



Playground Pounding Lesson Plan

Overview

In this lesson, students will learn that soils, plants, and people are closely connected. In particular, soils have structure that can be broken down if trampled by humans or animals. Students will first view and discuss photographs that show where soil-compression has occurred. Then, using soil and sponges, students will observe how soil can be compacted, and the implications of this compaction on soil structure and function. At the end of the lesson, students will have a deeper understanding of how people, animals, and plants are all connected through soils.

Suggested Lesson Sequence	Please see the Earth Systems Foundations - Plants and Soils, Landscape Changes , Greenlinks , and Earth Systems and Humans module descriptions.
Lesson Level	Entry, Intermediate
Mathematics Connections	<ul style="list-style-type: none"> Students will use non-standard units to measure water and soil.
Science Connections	<ul style="list-style-type: none"> Students will explore soil structure and soil composition. Students will learn that plants are intimately connected to soils. Students will recognize that when feet, hooves, and tires trample plants, they also compact the soil. Students will learn that compacted soil can hold less water.
Technology Connections	<ul style="list-style-type: none"> Students will view aerial photos and satellite images of paths and compacted soil.
Human Connections	<ul style="list-style-type: none"> Students explain how humans affect plant and animal life through soil compaction.
Lesson Assessment Tools	<ul style="list-style-type: none"> Assessment and Standards Table (Word) Assessment Activity Description Authentic Assessments

Materials

- This lesson requires Powerpoint Reader ([Windows](#) / [Mac](#)) and [Adobe Reader](#).
- [Soil Compaction Activity Sheet](#) (PDF)
- [Squishing the Soil Activity Sheet](#) (PDF)
- [Soil Draw Activity Sheet](#) (PDF)
- [Pounding and Paths Photo Essay](#) (Powerpoint) (to be viewed by students on individual computers or on a large projection screen using the ESC CD-ROM)
- One sponge (the larger, the better)
- Clear plastic 2-liter pop bottle cut in half and filled halfway with lightly packed potting soil
- Clear plastic cups filled halfway with potting soil
- Centimeter cubes (to be used as a measuring tool)
- Small dish tub
- Bottle of water
- Marker for writing on the plastic cup
- Magnifying glass (optional)

Vocabulary Word

- **Soil compaction:** Soil is *compacted* when it is firmly pressed together. This often occurs when soil is trampled by humans, animals, or vehicles.

Procedure

This is a two-part lesson to be completed over two or more lesson periods.

I. Assessing Prior Knowledge

The goal of Part I of this lesson is to elicit students' existing conceptions about paths and path-making. Teachers might begin this assessment by asking students to think about sidewalks - What are they? Why do we have them? From this discussion, the teacher then might encourage students to think about natural paths in grass, or on the playground. For example: *Has anyone noticed what the grass looks like between _____ and _____? Have you observed anything like this in other places? How do you think these paths were first formed? If nobody used a path ever again, what do you think would happen to it?*

The following paragraph includes some additional background information you may wish to include in the discussion.

People and animals make travel paths for several reasons. Sometimes a path is first taken through thick vegetation because it is the shortest distance between two points. Soon,

however, a path becomes well used because it is the easiest way to travel. There are often no longer any plants growing on it, and so it becomes the preferred way even if it isn't the shortest distance between two different starting and ending points. It is important to note that paths come in many forms—from small paths made by feet and animal hooves, to larger paths (roads) made by the tires of bicycles, motorcycles, and cars.

II. Contextual Preparation

Prior to engaging in the following hands-on activity, students should view the Pounding and Paths Photo Essay. This part of the lesson will provide students with specific examples of paths and compressed soil. Students will view photos and images that illustrate what happens when soil gets compressed. Teachers may wish to show and discuss the photos and descriptions to the entire class by projecting the photos on a TV connected to a computer or projected on a screen. With each photo invite students to share their observations, ask their own questions, and make connections between the photos and their own life experience. Some children may also share inferences, predictions and theories about what is happening in the photos. You can also use their emerging theories to set the stage for the experiment that will take place in the next part of the lesson.

III. Student Activity- Squishing the Soil

Background Information:

So, why is it that plants no longer grow in soils that have been repeatedly trodden by humans, animals, or tires? Soils are like sponges in several ways. Healthy soils consist of a combination of mineral and rock fragments, small animals such as earthworms, living and dead plant tissues such as roots and decaying leaves, and billions of microscopic organisms called microbes. These different materials make a miniature underground scaffolding that creates small air spaces throughout the soil. When it rains, these air spaces become filled with water, which can then be used by plants through their roots. When soil is repeatedly trampled by people, animals, or tires, its miniature structure breaks down, limiting the soil's ability to soak up water and decreasing its ability to support plant life.

1. Set Up Put the following items in an area where all students may see:

- one sponge
- a clear plastic 2-liter pop bottle cut in half and filled partially with loose potting soil
- clear plastic cups filled halfway with potting soil
- a small dish tub
- glasses or bottles of water
- centimeter cubes for measuring
- a magnifying glass (optional)

2. Thinking about Structure Using centimeter snap cubes, measure the height of the sponge. Now, press down hard on the sponge and measure its height again with the cubes. Release the sponge, and then measure again. (The teacher or a student volunteer should record all measurements on the board.) Repeat this procedure with soil in the 2-liter pop bottle (use the same starting height as the sponge). When pressing on the soil, you may strike the soil repeatedly to simulate a person or animal walking on it. Students should measure and record the height of the compacted soil, hopefully noting in particular that it does not rebound like the sponge did.

Questions for discussion:

- Why do you think we can squish the soil and the sponge, but we couldn't possibly squish a rock? (You may wish to illustrate with a rock.)
 - What is happening when we squish the sponge and soil? (*The sponge and soil both contain empty space within, whereas the rock is solid. Hence, the sponge and soil can be compressed as we squeeze out the air pockets within.*)
 - What do you think takes up the space before we squished the sponge and soil? (*air*)
 - What happened differently after squishing both the soil and sponge? Do they look the same before and after squishing? (*The sponge rebounded to its original shape whereas the soil did not.*)
3. Predicting. Prepare several different-sized glasses of water and display on a desk or table. Ask the students to predict which glass(es) of water the sponge will be able to hold. Pour water onto the sponge. If it is a large sponge, it may hold all of the water in all of the glasses. Ask the students what allows the sponge to hold so much water. (*The water soaks into the spaces created by air holes.*)
4. Observing. To help illustrate the importance of the air pockets in the sponge, the same activity is repeated, only this time students try to pour water into a sponge that has been squished. Have a student help squish the sponge, and over a tub, pour water onto the sponge. Ask the students what they notice. Why didn't the sponge hold much water this time? Release the sponge, and pour water into it again after it has returned to its normal shape. Was the sponge able to hold water again? The teacher may wish to emphasize that the sponge is able to soak up so much water because it has much air space in it for water to soak into.
5. Diagramming. On the chalkboard, model how to record observations with pictures, numbers and words. Measurement data should be recorded by including pictures of the stack of measuring cubes, as well as counting and recording the number of stacked cubes. Your model will help children record their own observations in the soil experiment that follows.
6. Squishing the Soil Activity Sheet. Next, the students will complete a similar experiment

using the cups of soil. Each group should get two cups of soil, two half-cups of water and the Squishing the Soil Activity Sheet. Have students firmly pack the soil in one of the cups only. Using the cubes, they should measure the height of each cup of dirt - one squished, one not - and then predict what will happen as they pour water into each cup of dirt. Record their measurements and predictions on the activity sheet. Finally, after the soil has been firmly compacted, the students may slowly pour a cup of water into each cup of soil. The cups of water should be equal in volume. The activity will work best if you try it yourself first so you know how much water it will take to show the difference between the cups of dirt. The water should pool on top of the compacted soil. Students may draw a picture and describe the results of this experiment on the activity sheet.

IV. Assessment - Explaining Real Life Examples of Soil Compaction

1. Starting the assessment. To begin the assessment portion of the lesson, students will return to several of the images in the photo essay. Distribute the Soil Compaction Activity Sheet. Questions accompany each image, and may be discussed and answered by students. Depending on the literacy skills of the students, this assessment activity may be done individually, in pairs, orally or in writing.

Sample Question Responses:

- Photo of Path and Dogs: Students should understand that the dogs created that path by walking over it many times. This caused the soil to be squished, which does not allow for plant (grass) growth.
- Photo of Cows: The cows have compacted the soil and eaten the vegetation.
- Wagon Track Photos: Answers will vary. Students should understand that cars compact the soil. Pavement (or concrete) is densely compacted, solid material. Students may notice that the plants that now grow on the wagon tracks are significantly different from those that grow next to the tracks.
- Balloon Photo: Students should be able to observe the roads (paths) made by automobiles.
- Satellite Image: Students should be able to identify the paths in contrast to the existing foliage captured in the image.
- Aerial Photo of Texas: Students should understand that cows walking along the fences compact the soil along those fences. Students should be able to identify the locations of the fences by the white lines (cow paths) on the photo.

2. Drawing the soil. As a second assessment task, distribute the [Soil Draw Activity Sheet](#) to students. Students will complete a diagram of soil that has been compacted by a tractor wheel. Look for students to distinguish between soil that has and has not been compacted by noting in particular their illustrations of air pockets in the soil.

3. Assessment discussion. You might also choose to lead a whole class discussion about soil compaction to more broadly assess students' understandings of the effects of soil compaction

on plant growth, and the ability of underlying soil to hold water and nutrients. The following are ideas for possible discussion questions.

- What are the ways in which paths get made? (*Paths are made because soil has been compressed and plants are unable to grow in compacted soil. They may be made by people or animals repeatedly walking over the soil, or by cars, bicycles, or motorcycles driving over a path.*)
- Why is it difficult for plants to grow on paths and roads? (*On paths and roads, the soil is compacted and doesn't allow room for soil water that nourishes plant roots, and contributes to water running off the surface instead of infiltrating the soil.*)
- If you were growing a garden, why would you want to walk on paths in the garden? (*Walking all over the garden would cause soil compaction where the plants are trying to grow. This would not allow the plants to grow.*)

Lesson Extensions for Authentic Assessment

1. If a path or road becomes abandoned, through time the soils will often become less compacted because of earthworm activity and plant root growth. When soils become less compacted, they become *aerated*, a term that describes how soils regain their air spaces and internal structure. Watch how soil aeration takes place by compressing potting soil in a clear container (perhaps even in an aquarium) and then adding earthworms to the soil. What changes occur through time? Follow the development of the earthworms through time and record how the compressed soil changes as the earthworms burrow into the soil. You may also wish to mark lines on the side of the clear container to determine whether the soil expands as it is aerated.
2. Invite children to dig up and bring in samples of soil from their yard or neighborhood. Display the soil and have kids predict where the soil samples came from. Children might also want to compare the amounts of water each soil sample can hold.

Acknowledgments

Photographs used in this lesson were provided courtesy of Lee Vierling, Steve Archer, NOAA, and the National Park Service. IKONOS imagery is © Space Imaging, L.C. and used through the NASA data purchase program.

-