

Qualitative variables to investigate soils

GLOBE		Related SDGs:	Type of activity
Sphere	Protocols		
Pedosphere	Soil characterization	2 (Zero hunger)	Cognitive
	Soil fertility	12 (Responsible production and consumption)	
		15 (Life on land)	

Overview

Research is a process that aims to generate knowledge. It begins with a research question that must be answered based on observations made of reality and becomes quantitative or qualitative data. Through this activity, students will integrate qualitative data to characterize soils.

Time

50 min.

Prerequisites

None.

School level

Primary.

Purpose

Students collect qualitative data to describe soils and infer from them their ability to produce food.

Student outcomes

- Define in your own words what qualitative data is.
- Collect qualitative data on soil.
- Assess the ability of soils to grow food based on qualitative data analysis.

Introduction

To answer a research question, it is essential to contrast the ideas or hypotheses of the researcher with reality, for which it is essential to take field information using a selection of variables (Manterola & Otzen, 2013). These variables are characteristics of the elements we are studying, which can be measured, and which change from one component to another or over time.

Variables can be quantitative or qualitative. This activity will focus on qualitative variables. These variables can express themselves with words. However, sometimes qualitative characteristics can be transformed into numerical variables.

Qualitative variables can be:

- Dichotomous or binary: When they admit two possibilities
- Polytomical: When more than two values can be attributed to a variable. This type of variable can be divided into:
 - Nominal: They do not support a hierarchy or order
 - Ordinals: When they can be sorted according to established rankings

On the other hand, soils can be defined as the natural environment composed of weathered minerals, organic matter, air, and water in which plants grow (FAO, 2022). Therefore, fertility is an essential characteristic of soils. To ensure fertility, soils must maintain an adequate structure that guarantees the amount of air and water for the roots and the necessary nutrient renewal (mediated by microorganisms) to sustain the plants.

Soil fertility can be determined based on three significant variables:

- Physical
- Chemical
- Biological

Among the physical characteristics of fertility can be considered the following:

- Soil texture: Proportion of sand, silt, and clay in the soil. The texture can be classified into three large groups (Figure 1)
- Sandy soils: It feels rough to the touch, characterized by large pores that easily let water pass and accumulate a good amount of air between their pores. The advantage that sandy soils have is a good ventilation capacity. The disadvantage is a poor ability to retain water.
- Loamy soils: The ideal soil for crops is an intermediate texture between sand and clay.
- Clay soils: They are excellent soils when they are slightly wet. Therefore, they can be molded with some ease. They have the disadvantage of retaining a lot of water, being able to drown the plants, and not having good ventilation.

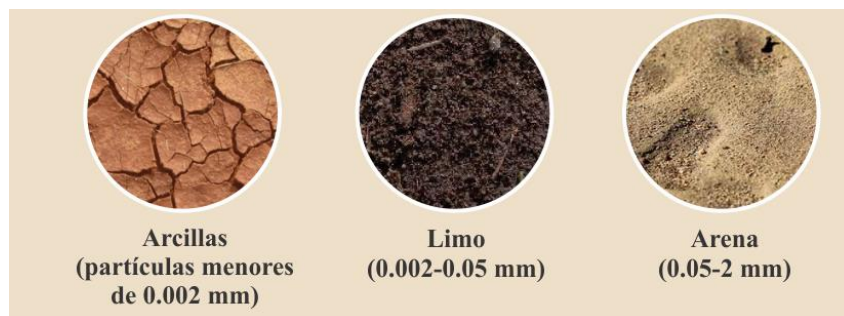


Figure 1: Soil texture
Source: <https://gensoil.net/>

Among the chemical characteristics of the soil that can be considered:

- Soil pH: The pH results from the composition of the soil; this can be acidic, neutral, or basic. In this regard, some crops grow best in slightly acidic or basic soils.
- Minerals: The most critical minerals in the soil are Nitrogen, Phosphorus, and Potassium. These materials are also known as macronutrients for plants. Nitrogen offers vigor for the growth of plant leaves (its deficiency can be seen in the leaves when they appear yellowish or brown). Phosphorus benefits the root and the development of shoots and seeds (its lack can be noticed in the leaves when they turn a bluish-green color). For its part, potassium strengthens the metabolism of plants and helps generate resistance to pathogens (its deficiency is expressed in plants showing them withered).

Among the biological components of soils can be considered the following:

- Macroinvertebrate animals: Many insects and worms are crucial for fertility. Among these, for example, earthworms provide organic matter through humus and provide ventilation by creating channels in the soil through which air circulates.
- The presence of bacteria that facilitate the recycling of nutrients; many bacteria have an affinity for the roots of plants of the Fabaceae family with which they form a symbiotic relationship.
- The presence of leaves in the soil that is in the process of decomposition, produces.

Guiding Research Questions

- What is qualitative data?
- How is qualitative data taken?
- How can qualitative data help to make decisions?
- What observations can I make to describe soil fertility?

Scientific concepts

- Qualitative data
- Soil fertility

Materials and tools

- Writing paper
- Vinegar
- Water
- Stopwatch
- Pencil

What to do and how to do it***Beginning***

- Teachers take students to the field, or, if there are no gardens in the school, bring some pots with plants or ask students to bring some plants into the classroom.
- Once in the gardens or observing the pots, teachers ask students to write everything that catches their attention about the soil and plants in their own words on paper. Students are especially asked to observe the color of the plant's leaves and the color of the soil to see if there are animals in the soil or if there are little animals in the leaves of the plants. It will also be important to observe if the soil is cracked, wet, saturated, or garbage.
- Next, some students share what they have written.

Development

- It is time for more detailed observations. Teachers hand out Table 1, containing the data sheet, and ask students to do some simple experiments to record their observations, marking the correct answer.

Table 1
Soil characteristics

Texture	Water passage	Presence of animals on the ground	Soil color	Presence of leaves in the soil	Presence of carbonates, bubbles with vinegar	Leaf color	Other
Sand	Fast	Yes - Which	Black	Yes	Yes	Green	
Slime	Slow	No	Dark brown	No	No	Yellow	
Clay	Middle		Light brown			Bluish	
			Red			Brown	
			Orange				
			Green				

Closing

- Students analyze the information they have written and with it, they elaborate a news cable to describe the soils.
- The news cable consists of a short and clear paragraph in which students can share their main findings about the soil they analyzed and also be able to infer if they have good soil to cultivate or not based on the observed characteristics.

Frequently asked questions

-Can qualitative data be supplemented with quantitative data?

Of course, the idea is to have as much information as possible to describe soils better.

Suggested Resources

Elementary GLOBE Soils Description: [The Soils - Elementary GLOBE - GLOBE.gov](#)

Bibliography

FAO, 2022. *FAO Soils Portal*. Retrieved from [Definitions | FAO Soils Portal | Food and Agriculture Organization of the United Nations](#)

Manterola, Carlos, & Otzen H, Tamara. (2013). *Why Research and How to Conduct an Investigation International Journal of Morphology*, 31(4), 1498-1504.
<https://dx.doi.org/10.4067/S0717-95022013000400056>