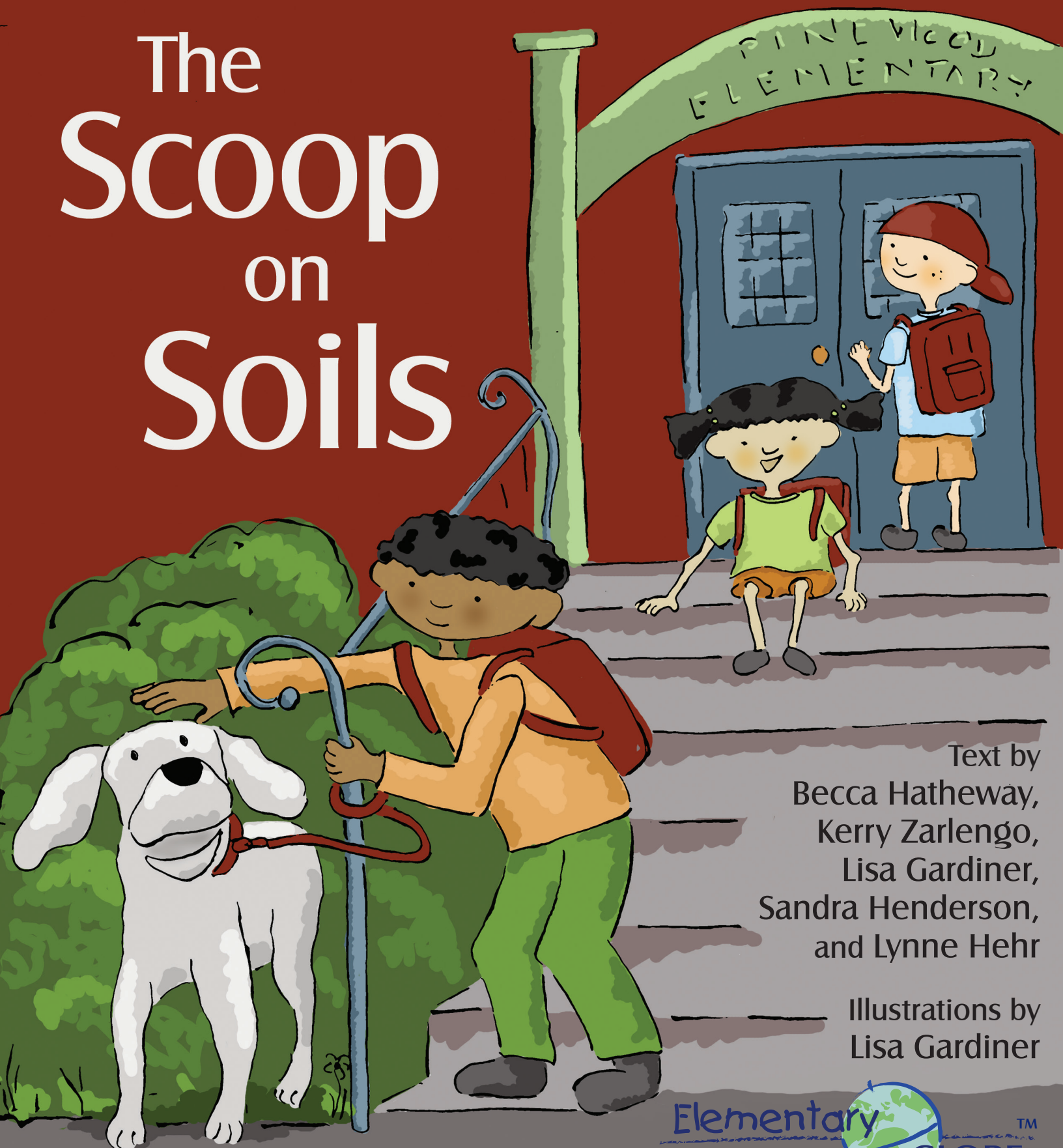


The Scoop on Soils



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Illustrations by
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Elementary



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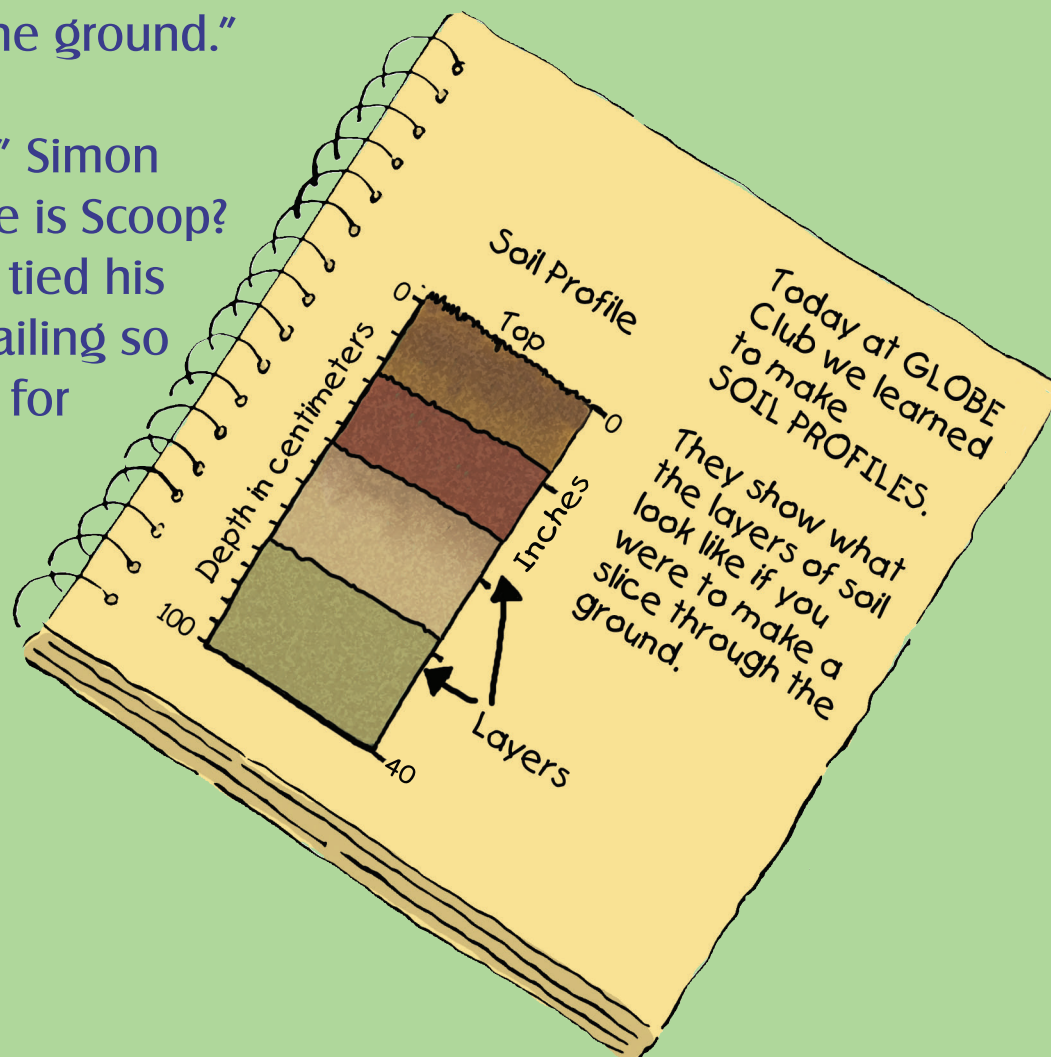


"Wow, that was fun!" said Simon. "I am glad our GLOBE Club is doing a project on soil."

Anita agreed, "I really liked learning about the different things in soil like rocks, roots, and critters. This is going to be great!"

Dennis added, "I also liked looking at soil profiles and learning how the layers of soil look as you go deeper into the ground."

"Hey, Dennis," Simon asked. "Where is Scoop? I thought you tied his leash to the railing so he could wait for us."





"Uh-oh!" cried Dennis, "When Scoop got away last summer he dug a big hole in Mr. Webster's flower garden. It took a whole weekend for me to replant everything!"

"Scoop really does like digging holes, doesn't he?" asked Simon.

"That's for sure," replied Dennis. "And that is why we named him Scoop. We should find him before he gets into trouble."

"Hey," said Anita. "He loves it when we take him to explore in the forest. Maybe we will find him there."

The three friends ran across the soccer field and up a hill to the forest path.



Right away they heard digging noises.

"I think I hear Scoop!" Anita called out.

They hurried around a curve in the path and saw Scoop. "There he is!" said Simon.

Scoop had dug a big hole in the ground. His paws were covered with brown, white, and red soil. Scoop stopped digging when he saw the kids and wagged his tail.



"Oh Scoop, look at you!" said Dennis. "You need to stay with us."

"Hey you guys! Look inside the hole he dug!" Anita called out.

Simon knelt down on the ground and picked up a handful of soil. He could see different colors of soil in the hole. The soil felt gritty like the sand in a sand box and fell through his fingers. He said, "This is perfect for our GLOBE project. Let's record what we see here."

They pulled their journals out of their backpacks and started to write and draw what they saw in Scoop's soil profile. While they were making their observations, Scoop sneaked away.



Anita looked up from her journal and noticed that Scoop was gone. "Oh no," she cried. "Scoop is on the loose again!"

"I see his white and sandy paw prints going toward the meadow," said Simon.

They quickly gathered their supplies and ran down to the bottom of the hill after Scoop. They could see him digging in the meadow.

"Oh, Scoop," Dennis called out. "Another hole? What am I going to do with you?"

Scoop looked up from his digging and wagged his tail.

"Hey," said Anita. "This hole looks different from the other one."



"Let's record what we see in this hole, too! Then we can compare this hole to the one in the forest," said Dennis.

Anita replied, "I can see critters moving in the hole. Let's draw what we see." She pulled out her magnifying lens so she could take a closer look.

They noticed lots of critters including earthworms and ants. Starting at the top of this soil profile, there was one deep dark brown layer and a beige layer underneath. The soil felt smooth and silty like flour. When Simon picked some soil with a plant in it, the soil stuck to the roots like cookie crumbs.

Once again, while the kids were busy, Scoop slipped away.



Simon looked up and found that Scoop was gone. "Oh brother," he said. "We were so busy looking at the soil that Scoop got away again!"

Anita replied, "Look, this time there are dark brown tracks going toward Mrs. Chang's garden! I hope he isn't causing trouble there."

They ran across the meadow and saw Scoop digging in the garden. "There he is," all three kids called out.

"Oh, Scoop, not again! I think we got here just in time," said Dennis. "I see Mrs. Chang's tools, but luckily she has not begun to plant her garden."

Scoop looked up and wagged his tail.

Simon added, "Great! I don't think Scoop did any damage this time. We can just fill in the hole before we leave."

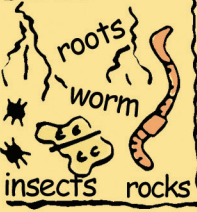
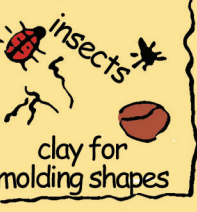


"This hole looks different from the other holes Scoop dug," commented Simon.

Dennis remarked, "I have my soil color chart in my backpack. That will help us here."

Anita said, "It is really neat that the soil is different in each place Scoop dug a hole!"

This time they saw a layer of very dark soil on top of a layer of red soil. The dark soil was full of organic matter. Because Mrs. Chang tilled the soil every year, the line between the dark brown soil and the red soil was very straight. They also saw critters in the dark brown soil. The clumps of soil felt sticky and damp. It stained their fingers red and felt like the clay they used at school to mold shapes.

	Forest 	 Meadow	Garden 
Color 			
Texture 	Sandy (Gritty)	Silty (Smooth)	Clayey (Sticky)
Structure 	 Single-grained	 Granular	 Blocky
Treasures 			

“Now that we have data from the three holes, let’s compare our notes,” Dennis suggested.

“I will make a chart in my journal to record what we saw,” said Simon.

Together, they filled in the chart with the information they had collected from the three holes. They wrote about the soil’s color, texture, and structure. They called the different critters and plants they found “treasures.”



"This is cool!" exclaimed Anita. "From here we can see the three places that Scoop dug his holes. And look! The plants are different in the forest, meadow, and garden. Do you think the different kinds of soils allow different kinds of plants to grow?"

"You may be right, Anita," said Simon.
"That is something we can look into."



"Wait a minute," Dennis said. "Scoop is gone again, but I can see him heading up the hill. Let's catch him before he goes too far!"





Anita, Simon, and Dennis caught Scoop as he was running up the hill away from Mrs. Chang's garden.

Dennis leaned down to pet Scoop and said, "Oh, Scoop, I am not going to let you get away again! You have dug enough holes for one day."

Anita agreed. "You are right, Dennis. But Scoop's adventure helped us to collect lots of soil data."

Simon looked at Scoop and started to laugh. "It looks like Scoop collected lots of data, too! He has soil on him from everywhere we have been today."



"You're right, Simon!" said Dennis. "I can see the sandy white soil from the forest on his front paws, the smooth dark brown soil from the meadow on his nose, and the sticky dark brown and red soil from the garden on his chest!"

Anita added, "Different plants grow in all of these places, too. You can tell that from what we saw in Scoop's holes and from looking at each location."

Simon gave Scoop a pat on the head and said, "We are lucky that we had Scoop to help us collect all this data. As we walk back, let's make sure we fill in all of the holes."



“When we started talking about soil at school, I did not realize how cool it is!” exclaimed Simon.

“Scoop, thanks for taking us on this learning adventure because now we know the *scoop* on soils,” Anita said.

Dennis added, “But from now on, I am keeping you on a leash!”

Scoop barked and wagged his tail. He had fun on this soil adventure, too!

Teacher's Notes

Note about safety: In “real life,” Anita, Simon, and Dennis would need to tell an adult where they were going before they went off to search for Scoop. Remember to fill in holes in the soil so people don’t get hurt. Also, unlike Scoop, people need to ask for permission before digging holes.

What’s soil and why’s it useful?

Soil is made of non-living components (such as rocks, minerals, air, and water) and living components (such as plants, animals, microbes and fungi).

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.

Dirt? Soil? What’s the difference?

Dirt is simply soil that is out of place. When soil sticks to something and ends up anywhere it is not supposed to be, it is called dirt. For example, when you track soil into your house on your shoes, it’s often called dirt. And when a person falls into a mud puddle made from soil and water, he or she becomes dirty! Soil is an important resource. In order to show that we have respect for our natural environment, we call it soil and not dirt.

Soils is composed of four main parts.

- Rocks and minerals of different sizes (including sand, silt, and clay)
- Parts of living and dead plants, animals, fungi, and microbes (known as organic matter)
- Water that fills open spaces (called pore spaces) between sand, silt, and clay particles.
- Air that fills open pore spaces

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 on 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.

Note: Below is a copy of the Soil Characterization Data Sheet used by The GLOBE Program that is filled in to display the information Anita, Simon, and Dennis collected at the forest site in this book. This is an example of how you can take measurements for the GLOBE Soil Characterization Protocol. Please see the pedosphere (soil) section of the GLOBE Teacher's Guide for more information (www.globe.gov).

Soil Investigation

Soil Characterization Data Sheet

Date of Characterization: _____ Local Time of Characterization: _____ UT of Characterization: _____

Study Site: SCS- A (Forest) Method (choose one): ☒ Pit ☐ Auger ☐ Near Surface

Horizon Number	Top Depth (cm)	Bottom Depth (cm)	Structure (granular, blocky, single grained)	Main Color	Second Color	Consistence (loose, friable, firm, extremely firm)	Texture (sand, silt, clay)	Rocks (none, few, many)	Roots (none, few, many)	Carbonates (none, slight, strong)
1	0	5	single-grained	black	n/a	loose	sandy	few	many	n/a
2	5	15	single-grained	white	n/a	loose	sandy	few	few	n/a
3	15	20	single-grained	red-brown	n/a	loose	sandy	none	few	n/a
4	20	100	single-grained	red	n/a	loose	sandy	none	few	n/a

Critter

An animal (in soil, this can include earthworms, insects, or spiders)

Leaching

The movement of water through soil strips nutrients and minerals from the upper layers of soil, depositing them into the lower layers

Organic Matter

Any plant or animal material that is part of the soil

Soil Color

One of the most obvious soil properties; it is created by a combination of minerals, coatings on the minerals (such as iron or calcium carbonate), organic matter, and water that creates a unique color that can be identified with the *GLOBE Soil Color Chart*

Soil Horizon

An individual layer within the soil that has its own unique characteristics (such as color, structure, texture, or other properties) that makes it different from the other layers in the soil profile

Soil Moisture

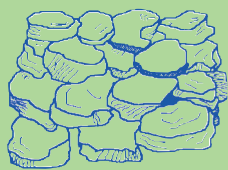
Provides water for living things, removes materials through leaching, and affects soil formation. Each soil has the ability to hold a specific amount of water. When water hits the soil surface or enters a horizon from above in the soil profile, the amount that moves through or is held depends on various soil properties

Soil Profile

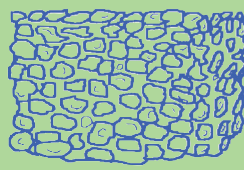
The view of soil when it has been exposed vertically that shows the individual horizons and soil properties with depth

Structure

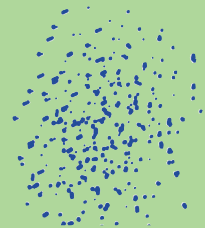
A soil's structure describes how the soil holds together. For example, if soil has clumps that are flat like plates, its structure is called "platy". If soil has clumps that are tall like columns, its structure is called "columnar". If soil has big clumps, it's called "blocky" and if it has small clumps, it's called "granular". Soils that don't have clumps are called "structureless" and may be a consolidated mass (called "massive") or individual particles (called "single-grained"). The following three soil structures are included in *The Scoop on Soils* book:



Blocky Structure
Irregular block-shaped soil peds that are usually 1.5 to 5.0 cm in diameter



Granular Structure
Roundish soil peds that are usually less than 5.0 cm in diameter and look like cookie crumbs



Single-Grained Structure
A structureless soil in which each soil grain is loose in the soil (i.e., there are no peds)

Texture

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 soil, as well as other factors (how wet it is, how much organic matter is in the sample, the type of clay, etc.).

- If soil feels gritty when it's moistened and rubbed between your fingers, it has a sandy soil texture. Sand is a mineral particle between 0.05 and 2.0 millimeters in size.
- If soil feels "floury and smooth" when it's moistened and rubbed between your fingers, it has a silty soil texture. Silt particles are between 0.002 and 0.05 millimeters in size, which are smaller than sand and larger than clay.
- If soil feels "sticky and dense" when it's moistened and rubbed between your fingers, it has a clay soil texture. Clay is made of mineral particles that are less than 0.002 millimeters in size.



The GLOBE Program is a hands-on international education and science program that joins students, educators, and scientists from around the world in studying Earth system science (ESS). The core objectives of GLOBE are to improve science education, enhance environmental awareness, and increase understanding of Earth as a system. For more information, please visit www.globe.gov.

Elementary GLOBE is designed to introduce K-4 students to the study of Earth system science (ESS). Elementary GLOBE forms an instructional unit that comprises multiple modules that address ESS and interrelated subjects including aerosols, seasons, soils, water, weather, and climate.

Each Elementary GLOBE module contains a science-based storybook, classroom learning activities that complement the science content covered in each book, and teacher's notes. The storybooks explore a component of the Earth system and the associated classroom learning activities provide students with a meaningful introduction to technology, a basic understanding of the methods of inquiry, and connections to mathematics and literacy skills. For more information, please visit www.globe.gov/elementaryglobe

Book and Learning Activity Credits

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Where is Scoop?

Dennis' dog Scoop likes to dig holes in the soil and he is on the loose! Simon, Anita, and Dennis set out to look for Scoop as he digs holes all over town. Along the way they discover that soils are special.



This storybook is one of several books in the Elementary GLOBE unit. Elementary GLOBE is designed to introduce K-4 students to the study of Earth system science (ESS). The books form an instructional unit that addresses ESS and related subjects including aerosols, weather, water, seasons, soils, and climate. The science content provided in the books serves as a springboard to GLOBE's scientific protocols, and also provides students with a meaningful introduction to technology, a basic understanding of the methods of inquiry, and connections to mathematics and literacy skills. Each book has associated hands-on Learning Activities to support learning exploration. For more information, please visit www.globe.gov/elementaryglobe.



Simon



Anita



Dennis