National Park Service, Kenilworth Park and Aquatic Gardens
Soil Assessment for Grade Schools

Soil is made from a variety of materials. Some are base materials common to all soils such as broken down rocks eroded by wind or precipitation. Some are unique to a location, such as the decaying stems of a particular plant, or the bones of a rare species. Minerals from deep in the base layer of soil (bedrock) may be dissolved by precipitation that stays in the soil, and is brought to the surface by tree roots and are released to shallow rooted plants when the tree dies and fungi and insects break down their trunks. Sometimes these new plants begin growing in the half rotten tree. The minerals get taken up in the bodies of animals that eat these plants and then return again to the soil as they decay.

Soil is a habitat. In the cross section picture above, there are animals living in a burrow, ants live in a burrow underground, reptiles like the turtle lay their eggs to incubate in the ground, plants have the ground to anchor their roots. How would we and other land animals be different if there was no ground to walk on?

Introduction: Basic Instructions for All Grades

Equipment needed: narrow trowels or soil corers, paper cups and bowls, spoons, water for the class. Side experiments are in shaded boxes.

Instructions for all grades:

Select a minimum of three sites:

1: uncompacted soil (forest, meadow, stream bank)
2: compacted soil (play ground, trail)
3: little impacted by people.

If you can find sites for each of these criteria in and out of shade for a total of six sites, that's better.

Use trowels or corers to create cores of dirt that can be lifted out intact and placed in the bowls.
Before breaking the cores up, look for changes in color that represent different layers of soil.

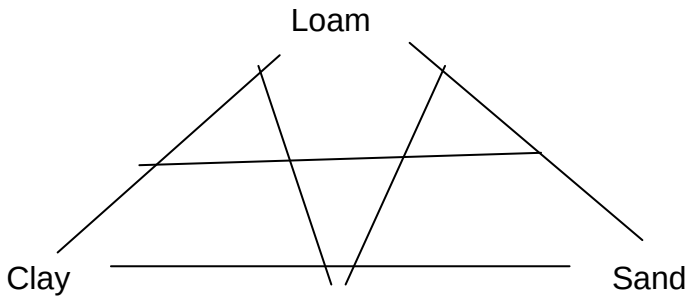
Humus (dead plant material) will usually be the top layer, then soil will change depending on your area. Ask students to look for changes in color and write, verbalize or draw the description, changes in size of particles (compare size to a common reference like eyelash thick or corn meal), and look for and write or verbalize descriptions of parts of plants or animals that were buried.

Have them feel the different layers and compare moisture content. Is it squishy, did it leave the bowl wet, is one layer damp and another dry and crumbly? Practice language and observation skills. Many soils are clay but have different colors of clay in spots in the base color.

Break the core apart and look for clues to what formed the layers (leaves, rocks, shells, bones, roots)

Soil will most likely be:
Clay - slippery when wet/hard when dry, holds shape well when wet and can be squished to a ribbon between fingers
Sandy - small particles of rocks/does not hold shape well
Loam – rich in organic material, loose, dark, does not hold shape well

A mixture of these with possible mix of all three



Directions by Grade Begin Here

<u>Pre-K and K Adds where does water go when it snows or rains</u>

Added equipment: each child should have a cup and the class should have access to water in the field so each child can pour out two half filled cups of water. (Our experience has been that if you give them a full cup and ask them to pour half, many students will pour it all out at the first stop.)

Questions to explore: Where does water go when it hits the soil? Will soil absorb water?
Explain: we see some water run downhill, but not all. Let's experiment:
-Go to each soil selection site you've selected. **Before you dig,** pour a half cup of water on the compacted soil, and make observations of how much runs off or if it sits there. If it runs off is it fast, or how long before it soaks in.
- Compare results from the most compacted to the least compacted area.

Question to ask: Is there a difference in what's growing in the soil from one site to another?
Explain: Plants absorb water. Plants, along with animals living in the soil create air spaces in soil that can fill with water. Plants have very delicate roots. If the roots of a plant dies, then so does the plant. Walking on soil will reduce the air spaces in it over time and kill plants growing in it.

Experiment: Take three bean seeds and spout them on damp paper towels. With one, just keep the roots in a damp paper towel. With the second, sprout the seed and leave it on a hard surface. With the third, plant the roots and keep the soil damp. Put them all in the sun and see which does best over a month. What does this tell us about the relation of soil and plants?

Follow basic instructions from introduction:
When done: Have students describe the soil that had the most different stuff in it, or had the best plants growing in it. Describe the soil with the least.
Could they tell before they dug why one soil let water soak in and one would not? Could they make a drawing to show where their soil came from? How much stuff that was man-made did they find in the soil? If they found a lot, bring some into the classroom and observe over several weeks to see if it will break down. Some does, and some does not. This is how archeologists know about the people from the past.

Grades 1-3, Adds percolation of soils

Additional equipment needed, plastic bottles with the bottoms cut off for each child

Question to explore: Where does water go when it hits the soil?
Explain: we know we can see some run off, but not all. Experiment:
-Go to soil selection sites. Before you dig be sure the lids are off the bottles and screw the bottle's narrow end into the soil about 1/8 inch. Pour a half cup of water in the open ends of the bottles, and make observations of how long it takes before it soaks in.
= Compare sites

Question to ask: Is there a difference in what's growing in the soil? How might that impact the water absorption? Will plants take up some water?

Follow basic instructions in the introduction but have them look for air spaces in the soil.
Follow up. Do their observations show what formed the soil? Did shaded or sunny spots have the most moisture in the soil? Do their observations show a connection between soil dampness and evidence of other life such as bones and plant material in the soil? Are there other things that might impact the rate of water absorption that have nothing to do with the soil? If so ask "Is there a way to test to see if they are right?" and try their experiment if practical. Make a soil map of the area. On it show where people walk the most and where plants shade the soil (label them grass, trees, etc.)

Grades 4—6 Adds watershed to soil study
Additional equipment need: bottles for students with the bottoms cut off, a map of water bodies near the school and rulers, crayons, paper, an aquarium or tall clear container, food color
In Class: Use a topographic or other map to find the nearest body of water to your school. Ask how water might get from your school to that body of water? How can this be tested? (Responses may be silly, but someone will say pour water out and follow it) Explain that this is what is meant by run off, and through run off and ground water, water does get from the school to the body of water, maybe traveling through storm drains for some of the trip.

Question to explore: Where does water go when it hits the soil?

Explain: we know we can see some run off, but not all. Experiment:

-Go to soil selection sites. Before you dig, pour a cup of water onto the soil. Have students monitor how much they think runs off (all, some). Where did water that didn't run off go? Explain ground water is water in the ground that moves slowly to the lowest place. It may take hundreds of years to move a few hundred yards.
- Before you dig be sure the lids are off the bottles and screw the narrow end of the bottle into the soil about 1/8 inch. Pour a half cup of water in the open ends of the bottles, and make observations of how long it takes before it soaks in. (Count Seconds or minutes if needed) If there is no change in two minutes take the bottles out and consider this a very compacted soil.

Question to ask: Is there a difference in what's growing in the soil? How might that impact the water absorption? Will plants take up some water?

Follow basic instructions from introduction.

Follow up. Do their observations show a connection between soil conditions and water absorption? Make a horizon map using crayons to match the colors of soil they found. Generally sepia and raw sienna are organic oxygen rich soils, red soils are high in iron, grey or black soils (if clay) are typical of wetlands soils and anoxic, and light brown or sandy soils are from weathered sand stone. Clay soil has a negative charge to it which holds the positive charged water keeping it locked away from plants. Sand will allow it to run through quickly. Loam will hold some water but drain better than clay.

If practical, bring soil from your dig sites into the classroom and create a slope of layers of soil in an aquarium or tall clear container. Make sure the layers are the same depth as you found them outside. Add dark food coloring to a small amount of water so it will show up against the layers of soil in the container and pour it slowly onto the top of the slope. Observe what happens. Does this reflect what was seen outside? Does one layer absorb the water and another stop it from going down? Does it leak out the side of the slope? If a layer of soil stopped the water, this is what soil scientists call an impervious layer. In the ground, these layers stop the flow of water and create aquifers that keep ground water where plants can reach it. Sandy or gravely soil will allow it to go through quickly.

Grades 5 & 6 : Which of your soil test sites would be best to feed the groundwater supply and get it to the body of water near the school? Which area would be most likely to flood in heavy rain? Which soil would be best for plants to grow in?

Grades 6 optional: Try taking a single core from each area in separate bowls and pour the same amount of water on each. Cover with plastic and see how much water pours off at the end of the week. Soils with lots of humus will hold the water normally better than sandy. However clay soil has a charge that attracts and holds water ions.