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# SOIL BASICS: FUNCTION AND VARIATION

Jennifer Reese, F.A. Day Middle School, Newtonville, MA

**Grade Level:** 6-8

**Introduction:** Soil is a critical component of any ecosystem; however, it is often overlooked. In this lesson, students will examine the soils of a tropical montane cloud forest. As they visit a series of panoramas, they will record data about the soil's color, water content, organic content, and other characteristics. Students will then create two trend graphs: one which represents the relationship between altitude and water content, and another that relates altitude to organic content. Students will then suggest explanations for each trend.

**Major Themes:** Properties of soil

**Connections to National Science Education Standards:** Structure of the Earth system (D); populations and ecosystems (C); use appropriate tools and techniques to gather, analyze, and interpret data (A); develop descriptions, explanations, predictions, and models using evidence (A); think critically and logically to make the relationships between evidence and explanations (A).

**Time:** 60 minutes (5 minutes for opening, 20 minutes to complete data tables, 20 minutes for graphing, 10 minutes for graph analysis, 5 minutes for closing)

**Materials:** Students will need to view the following Canopy in the Clouds videos:
Panorama 1: Ground videos 2, 3
Panorama 2: Ground video 2
Panorama 3: Ground video 2
Panorama 4: Ground video 2
Panorama 5: Ground video 2

Computers with internet access (at least one, preferably enough for one per pair of students)
LCD projector (recommended)
Student handouts (*Tropical Montane Soils* and *Tropical Montane Soils: Student Assessment*)
Graph paper
Rulers
Overhead projector, interactive whiteboard, or graphing/illustrating software installed on designated computer (optional)

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**Objectives:** Students will be able to: (1) recognize and understand the different functions of soil in the environment, (2) understand that not all soil is the same, soil properties vary among locations, 3) and relate soil conditions to other biotic and abiotic factors.

**Potential Misconceptions:**

(1) Soil is not dirt, although laypeople often use the words interchangeably. Soil is composed of both inorganic and organic (presently or formerly living) material that forms a thin layer at the Earth's surface. Dirt is a more general term, thought to originate from a word meaning excrement, that does not describe all the properties of soil.

(2) Organic material is any matter that is living or used to be living. Students may think that once an organism is no longer living, it ceases to be organic. Students may also think that if an object is manmade, it cannot be considered organic. A piece of wood that is used to make a ruler *is* organic, because it originated from a once-living tree.

## PROCEDURE

**Opening:** Have a small dish or cup of soil at each table (or in selected locations around the room, depending on your seating arrangement). Colorless, transparent containers work best. Write the following questions on the board: *What is it? What's in it? Why is it important?* When class begins, draw students' attention to the soil samples (students will have noticed them unless they are on lab counters or otherwise not on their tables/desks). Simply call them "samples" rather than "soil samples" so as not to influence students' perceptions.

Point out the questions on the board and give students 1-2 minutes to jot down answers. Solicit volunteers to share their responses. After students have shared their ideas, provide (or reinforce) these responses:
*What is it?* Soil! Soil and dirt are different. Dirt is a more general term, whereas soil is the proper term for the thin layer of inorganic and organic material that covers the earth's land surface.
*What's in it?* Air, water, minerals, organic material, bacteria, fungi, other small animals
*Why is it important?* Habitat for plants and animals, recycling of nutrients, surface for building houses, filters water, etc.

Explain that soil has many roles in the environment and that a lot can be learned about an area based on its soil. Today, students will make explore and learn about the tropical montane cloud forest through the soils.

**Development:** Distribute *Tropical Montane Soils* student handout. Solicit volunteers to read the introduction of the handout aloud. Using the computer and LCD projector,

watch Panorama #1 (low elevation forest), ground video #3 for an introduction to soil sampling. Ask students to share any key words or ideas that they heard, then review the soil characteristics that are described on the student handout. Address any questions that students have before moving on.

Read the remainder of the front page of the handout together. Articulate the difference between relative and absolute data and ask students to offer several examples to check for understanding. Be sure students understand how to read and use the data table, then allow students to begin watching videos and recording the properties of the soil at each site. Some students may not follow the footnote that offers a hint for finding elevation information. Demonstrate that one can find this information by placing the mouse pointer over the site number on the forest map (on the homepage).

If you are using a single computer, work through the handout together as a class. If students are working alone or in pairs, circulate around the room and stop to interact with every student (or pair) at least once.

Allow students 20 minutes to fill in the large data table and the two smaller tables under the "Graphing" heading. When students are ready to make their graphs, you may want to: (1) distribute graph paper and rulers and allow students to begin working on their graphs immediately; (2) review the basic strategies for constructing a graph; or (3) complete one or both graphs together as a class. If you plan to complete the graph(s) together, an overhead projector, interactive whiteboard, or graphing/illustrating software (installed on the designated computer) will be extremely helpful.

Elevation will be plotted along the x-axes and water/organic content will be plotted along the y-axes. The x-axes will use numbers and the y-axes will use a continuum from low to high. Many students will be unsure about how to plot data along this continuum; modeling it for them is important. Students may also struggle with how to plot three data points for 1600 meters (high elevation forest, elfin forest, and Atlantic slope). Model the plotting of these points for students and ask them to label each point with the location for future reference. During this graphing instruction, introduce (or review) the concept of outliers and demonstrate how to handle outliers when analyzing graphs for patterns or trends.

If time is a concern, ask half of the class to complete the altitude/water content graph while the other half completes the altitude/organic content graph. Students may then pair up or trade papers to complete the "Graph analysis" portion of the handout.

Allow 15 minutes for students to complete the graph analysis. Students who are unfamiliar with reading graphs will need additional support here.

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**Closing:** Discuss students' responses to graph analysis questions. If possible, have images of the two graphs available (e.g., projected via the LCD projector or overhead projector) for reference. If data was graphed properly, students should have identified trends for both subsets of data. Allow time for students to share their explanations with a partner or with the entire class. Ask students if they have evidence of a correlation between water content and organic content at the sites. Encourage students to think through their ideas out loud.

**Suggested Student Assessment:** Assign *Tropical Montane Soils: Student Assessment* handout. Collect completed assignments, grade them, and return them to students. Provide an answer key, allow students to meet in small groups to discuss their answers, and/or go over the answers together as a class. Be sure to allow some class time in the near future to revisit the themes of this lesson and to address any components of the assessment with which students had difficulty.

**Extending the Lesson:** Ask students to collect soil samples from their own yards (or the yard of a friend or family member). Students should label the container of soil using masking tape with their name, location of the sample, and date/time sample was collected. Use these to create a classroom soil display and allow students to spend time comparing and contrasting the samples. Students can also perform simple activities like sorting the samples into like groups, using samples to create a dichotomous key, or observing and describing samples using a hand lens or microscope.

**Vocabulary:** substrate, fungi, ecosystems, soil structure, biomass, nutrient, organic, relative data, absolute data, uniform, plot, x-axis, y-axis, pattern, trend, outliers, correlation

***WORKSHEETS:*** *Tropical Montane Soils, Tropical Montane Soils: Student Assessment*