ACTIVITY 3: SOIL COMPACTION

Activity Summary

In this activity, the students examine the effect of soil compaction on water infiltration.

Introduction

Many of us think of soil erosion as a problem caused by a long drought coupled with either high winds or torrential rains. While these are important causes of much soil erosion, there are other factors that cause soil erosion during periods of less severe weather, and many other factors besides erosion that affect soil's value or productivity. Soil compaction is one of these factors.

Most soils are a complex mixture of inorganic minerals (mostly clay, silt, and sand) and a variety of other components including decaying organic matter, air, water, and many organisms, both microscopic and macroscopic. A healthy soil has all of these components, while unhealthy soils may be without one or more of them.

A healthy mature soil is usually arranged in layers, called horizons. These layers are seen in a soil profile. Soil, as opposed to sand or clay, is a mixture of minerals from the breakdown of the bedrock and other rocks and organic material added from above. The black-line transparency master given with this activity shows these layers or "horizons."

A soil with an almost equal mixture of sand and silt, with some clay, is called a loam soil. Loamy soils are generally the best soils for most crops because they allow for water and air to enter, and they hold water that plants can then utilize.

A very sandy soil has a high permeability to water and air because of the relatively large spaces between particles. Thus, sandy soils do not hold water well and are best for crops that do not have large water requirements or where irrigating is practical.

A soil with much clay is easily compacted. Once compacted, the clay particles do not easily separate from each other and thus do not allow for the easy passage of air and water that is necessary for a healthy soil environment. Even low-clay soils can be compacted.

Soil compaction is a complex issue. When a lot of people walk repeatedly in the same place, such as on a wilderness trail or across the school lawn, compaction generally occurs. Some of the early pioneers' trails, such as the Oregon Trail, are still visible due to the compaction and subsequent erosion.

There are differing viewpoints on how to deal with the problem of compaction. Some people feel that it is better to limit the area affected by the compaction by encouraging or requiring people to use specific well-defined trails. Others feel that the impact should be spread out by not building trails so that no area is compacted as much as it would be if it were a trail. Still others feel that people should not be allowed into sensitive areas because of this and other impacts. These conflicting opinions apply as much to paths on the campus and in the school neighborhood as they do to wilderness trails.

In this activity, students test various sites to determine how rapidly water will enter the soil. There are numerous related activities and extensions to this activity.

Grouping

Students should work in teams of two or three students.

transparency master

A Generalized Soil Profile

Surface Litter:

recently fallen organic matter, beginning to **decompose**

Topsoil (Horizon A):

partially decomposed matter (humus), roots, living organisms, some minerals

Subsoil (Horizon B):

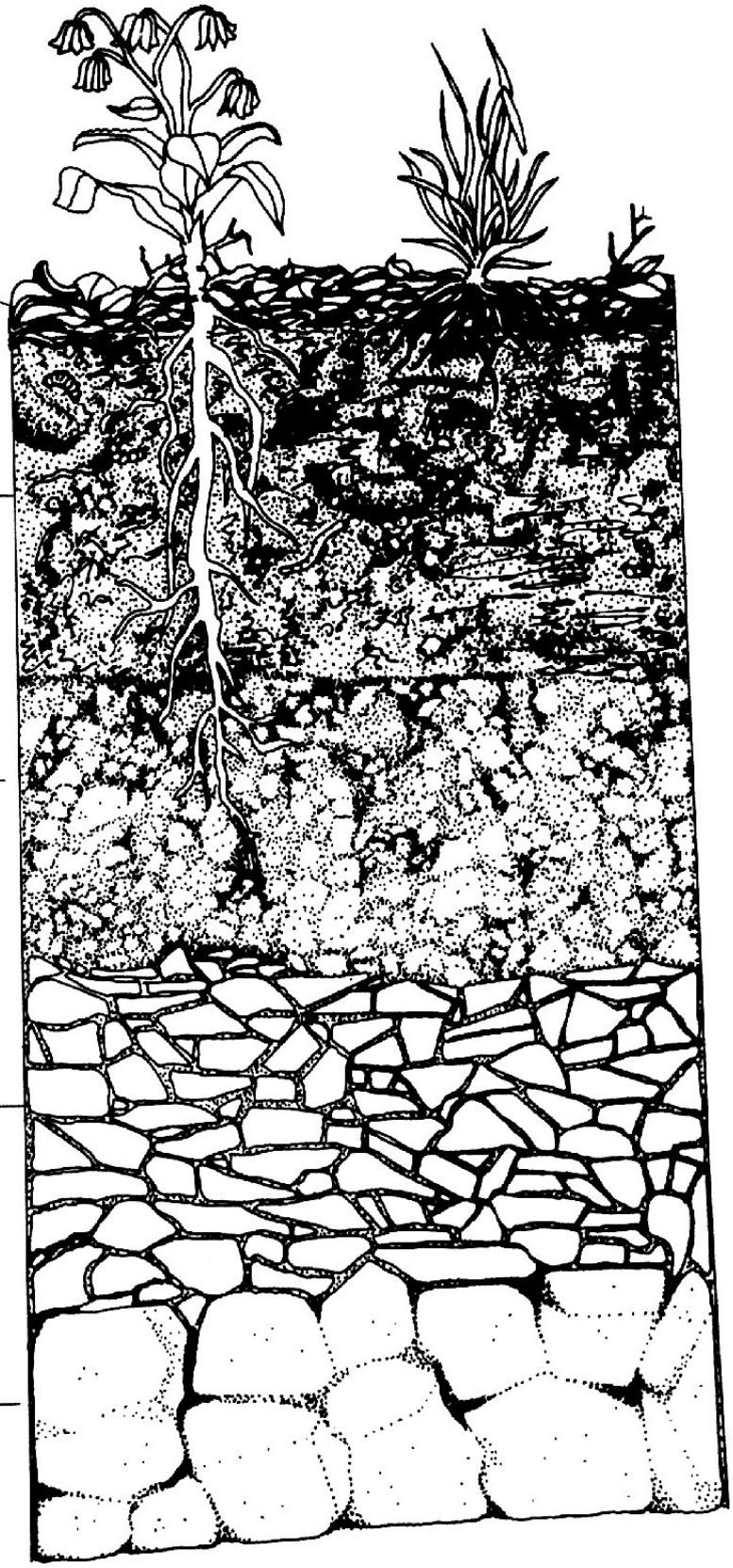
fine particles, material leached from above, some roots

Parent Material (Horizon C):

weathered bedrock and some **leached** material (organic and inorganic)

Bedrock:

underlying solid rock material



3.1 Soil Compaction: Background Information

That we all depend on a healthy soil should be no surprise to you. Plants require nutrient-rich soil to prosper. We depend on plants for our food. Soil is a complex substance made up not only of pieces of rock, but also of numerous plants and animals as well as air and water.

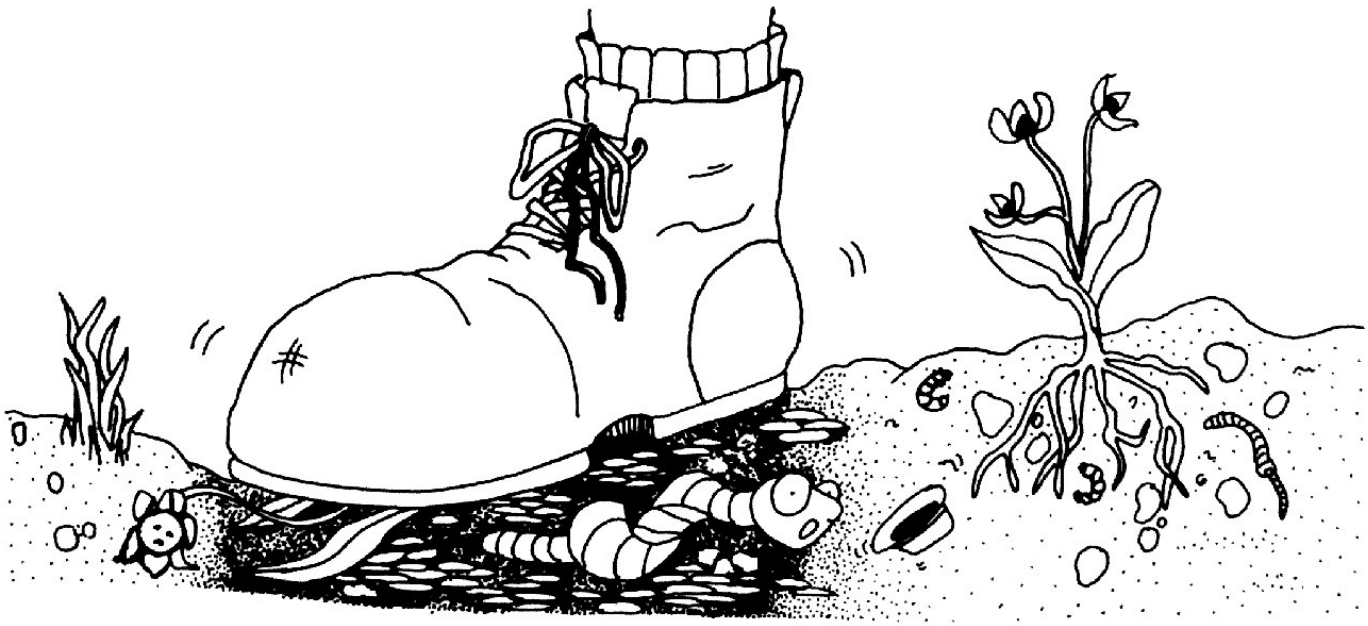
The organisms that live in the soil, including plants, bacteria, worms, insects, and a variety of other vertebrates and invertebrates, depend not only on the minerals but also on the ability of water and air to penetrate the soil. Spaces between the mineral particles and other soil components allow for this **percolation** of water and the passage of air into and out of the soil. The relative proportion of different types and sizes of soil particles is called soil texture. Soil texture is the main factor in determining soil **porosity,** which is a measure of spaces or openings in the soil.

One of the most common impacts that people have on soil is simple **compaction**. When we walk, ride a bike or horse, or drive on soil, it becomes compacted. The degree of compaction is determined both by the compacting activities and by the soil type. Once compacted, the soil particles do not easily separate from one another and thus do not allow for the easy passage of air and water that is necessary for a healthy soil environment.

Soil compaction has a number of harmful effects. Plant seeds have trouble working their way into the soil to germinate. If a plant does begin to grow, its roots cannot easily penetrate compacted soil. Even if the roots do penetrate the soil, the roots will not survive if air and water are not able to enter the soil. Without air and water, worms, insects, bacteria, and other organisms cannot live in the soil. Without plants and animals living in and on the soil, its fertility will not be built up. If plants cannot live on the soil, it is more easily eroded by water, air, and by such mechanical factors as tire treads, horses' hooves, and treads on shoes and boots.

Soil erosion is an environmental problem of enormous magnitude. You have probably heard of the "dust bowl" in the United States in the 1930s. Even though most erosion in the United States today is not as dramatically visible as the dust bowl, it is still occurring here and elsewhere in the world at alarming rates. Erosion of soils on farmland is especially alarming as we attempt to feed ever-increasing populations and as we cover cropland with roads, houses, and other buildings.

In this activity, we will investigate one common soil problem . . . compaction.



Name _____ Class _____ Date _____

3.2 Soil Compaction: Instructions and Data

In this activity, you will determine the rate at which water percolates into the soil in two or more locations. This percolation rate is very important for the health of the soil and, therefore, of the plants and animals that depend on it.

Your teacher will demonstrate the use of the "percolation can." To obtain data that is useful, it is important that you follow the same procedure in each percolation test that you do.

CAUTION: One end of the can is sharp! Be careful not to cut yourself!

Also be careful not to damage the can.

Record your data below.

Depth of soil penetration by can (distance from the sharp end of the can to the mark):

_____

Amount of water poured into can: _____

test #	location	description of site/soil	time for the water to percolate into the soil

Name _____ Class _____ Date _____

3.3 Soil Compaction: Questions

1. Of the sites tested, which had the most rapid percolation? Why?

2. Of the sites tested, which had the slowest percolation? Why?

3. Which site seemed to have the most healthy plant growth?

4. List several ways that soil might become compacted.

5. In what ways might soil compaction increase soil erosion?

6. What should be done to reduce soil compaction?
   a. on the school campus

   b. in wilderness areas