



Tradition: Soils Lesson

Tradition: Soils Lesson

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Overview

The theme for this week is tradition. We are proud of it. We learn from it. We are not bound by it. Agriculture is an age-old tradition that we are proud of, but we must also learn from the mistakes that have led to soil degradation and fix it.

Learning Objectives

- YCC precipitants will know some of the factors that impact soil formation.
- YCC precipitants will be familiar with some of the crucial services that soil provides.
- YCC precipitants will have a basic understanding of the main threats that soils face.
- YCC precipitants will know a few best management practices for soil conservation.

Materials Needed

- Threat cards (cut)
- BMP cards (cut)
- Ecosystem posters
- Tape (to paste the posters to the wall)

General Outline

1. Soil Basics

- a. Definition*
- b. Soil Formation*
- c. Horizons*

2. Soil Importance

- a. Discussion*
- b. Ecosystem Services*
- c. Climate Change*

3. Soils and Parks

- a. Soil in Parks*
- b. Park Soil Science*

4. MONO Geology

- a. Geological Context*

5. Activity

- a. Description*



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Background (for park employee benefit)

Soils preserve events of the past. The layers that are buried deep into our Earth were deposited by a plethora of historic events, from volcanic ash to glacial melting to uplifted marine deposit. Volcanic eruptions, frozen periods, tectonic movements all left traces that only soils can remember. Most relevant to MONO, soil carries the scars of agriculture, and it takes hundreds of years for soil to form, so we must protect the resource we have. While farmers may feel bound by their agricultural traditions, we are not bound by them, and we can manage soils better!

Procedure

1. Soil Basics

a. Definition

- i. NPS defines soils as “the unconsolidated portion of the Earth’s crust modified through physical, chemical, and biotic processes into a medium capable of supporting plant growth.”¹
- ii. Minerals, organic materials (dead or living organisms), air, and water come together, they create unique, dynamic, and crucial soil ecosystems.

b. Soil Formation

- i. Pedogenesis refers to the process of soil formation, which occurs by the gradual breakdown of rocks through “weathering”, breaking down rocks. It can be:²
 1. Physical weathering: mechanical actions break down the rock, including temperature changes, abrasion (rocks colliding), or frost.
 2. Chemical weathering: chemical changes to the rock break it down, like when minerals in the rock react with water, air, or chemicals.
 3. Biological weathering: organisms break down rocks by burrowing and allowing water and air get into rock, and plant roots can grow into the cracks in the rock, expanding them.
- ii. Other factors affect the formation of soil, and the interactions between them produce infinite varieties of soils. They include:
 1. Parent material, the original rock. Soils inherent general chemistry.
 2. Organisms, who provide organic matter when they die and the microorganisms that breakdown said matter for nutrients.
 3. Climate, as the temperature and rate of humidity impact weathering and decomposition.
 4. Topography, as slopes affect drainage, erosion, and deposition.

¹ Southard, S., & Eckert, G. (2016) “Celebrating soils across the National Park System.”

² Queensland Government. (2016) “How Soils Form”

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5. Time, as older soils have different characteristics than newer soils.

c. Horizons

- i. As soil develops, layers called “horizons” are formed. The properties of the horizons present in the soil allow for soil classification and determining land-use potential. Not all soils have an O horizon, mainly organic matter like plant litter that accumulated on the soil surface. Most soils have 3 main ones:³
 1. A horizon: dark, nutrient-rich topsoil where nutrient, organic matter and biological activity are highest.
 2. B horizon: lighter, clay-rich subsoil with less fertility and biological activity but more moisture.
 3. C horizon: underlying weathered rock the above soil.

2. Soil Importance

a. Discussion

- i. Ask YCC precipitants: “Think of a rocky landscape with no soil, and one with dark, fluffy soil. Which one would host the most life?” After they say the one with soil, ask: “Why is that so? Why is soil so important?”

b. Ecosystem Services

- i. Soils are the basis for almost all terrestrial habitats. They filter water; they regulate water flow; they control erosion; they mitigate flooding; provide and cycle nutrients that feed plant life; provide habitat for billions of organisms like bacteria, fungi, invertebrates, plants, and burrowing animals; they supply a lot of anthropogenic products, like antibiotics, materials for construction, earthworms as fish bait, and so much more.⁴

c. Climate Change

- i. An important ecosystem service that soils provide is carbon sequestration. Microbial degradation of soil organic matter from plants and animals creates reserves of organic carbon in soil, resulting in soil carbon sequestration. Soil is the largest terrestrial carbon sink on Earth, an increasingly important service as climate change is driven by greenhouse gases including carbon.

3. Soils and Parks

a. Soil in Parks

- i. Soil is where we hike a trail, pitch a tent, stop at a scenic overlook. They support terrestrial food webs and park roads. Soils define the character of the parks and their stories. They limit what plants can grow in them.

³ Southard, S., & Eckert, G. (2016) “Celebrating soils across the National Park System.”

⁴ Soil Science Society of America. “Why is Soil Important?”

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- ii. Human history and culture are also entwined with soils, as seen in parks where soils provide paint and dyes for art and building materials.

- b. *Park Soil Science*

- i. NPS Natural Resource Stewardship and Science Inventory & Monitoring Program have been conducting soil type and distribution surveys in more than 270 National Parks. This data is always updated to help parks manage natural and cultural resources, facilities, and operations.
- ii. NPS Management Policies 2006 directs National Parks to conserve soils and use the best available science to inform our best management practices by understanding the soil properties and behavior, and what activities are detrimental to soils.⁵

4. MONO Geology

- a. *Geological Context*

- i. The park shares its geologic history and some characteristic geologic formations with a region that extends well beyond park boundaries. It's part of the Piedmont Physiographic Province, which extends 1,000 miles from Alabama to the Hudson River in southern New York.⁶
- ii. The region has complex bedrocks, which have been weathered to produce a surface of minimal elevations, often called relief. Some particularly hard rocks have resisted erosion and exist as isolated hills or ridges.
- iii. MONO has many soil types, but at its core, only 2 rock types are found:⁷
 - 1. Limestone: along the Monocacy River and northward.
 - a. Limestone-based soils tend to be very fertile, which is beneficial for the agricultural activities in the area.
 - 2. Slate: southern region of the park, where hills and ridges are found.
 - a. Very thin layer of organic material followed by a thick layer of slate that prevents vegetation from rooting deeply.

5. Activity

- a. *Description*

- i. Tell YCC precipitants: "Farmers in MONO's agriculture program must submit and abide by Nutrient Management Plans they wrote in cooperation with the Maryland Department of Agriculture to help guide what practices they will implement to protect soils. Let's explore why these practices matter."

⁵ Southard, S., & Eckert, G. (2016) "Celebrating soils across the National Park System."

⁶ NPS. (2018) "Series: Physiographic Provinces, Piedmont Province."

⁷ NPS. (2015) "Monocacy: Soils."

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- ii. Show YCC precipitants this video: [Journey 2050: Nutrients](#)⁸ (2:33 - 4:40).
- iii. Give each student a card. Tell them: “You will each represent either an impact of agricultural mismanagement⁹ or a best management practice (BMP)¹⁰. Follow the directions in the source, impact, and say portions.”
Lead discussions about the impacts mismanaged agriculture can have.

⁸ Nutrien. (2018) “Journey 2050: Nutrients.”

⁹ The Conscious Club. (2019) "Agriculture & Soil Degradation."

¹⁰ Carroll County Government. "Agricultural Best Management Practices."

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Threat: Agrochemicals in Soil

Definition: Overuse of pesticides and chemical fertilizers in farming.

Source: Stand by the plot of crops.

Impact: Walk towards the bare soil.

Say: “This can cause changes to the chemicals in the soil composition, disrupting the balance of microorganisms in the soil, and reducing its productivity by impacting the chemical nutrients.”

Threat: Overgrazing

Definition: Overconsumption of plant life by cattle.

Source: Stand by the pastureland.

Impact: Walk towards the bare soil.

Say: “When cattle are kept in a single area for too long, they can eat all the plants present. This exposes the bare soil to the elements.”

Threat: Agrochemicals in Water

Definition: Overuse of pesticides and chemical fertilizers in farming.

Source: Stand by the plot of crops.

Impact: Walk towards the stream.

Say: “When too many chemicals are applied to the soil, not all is absorbed by the plants. The remaining chemicals are carried over to streams by water.”

Threat: Erosion

Definition: Loss of loose soil due to weathering from physical elements like water or air.

Source: Stand by the plot of bare soil.

Impact: Walk towards the stream.

Say: “When soil is left bare, the wind and rain can carry it away. Soil can be a pollutant in water, dust storms can occur, and soil is renewed too slowly for this to be sustainable.”

Threat: Over-Irrigation

Definition: Over watering plots of land.

Source: Stand by the stream.

Impact: Walk towards the crops.

Say: “Irrigation draws from bodies of water, and overusing it can significantly reduce the flow of rivers, groundwater recharge, and impact the overall water cycle.”

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BMP: Vegetation Buffer

Definition: Use of vegetation strips to prevent pollutants from running into bodies of water.

Source: Stand by the stream.

Impact: Stop the agrochemicals from reaching the stream.

Say: “Planting a strip of vegetation, like trees and bushes, along the edge of streams acts as a protective barrier from agricultural runoff to streams.”

BMP: Grazing Management

Definition: Move of grazing livestock between pastures on a regular basis.

Source: Stand by the pastureland.

Impact: Reduce the impact cattle have on plant life by rotating them between plots, letting the grass rest.

Say: “Rotating cattle between plots of grass reduces the pressure on the land.”

BMP: Nutrient Management

Definition: Provide fertilizer only for the crops’ specific needs, including quantity and location.

Source: Stand by the crops.

Impact: Stop agrochemicals from going to the water and impacting the land degradation.

Say: “By only applying the amount of nutrients necessary for plant growth, nutrient runoff is reduced.”

BMP: Conservation Tillage

Definition: Leaving leftover plant material on the soil surface after harvesting.

Source: Stand by the plot of bare soil.

Impact: Walk towards the crops.

Say: “By leaving some plant life on the soil, soil erosion can be reduced and nutrients are returned to the ground.”

BMP: Irrigation Management

Definition: Provide water only for the crops’ specific needs, including quantity and location.

Source: Stand by the crops.

Impact: Walk towards the stream.

Say: “Having micro-irrigation systems that deliver water a bit at a time directly to the root of the crop reduces the water usage and allows more to stay in its ecosystem.”

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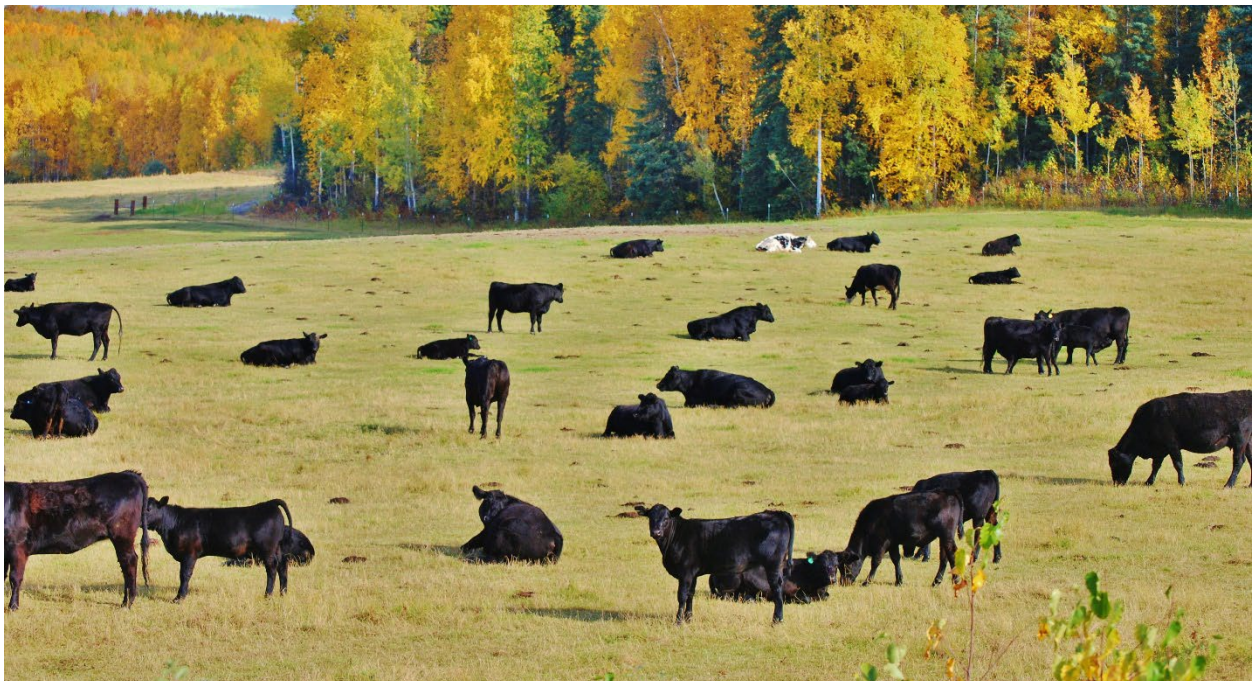
Informal Lesson

Urban Ecology Research Learning Alliance

National Park Service
U.S. Department of the Interior
Natural Resource Stewardship
& Science Network



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