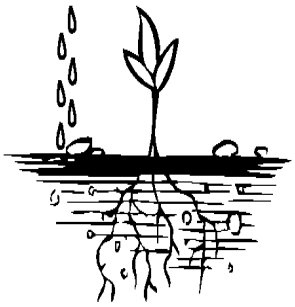


# SAVVY ABOUT SOIL
## INTRODUCTORY LESSON

**OUTCOMES:**

1) Students will understand the composition of soil: particle size, air space, organic material and nutrients.
2) Students will be able to identify the textures: sand, clay, silt, and loam.
3) Students will begin to develop an understanding of soil profiles and the composition of the layers of the earth.

**GRADE LEVEL:** 5TH – 8TH

**TIME:** one class period

**ESSENTIAL QUESTION:**

***How does one identify soil texture and why is it important to do so?***

**MATERIALS:**

- ❑ **Document camera**

ITEMS PROVIDED BY THE GREENWAY EDUCATION PROGRAM:

- ■ **Photo of thin slice of soil**
- ■ **Photo of soil profile**
- ■ **Jeweler's Loupes**
- ■ **Soil samples**

**ESSENTIAL ACADEMIC LEARNING REQUIREMENTS:**

Please see SUPPLEMENTS section.

**BACKGROUND INFORMATION FOR TEACHER**

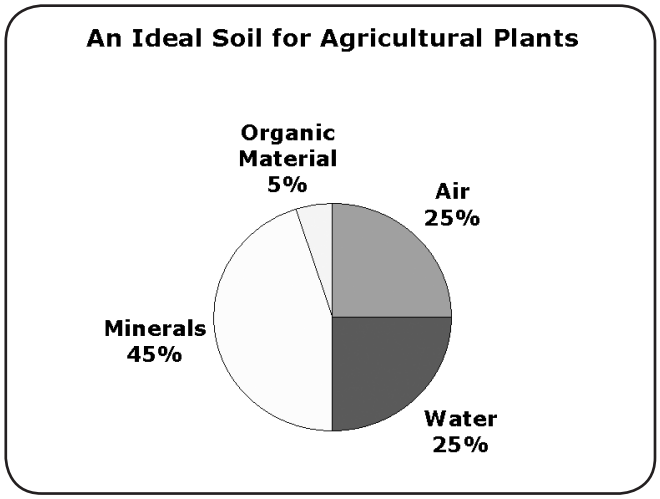
Soil recipe: Original material from the earth + climate + organisms + location + time = soil

It takes 100 to 600 years to form one inch of soil. Bedrock, organic materials and lava are all examples of materials that make soil. Heat, rain, sun and wind (climate) help to break down the parent material. This is called weathering. Roots and animals invade the soil, changing it chemically and physically. The location of a soil determines the amount of sun and/or water that it receives and the location also affects the composition. The last ingredient for making soil is time. Some of the forces that create soil occur slowly over a long period of time.

Soil is made up of what you see and what you don't see. Water and organic materials (like trees/plants/animal remains) are the components you CAN see. What you CAN'T see are the air spaces between each particle and the mineral nutrients in the soil. It looks like the surface of soil is solid, but actually there are spaces between the particles. Different textures of soil have different particle sizes and so the air space between the particles differs. The air spaces in soil are an important part of what makes soil. Variable amounts of air space in the soil allow different amounts of water to flow through. This in turn affects what kind of vegetation can grow or the ideal use of that particular piece of land. For example, if the soil is mostly clay in a field it is not a good place to farm or build a house because

the water tends to sit on top of the clay. An ideal soil texture for farms is loam which has 25% air, 25% water, 45% mineral nutrients and from 1% - 5% organic material. “Even if you have a good mix of mineral soil particles, and air and water without organic matter the soil will not be fertile.” Jeffrey Smith, Soil Biochemist, WSU. The mineral nutrient soil in loam is typically 40% sand, 40% silt and 20% clay.

The other component of soil that you can’t see are mineral nutrients. A nutrient is a substance or ingredient that nourishes living things. Mineral




nutrients enter the soil from decomposing organic material and the breakdown of rock. Healthy soil contains 13 of the essential 16 nutrients that plants/ trees need to grow. There are mineral nutrients and nonmineral nutrients.

MINERAL NUTRIENTS

| | |
|---|---|
| Nitrogen | Manganese |
| Copper | Calcium |
| Phosphorus | Molybdenum |
| Iron | Magnesium |
| Potassium | Zinc |
| Chloride | Boron |
| Sulphur | |

NON MINERAL NUTRIENTS
Hydrogen
Oxygen
Carbon

On the next few pages you will learn about four soil textures and biosolids. Please refer to the Guide sheet for a concise explanation of soil texture, pH, and nutrients.

## PROCEDURE:

**1** Hold up the photo of the thin slice of soil. Have the students guess what it is. Using the information on the back of the photo, help the students understand how thin slices are made. Later in the class, if there is time, they will be invited to examine a picture of a soil profile dug in Washington State.

*The photo you just looked at is a special way of looking at one tiny sample of soil. When you look out the window at the earth you don't see soil that looks like the photo. What does the soil look like that you can see?* Elicit a couple of answers and then say that you have some samples that might remind them of what they have seen. Show the provided soil samples and ask for observations.

Divide the class into small groups and explain how to use the jeweler's loupes. Put the wide end up to your open eye, close the other eye and bring the soil sample up to the loop until it is in focus. Give each group a baggie of soil samples that contain four different soil textures and the biosolids sample. *Tell them it is OK to open the jar and feel the soil.* Suggest they squeeze the samples between their fingers.

## SOIL EXPLORATION:

**2** Note that each jar has a number: #1 Loam, #2 Sand, #3 Clay, #4 Silt, and #5 (Mystery) Biosolids. After students look and touch all the samples, take their observations and record on the Soil Texture Chart. Be sure to introduce the term "particle size" as the students share their findings.

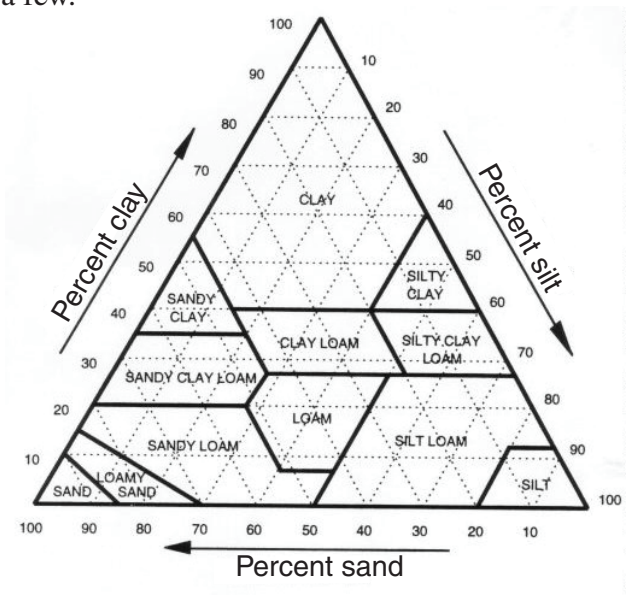
Sample #5 is a mystery sample. Please do NOT tell the class what it is. It actually is biosolids, or recycled waste from the wastewater treatment plant. It is pathogen-free so don't worry! Ask the students what differences they see between the soil samples. Tell them the names of the four different soil textures.

Have the groups arrange the samples in order from the smallest to the largest particles. Share their results.

## DISCUSSION:

**3** When the size of the particles in a soil sample is known, the texture of the soil is also known. Texture of soil does NOT refer to how hard or soft it is. Texture of soil refers to the size of the particles. Sand has the biggest, heaviest particles, feels gritty and has the largest air spaces. Water tends to run right through sand. Silt has the consistency of flour or cocoa and has small air spaces. Clay has the smallest air spaces and the smallest particle size and so water moves through clay slowly. Loam is crumbly with lots of organic material and contains sand, silt and clay. Loam is great soil for farming because it holds onto water just the right amount of time for plants and trees to absorb it.

In the forest and farmlands, these textures are mixed together and soil scientists find combinations like: sandy loam, silty loam or sandy clay, just to name a few.




A soil texture triangle is used by soil scientists to understand the texture of soil. Sand percentages are read from right to left across the triangle; silt is read from the upper right to the lower right; clay is read from the lower left towards the top of the triangle. The intersection of the three sizes on the triangle give the texture class. For instance, if you have a soil with 50% sand, clay, and silt you have a loam soil. For more information go to the following website: http://soil.gsfc.nasa.gov/tbf/txtbyfel.htm

**Why is it important to understand the different soil textures in our earth?**

**Each texture is suited for a particular type of activity. Loam is the best for farming; silt, clay and sandy soils would not be a good place to build a house.**

The size of the soil particles determines the amount of air space in the soil and thus affects the amount and speed with which water flows through the soil. How quickly water flows through the soil affects the ability of plants/trees to absorb the water and mineral nutrients that are in the soil. Remember that mineral nutrients enter the soil through decomposing plants, animals and rocks. The nutrients dissolve into the water in the soil, and then the tree roots absorb the water (along with the nutrients). If the water moves through the soil too quickly then the trees/plants lose their chance to absorb water/nutrients. If the water is absorbed too slowly by the soil, then the trees can't get the nutrients they need also. We want the water to linger in the soil, not drowning the roots or rushing through.

## FURTHER STUDY:

**4** If there is time, show the photo of the soil profile. It is about 3 feet or 1 meter deep. The profile tells a story about how the soil was formed and what the texture is. *How many layers do you see? What is your best guess about the differences between the soil closest to the surface vs deeper in the pit? What could the dark soil indicate? What is organic material? Which layer of soil has the most mineral nutrients in it?*

All the soil you see on earth has different combinations of sand, silt, and clay. The combination in the Pacific Northwest is determined by a glacier that covered our land 14,000 years ago. When the glacier left, it scoured the earth and left a mix of sand, rock and clay with no organic material. Even though 14,000 years sounds like a long time, it really isn't long when it comes to making soil. Anther variable that affects the texture of our soil is the nutrient-rich volcanic ash that was deposited.

A farmer who fertilizes the land can improve the health of the soil by improving its texture and level of nutrients. By adding organic material and fertilizer, a rich loam layer of soil can be created to grow trees and crops.

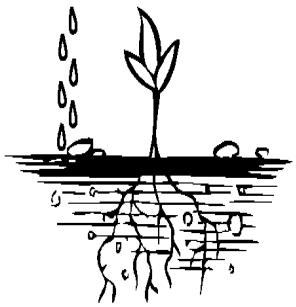
## CONCLUSION:

**5** *Now that you know that there are different textures of soil, describe how water would move through them. Why is it important to plants/trees to have water move slowly and steadily through the soil? What can you do to help improve the health of our soil?*

Tell students that a Mountains to Sound Greenway Educator will be coming to the class to talk about soil texture and how it affects plant and tree growth.

## VOCABULARY:

Texture, particle, silt, clay, loam, organic material, bedrock, mineral nutrient, weathering

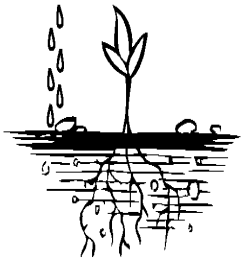


# SAVVY ABOUT SOIL

## SOIL TEXTURE CHART

| Texture #1 | Texture #2 | Texture #3 |
|---|---|---|
| | | |

| Texture #4 | MYSTERY |
|---|---|
| | |



# SOIL GUIDE

Knowing how much sand, silt, clay and organic material are in the soil helps determine how water moves through the soil. When water is held in the soil, rather than rushing straight through, it allows time for roots of trees to absorb the water. This is good, because then trees get water AND they get the nutrients that have been dissolved in the water.

**Soil textures**

**Clay** - smallest particles that feel slippery and cannot be seen with unaided eye. There is very little space between the particles. Clay allows water and air to enter and exit very slowly. It holds the most nutrients and can make slippery mud.

**Silt** - medium particles that feel like flour when dry or a little bit gritty. Silt allows water to pass through slowly and is one texture that makes mud. This texture makes good farm land, but erodes easily.

**Sand** - largest particles that feel gritty and can be seen by unaided eye. There are large air spaces between particles and so sand doesn't hold water or nutrients. Plant and tree roots can't hold onto this soil texture, but some plants send roots deep through the sandy topsoil to the subsoil.

**Loam** - healthy combination of sand, silt, with a little bit of clay and organic material. This texture has enough large and small air spaces between the particles for air and water to flow in. Plant roots can easily grow through these spaces. Loam is the best for growing plants/trees as it holds water just long enough for trees to absorb nutrients.

**Clay** **Silt** **Sand** **Loam**

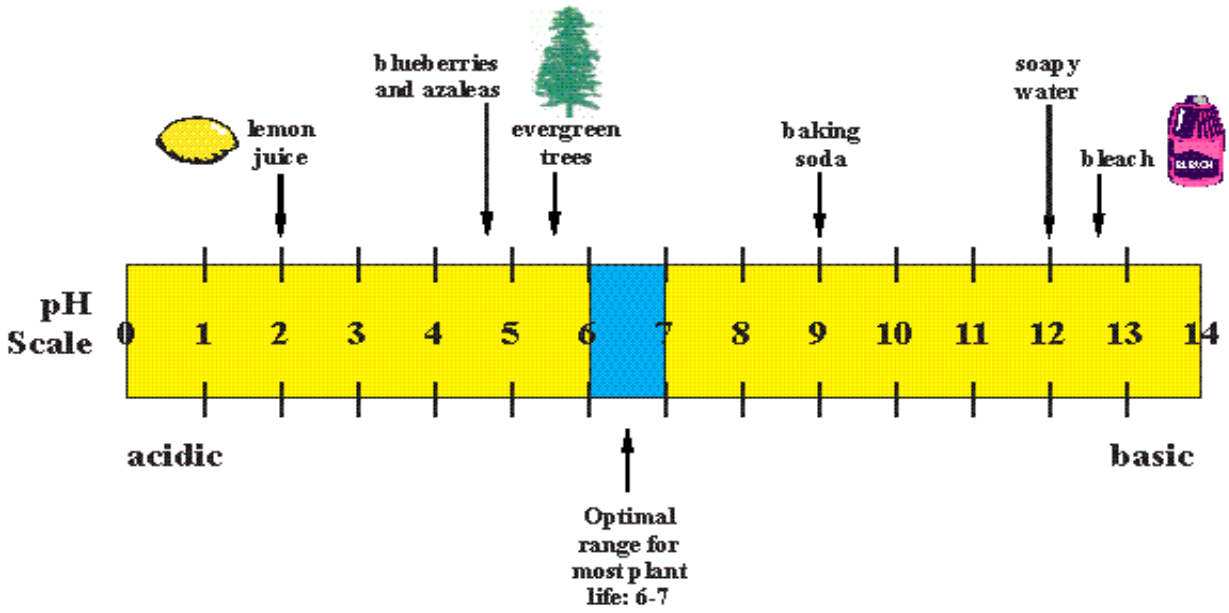
*Clay particles - 12,000 particles in a line = 1 inch*

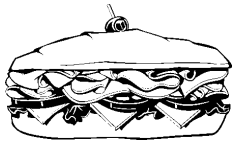
*Information provided with permission by Colorado State University Cooperative Extension*

Which soil holds water the best? Worst? What could you add to the soil to improve the texture and increase the fertility?

**pH** determines how acid the soil is on a scale of 1 to 14, the opposite of acid is base.

The pH level of soil is important to know because it helps determine whether trees/plants can use the nutrients in the soil. If the pH is off then some nutrients stay locked in the soil and are unavailable for trees to use. A pH of 6 to 7 or **neutral** is the best for most trees and plants. But some trees and plants like acidic soil. Evergreen trees, rhododendrons, potatoes and blueberries prefer acidic soil and thus grow well in the Pacific Northwest. PH increases logarithmically. That means a pH of 7 is ten times more basic than a pH of 6. A pH of 8 is ten times more basic than 7, and so on.

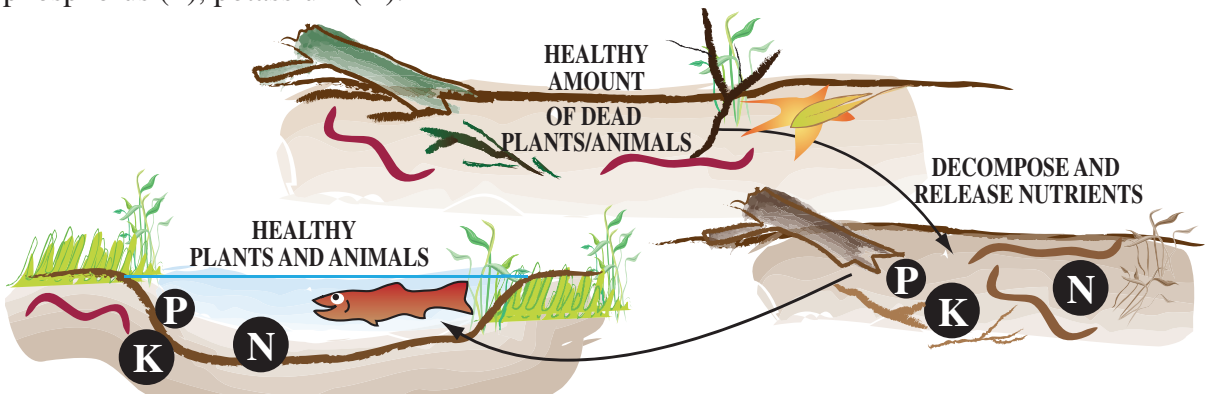


**Nutrients** provide nourishment (food). As a human you get nutrients from eggs, bread, cheese and vegetables. Trees get nutrients (food) from the soil but it doesn't look like your food. The trees absorb nutrients from the soil that have been dissolved in water. Fourteen of the seventeen essential nutrients for trees to grow are obtained from the soil. Three important plant and tree nutrients are: **Nitrogen (N), Phosphorous (P), and Potassium (K).** Knowing the amounts of these nutrients in the soil helps farmers and scientists determine how much fertilizer to add.


**Biosolids** (recycled solids from the wastewater treatment plant) is one fertilizer used in the Pacific Northwest that adds nutrients while improving the texture of the soil.

A **nutrient** is a substance or ingredient that nourishes living things. You can't see them in the soil or water, but they are in there. 16 chemical nutrients are necessary for a plant's growth. These are either non-mineral nutrients or mineral nutrients. Examples of non-mineral nutrients are: hydrogen, oxygen and carbon and are found in the air and water. Out of the remaining 13 nutrients, we are measuring three: nitrogen (N) and phosphorus (P), potassium (K).




What are **nitrogen, phosphorus, and potassium**? Nitrogen and phosphorus are nutrients needed for growth by all plants and animals that live in the water or on land. They are added naturally to soil and water by decomposing plants and animals.

**Problem:**

Sometimes too many nutrients enter streams from sewage leaks, dog waste, factories, or from fertilizers running into streams from people's lawns, gardens, or farms. High levels of nutrients in stream water can reduce the amount of oxygen in the water which then kills fish.