How Outdoor Recreation Affects Soils (Grades 3-6)

Science

Standard 2. Understands Earth's composition and structure

4. Knows the composition and properties of soils (e.g., components of soil such as weathered rock, living organisms, products of plants and animals; properties of soil such as color, texture, capacity to retain water, ability to support plant growth)

Standard 6. Understands relationships among organisms and their physical environment

4. Knows that changes in the environment can have different effects on different organisms (e.g., some organisms move in, others move out; some organisms survive and reproduce, others die)

Standard 11. Understands the nature of scientific knowledge

1. Knows that although the same scientific investigation may give slightly different results when it is carried out by different persons, or at different times or places, the general evidence collected from the investigation should be replicable by others

2. Knows that good scientific explanations are based on evidence (observations) and scientific knowledge

Standard 12. Understands the nature of scientific inquiry

1. Knows that scientific investigations involve asking and answering a question and comparing the answer to what scientists already know about the world

2. Knows that scientists use different kinds of investigations (e.g., naturalistic observation of things or events, data collection, controlled experiments), depending on the questions they are trying to answer

3. Plans and conducts simple investigations (e.g., formulates a testable question, makes systematic observations, develops logical conclusions)

4. Uses appropriate tools and simple equipment (e.g., thermometers, magnifiers, microscopes, calculators, graduated cylinders) to gather scientific data and extend the senses

Travel Only On Trails

Why travel only on trails? When you are out and about in the great outdoors it is important to minimize your impacts. What does that mean? It means that when you leave an area, it looks as if you had never been there.

How do you minimize your impacts? It's easy: stay on the trail and pick up after yourself. If you come upon rocks, puddles, or downed trees on the trail, don't leave the trail to avoid them. Walk over them or through them. Don't cut switchbacks, which are zigzags in the trail. If you break these simple rules you can widen and/or make new trails. These rules are especially important when riding bikes, motorcycles, and ATVs because their size, weight, and wheels leave a greater impact. If you ride off trail you will not only damage plants and animal habitat, but you will also damage soils by compacting them.

Learning Outcome

To better understand how outdoor recreational activities affect soils students will:

- Determine how soil compaction affects biodiversity and the health of an ecosystem.
- Identify recreational activities that can cause soil compaction.

What is soil compaction? It is the process of how tightly packing soil particles together. The more compacted soils are the less space for air, water, animals (insects and microorganisms) and the roots of plants.

Soil compaction depends on the types of soil in a location and the impacts on that soil. Soils can be made up of a combination of **sand** (largest particles), **silt** (medium sized particles), and **clay** (smallest particles). **Loam** soils are a combination of all three types of soil particles. Sandy soils have a lot of space between particles and are less dense. Because of their particle size, clay soils are more densely packed, leaving less space for air and water. Do you think a loam soil with a greater amount of clay would be more compact or less?

Why do you often see standing water on trails after a storm? Soils on a trail are compacted, leaving less space within the soil to absorb water. Off the trail, water is absorbed in the healthy soils. Trails are designed to take the brunt of the impact, leaving the surrounding area intact and healthy.

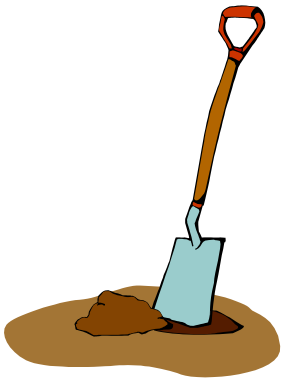
Soil compaction can also lead to higher rates of **erosion.** Erosion is the wearing away of land and soil by the action of wind, water, or ice. Because compacted soils often have less plant cover and are slow to absorb water, more soils can be lost to erosion, especially if compacted soils are on a hillside. You can sometimes see evidence of **erosion** on trails in hilly terrain.

Soil compaction is related to **soil biodiversity.** Soil biodiversity is a description of the variety of life (plants and animals) that live in soils. If there are many different types of plants and animals living in a soil sample, the soil has more biodiversity. If soils are compacted, there is less room for organisms and plant roots to grow—leading to low biodiversity. Why do you think farmers till the land before they plant?

How outdoor recreation affects soils

Student Goals

- Use observation skills to describe study sites.
- Determine soil compaction through different experiments, at different sites within a study area.
- Determine soil type through experiment and observation.
- Determine soil biodiversity through experiment and observation.



Activity at a Glance:
In this activity students will utilize a variety of different experiments to determine the health of soils at a field site as it relates to soil compaction: determining soil compaction, water absorption, soil makeup, and soil biodiversity.

Grades:
5th and 6th (adaptable for younger students)

Setting:
Outdoors and indoors

Time:
3, one-hour class periods **Activity**

Field Site Selection:
If possible pick a site around your school that shows variety in soil compaction. Look for an area that provides a lot of traffic, moderate traffic, and no traffic so students will see the difference in sites with compacted soils verse non-compacted soils.

Setting Your Study Plots:
Step 1: Students will work in pairs, with each pair working in a quadrant at the field site. Have each pair pick an area in the field site were they will place their quadrant. Make sure to spread out. There are a variety of different things that students could use as quadrants including hoola-hoops, string staked out in a square or circle, squares made out of PVC pipe, large poster frames, etc. Be creative, but make sure that all study plots are the same size.

Soil Compaction Activity

Materials:
Tent stake
Metric ruler

Step 1: How compact is the soil in the study plot? Record answer on the data sheet.
Step 2: Push the tent stake as deep into the ground as you can. Mark a line on your stake where it meets the ground. (Note: the same person should push the stake in each time)
Step 3: Pull the stake out and measure how deep it inserted in the ground with your ruler. Record your information on your data sheet.
Step 4: Repeat steps 2 and 3 at three other locations within the study plot. Record data.
Step 5: Average your insertion depths and record the data.

Water Absorption Activity

Materials:
Aluminum can with both ends removed
Metric Ruler
250 ml beaker
Water
Stopwatch

Step 1: How fast do you think the soil will absorb a specific volume of water? Record answer on the data sheet.
Step 2: Measure 2 cm from one end of the can and draw a line around the can. Push the can into the soil at the study plot until it reaches the line.
Step 3: Pour 250 ml of water into the can and time how long it takes the soil to absorb the water. Record data.
Step 4: Repeat steps 2 and 3 at three other locations within the study plot. Record data.
Step 5: Average your times and record the data.

Soil Composition

Materials:
Jar with lid
Water

Step 1: What do you think are the different components of the soil at the study plot? For instance, is it mostly clay or a combination of sand and clay or some other combination? Record answer on data sheet.
Step 2: Fill a jar half full with soil from your study plot.
Step 3: Add water to the jar until it is nearly full.
Step 4: Place lid on the jar and shake the sample. Let the jar stand overnight.
Step 5: The next day hold a piece of paper against the jar and draw a diagram of the different layers of soil. Label each based on the particle size.

Soil Biodiversity

Materials:
250 ml beaker
White paper
Magnifying glass

Step 1: Do you think the study plot will have higher or lower biodiversity in relation to the other study plots?
Step 2: Count the different types of plants growing in the study plot. Record data and describe each plant and its name (if you know it).
Step 3: Fill a 250 ml beaker with soil from your site.
Step 4: Pour your sample on a white piece of paper. Look for different types of organisms that live in the soil. Use your magnifying glass to see smaller organisms.
Step 5: Count the different types of organisms found in your sample and record the data and describe each organism.
Remember: Count the number of different types of organisms—not the total number of organisms.

Assessment:

Utilize the question bank to assess students' understanding. Allow students the opportunity to answer questions with their partner as part of their write-up. Once students have had the opportunity to work on the questions, a classroom discussion could follow to minimize any misconceptions that could develop.

Modifications for younger students:

For younger students the experiments might be difficult. Other alternatives include doing demonstrations and modifications to how you do the experiment. It may require more preparation time. For example you could pick three to five areas in your field site as your study plot. Do all the experiments with each student participating in one or more of the activities. Do each of the activities at each study plot with different students taking a turn with an activity. Assign a scribe to write down the data. Then as a class you can analyze the data and come up with conclusions.

Extension

Erosion Activity

Materials:
- 2 rectangular trays
- Soil
- Grass seed
- Water can
- Bucket
- 2 clear containers
- Water

Step 1: Poke holes on one of the short ends of each rectangular tray. Fill tray with soil.

Step 2: Fill both tray with soil. Plant grass seed in one of the tray. Place both pans in the sunlight; keep the soil moist. When the grass is an inch high proceed to the next step.

Step 3: Place blocks of wood under the end of the tray without the holes so that the tray are on an angle or slope. Place the bucket underneath the other end.

Step 4: With a watering can sprinkle water at the high end of one of the trays. Repeat the process with the other tray. Make sure you pour from the same height.

Step 5: After each trial, empty the bucket into a clear container, compare your results, and write down your observations.

Questions:

- What process is taking place?
- What role do the plants play?
- What do you think would happen if the soils where compacted both with the plants and without? Could you design an experiment to test your conclusions?

Group # _____ **Names: _____**

Pre-Experiment

How do you think soil compaction relates to biodiversity and the general health of an ecosystem?

Post-Experiment

How do you think soil compaction relates to biodiversity and the general health of an ecosystem? Is your answer different than before? Why?

Site Description

Soil Compaction

Hypothesis:

	Sample 1	Sample 2	Sample 3	Sample 4	Average
Depth (centimeters)					

Water Absorption

Hypothesis:

	Sample 1	Sample 2	Sample 3	Sample 4	Average
Time (seconds)					

Soil Composition

Hypothesis:

Draw a diagram of the different layers of the soil sample. Label each layer.

Soil Biodiversity
Hypothesis:

Number of different plants	Number of different soil organisms

Describe the different species found. Label them species 1, species 2 etc.

Question Bank for Assessment

Which sites have higher biodiversity—those with the most compacted soils or those with the least compacted soils? Why?

Which sites have the greater variety of plants—those with most compacted soils or those with least compacted soils? Why?

Do compacted soils absorb water faster or slower? Why?

How might soil compaction relate to erosion?

What environmental problems are related to erosion?

What are some of the factors that might increase soil compaction? What factors are specifically at your field site?

What recreational activities might cause soil compaction?

How does staying on roads and trails protect biodiversity and the health of the ecosystem?

Classroom Data Sheet for Field Site

Group #	Compaction	Absorption	Composition	Biodiversity
1				
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