



SOIL

Lesson 1 ♦ What is soil?

Grades 6-8

Key Words

Biotic, Abiotic, Organic Matter, Amendments, Composition, Aeration, Hummus

Key Concepts

- Soil is composed of minerals, water, air and organic matter. The minerals and organic matter in the soil may vary by location.
- Look at soil composition, soil chemistry(NPK) and overall soil health.
- Plant health is directly related to soil health, or soil fertility and look at ways of improving.

Lesson Outline

Soil may not seem like an exciting topic, but there is so much happening under our feet and below the ground that makes all of the beautiful plants we see above ground possible! Healthy soil grows healthy plants, and healthy plants support a healthy planet.

Open a discussion of what soil is and why it is important. During this lesson, examine soil composition, nutrients and overall soil health. Include the following information:

Soil Composition

Soil is made up of abiotic (abiotic = non-living) and biotic (biotic = living) materials broken down into 4 main components. Those are (abiotic factors) minerals, water, air and (biotic factors) organic matter.

Minerals make up about 45% of soil. They are naturally occurring, inorganic (or nonliving) compounds that make up rocks. These minerals in our soil can be grouped into 3 different categories based on their size. These categories of minerals are sand, silt and clay. The percentage of sand, silt and clay in soil determines the soil type. In a garden bed, we generally want loam soil which has relatively equal amounts of sand and silt, and a little less clay.

Minerals make up 45% of soil, and water and air make up 25% of soil each. Review why water and air are important in soil.

5% of soil is organic matter. Organic matter is any material that was once alive and is now dead and decomposing. Have the students think of examples of things they might find in their soil that were once alive and are now dead and decomposing. Organic matter is important because it contributes nutrients that plants need to grow! Review and model the nutrient cycle.

Soil provides more than just a place for plants to attach their roots. Soil is also the main source of water and nutrients for plants, without which plants could not grow.

Soil Types and Soil Chemistry

Loam soil tends to be the best for gardens. This is because of its ability to retain water and nutrients (clay) while still having good drainage and aeration (sand). Too much of one or the other will change the amount of nutrients, water and air that the soil can hold onto. Take a further look at how water flows through sand vs. clay.

Water that is moving through sand goes right through the sand particles, draining out immediately; it does not hold onto the water long enough for a plant's roots to absorb it. The opposite happens with clay; the water takes a while to absorb into the clay and actually pools on top. This could potentially rot out the stem and roots of a plant growing in it. One can understand why we want a nice balance between the two in our soil.

Soil is also important for providing plants with nutrients needed to grow. There are 3 main nutrients that plants get from soil: Nitrogen (N), Phosphorus (P) and Potassium (K). These 3 nutrients are crucial in plant growth, development, and reproduction.

Soil Fertility

Plant health is directly related to soil health, or soil fertility. Soil fertility refers to soils ability to provide plants with essential nutrients and adequate amounts of water needed for plant growth and reproduction. In simpler terms, fertile soil, or healthy soil, should be able to retain, or hold, water, but still have good drainage to avoid drowning the plant, AND it should have plenty of organic matter that provides nutrients for the plants.

How do we know if our soil is fertile or not? We will be testing the composition of our soil using the Soil Shake Jar Test.

Perform Soil Shake Jar Test. Have the student identify the different layers of minerals and organic matter. Discuss why this information is important and try to get the students to think of how the information gained might be valuable to a gardener.

Introduce the idea that as gardeners and stewards of the planet, students have the power to work with the natural cycles to make positive change in their immediate environment (in this case, the garden). By understanding the current state of the soil as well as the needs of the plant, the students will be able to influence the success of the plants in their garden.

Challenge the student to try to find ways that this can be a solution to challenges the greater ecosystem is facing (nutrient recycling, soil erosion, etc.)

Amending Soil

Testing for nutrient content in your soil is a little more complicated than the Soil Shake Jar Test, only because you have to have a soil test kit or send a soil sample into a testing facility. However, there are some ways to examine the amount of organic matter in your soil.

One way is by looking at the shake jar test. Is there a lot of organic matter floating in the water? Not much at all? Or you can look at the top layer, or soil horizon, from your soil sample. This is the O horizon made up of organic material known as hummus. It's often easy to visually see if your soil is rich in organic matter or not.

Once you know how your soil is made up, you can determine the best ways to amend, or improve, your soil. There are many simple ways to improve soil fertility, or build up your soil, just by using plants. One common way to do this is by adding compost to your soil. Composting is the process of using decomposition as a way to recycle plant material and nutrients back into the soil.

Another way to introduce more organic matter into your soil is using cover crops and green manure. Cover crops are plants that are grown specifically to enrich the soil. For example, plants in the legume family (such as beans, peas, clover and other plants) can increase the nitrogen content in soil through a process called nitrogen fixation. Cover crops can also help loosen and break up compact soil, prevent erosion, and suppress weeds in the garden. Most cover crops can also be used as green manure. Green manure are plants that are grown specifically to be cut down and mixed into the soil to decompose, thereby adding organic matter directly into the soil.

In fact, this method of using green manure to build your soil is similar to some traditional Hawaiian ways of caring for soil. In lo'i kalo that were left unplanted for a period of time (think crop rotations), grass and weeds would be incorporated into the soil as green manure by softening the soil with an o'o (digging pole) and stamping the dead plants into the mud. In this way, organic matter (and nutrients) were incorporated back into the soil before more kalo was planted.

Video Lesson

[Soil Lesson 1 Video - What is soil?](#)

Activities

- [ACTIVITY_Soil Shake Jar Test](#): Activity where students collect and analyze their soil.
- [STUDENT HANDOUT_What is soil_6-8](#): A worksheet to accompany the video lesson and soil shake jar test activity.

Additional Resources

- BACKGROUND INFO_Testing Your Soil: Covers equipment needed, specific soil nutrients to analyze, how to actually obtain the samples, getting them analyzed and a conclusion. The last page is a form to fill out and send in with your sample
Courtesy of University of Hawaii / College of Tropical Agriculture and Human Resources
- [VISUAL_Test and Improve the Soil pH](#): Infographic on soil Ph and nutrient levels and amendments suggestions *Courtesy of Original source unknown*
- [VIDEO LINK_The Soil Story](#): 4 minute YouTube video (with Spanish subtitles!) that shares the importance of healthy soil for a healthy planet and talks about what we can do about it
Courtesy of Kiss The Ground
- [VIDEO LINK_The Carbon Cycle](#): Short (2:40) YouTube video *Courtesy of From UK Science curriculum on JamJarMMX YouTube site.*
- [VIDEO LINK_How to collect a soil sample](#): How to collect a soil sample (2:30 video)
Courtesy of Centers for Disease Control and Prevention

NGSS - Next Generation Science Standards

- [5-LS1-1](#) Support an argument that plants get the materials they need for growth chiefly from air and water.
- [6-8-LS2-5](#) Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

KAP - Kū 'Āina Pā Curriculum Map - Courtesy of the [Kohala Center](#)

- KAP_2:LS_6-8_1.6 Know and describe the roles of oxygen, carbon, and nutrient cycling in the soil
- KAP_2:LS_6-8_4.2 Investigate, analyze and apply natural soil fertility systems
- KAP_2:LS_6-8_4.3 Understand decomposition