**Soils as Sponges-A Field Study Investigation on Land Surface Permeability**

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**Soils as Sponges?: A Field Study Investigation**

***Activity Overview***

WA STATE 6-8 SCIENCE STANDARDS

INQB Plan an Investigation

INQC Interpret Data from an Investigation

INQF Conclusions from Data

APPE Choosing a Solution

CONCEPTS, PROCESSES, AND ISSUES

Porosity

Soil

Land Surfaces

Pervious

Impervious

Permeability

OBJECTIVES

Students will:

* Make a prediction about the amount of time it takes the same amount of water to soak in (percolate) for three different land surfaces (Grass Sod v. Mulch v. Bare Soil)
* Identify these surfaces in their schoolyard and then follow a plan to measure and compare the time it takes for the same amount of water to percolate soak in (percolate) for the three different land surfaces (Grass Sod v. Mulch v. Bare Soil)
* Analyze and interpret class data and write conclusions
* Apply what they learn from this investigation to the problem of stormwater runoff in Seattle
* Which types of land surfaces allow water to percolate (soak in), and which cause water to run off the ground?How can we improve percolation of water on our school campus and our watershed to reduce stormwater runoff?

MATERIALS

**Student investigation sheets and data tables**

**Several pieces of outdoor flagging tape or small ground flags to mark study areas**

**Field study materials**

* Soup or small coffee can same size open at both ends and marked 2 cm from the bottom-duct tape on the top
* Measuring beaker or cup to hold 250 ml
* Water in a jug
* Stopwatch
* Trowel
* Copies of 3 Student Readings –Where Does Water Go, Percolation and Pollution, and Healthy Soils & Stormwater Percolation
* Stormwater Video either “Lost in Puget Sound” <http://www.seattlechannel.org/videos/video.asp?ID=5917> or other video on stormwater and permeable surfaces.
* Flip chart paper and markers and sticky dots (optional)

***Advanced Preparation***

**Background Information: Surface Permeability and Different Land Surfaces**

Permeability is the ability of a natural material to transmit water. Water quickly soaks into a very permeable (or pervious) material but runs off of a very impermeable (or impervious) material. In forested areas, soil rich in organic matter, structure and pore space, most of the water from heavy rainfall soaks into the soil, which later is taken up by plants and trees and then slowly feeds in to creeks and streams. Because development practices in urban areas remove forests and topsoil, most stormwater quickly runs off of roofs, roads, and compacted soils and directly into storm drains and into Puget Sound.

The “Lost in Puget Sound” DVD talked about pervious and impervious surfaces and the link between these surfaces and stormwater pollution. Surface runoff plays a key role in determining water quality in the Puget Sound Watershed. Runoff carries with it sediment and other pollutants including fertilizers, pesticides, zinc dust from tires, oil from cars, chemicals used in cleaning and manufacturing, construction debris and bacteria from pet waste. Anything on the ground can wind up in the water. Excessive runoff, especially when it flows at high rates of speed, also causes erosion and leads to flooding of waterways.

Some surfaces are better at holding and percolating (soaking in) surface water than others. Although the DVD compared grass versus a driveway as examples of pervious and impervious, respectively, lawns typically do not absorb much water during a heavy rain or when they have hardened following a period of dry weather.

A surface’s ability to hold water is affected by such factors as the percentage of rock in the soil, the degree to which the soil is compacted and the amount of organic matter.

A percolation test measures the rate (time) at which water seeps into soil. The rate of percolation is determined by how porous a surface is. If a land surface is not porous (e.g., pavement, roofs), water will not soak in but rather run off it rapidly. If a surface is very porous (e.g., areas with thick mulch), it can soak up large volumes of water. When water can soak into a surface and travel through the ground slowly, much of the pollutants are filtered out. Water that runs off the land quickly, on the other hand, carries pollutants directly to the waterways.

**Prior to beginning the field study**:

1. Identify areas in your schoolyard that contain the land surfaces being compared in the investigation. Be sure that there is sufficient room for up to 8 students groups (dependning on your class sizes) to place their cans and perform the experiement

2. Flag these areas so they will be easy to identify when you return with students to perform the investigation

3. Flag a storm drain on our near your schoolyard\*\*\*

4. Prepare materials for the classroom demonstration.

5.Gather field study supplies into plastic tubs for each student group

***Teaching Suggestions***

GETTING STARTED

1. Begin the class with a warm up question asking them to recall what they learned from the *Lost in Puget Sound*  DVD or other video about pervious and impervious surfaces or have them
2. Set-up a demonstration for the class to observe pervious and impervious surfaces. Present students with a brick and a sponge. Tell them you will pour 5mL of water (approx a Tbs.) onto each surface. Ask them to predict the behavior of the water. After pouring the water, ask them to identify which surface was pervious and which was impervious (adapted from the “My Place in Puget Sound” curriculum).
3. View Power Point photos of different land surfaces. Ask students to make inferences about each surface’s permeability.
4. Have students read the student readings 1(optional) & 2, **“Where Does Water Go?”** and **“Making Connections: Percolation and Pollution”** and answer the discussion questions.
   * What does impervious mean?
   * Name some examples of impervious surfaces in the city?
   * What is it called when water can soak into the ground?
5. Now have students read **“The importance of Soil and its Effect on Water Resources”** <http://www.soilsforsalmon.org/pdf/RelationshipBetweenSoilandWater10-14-99.pdf> . Ask some of the following questions:
   * Name 3 functions of soil
   * Name 3 ways that soil helps the problem of surface runoff.
   * What is the role of soil in the water cycle?
   * Why is it important to reduce the amount of runoff?
   * What is the role of vegetation in surface runoff?

INVESTIGATING: FIELD STUDY

Part 1-School Campus System

1. Tell students that they are going to be doing a field investigation on permeability on their school campus, but first they are going to describe the study site (the system the investigation is going to take place) and identify impervious land surfaces on campus.
2. Inform students that their task is to draw and label the parts of the school campus in a given area (this includes sidewalks, buildings, etc.). After they have drawn the area they need to mark on their drawing all the impervious surfaces.
3. Take students outside to where the investigation will take place and have students draw and label the area and identify impervious surfaces.
4. Back in the classroom have students in groups combine their individual drawings to make a large drawing of the campus system on flipchart paper.
5. Have groups identify the impervious surfaces with sticky dots or specific symbol.
6. Talk with students about the inputs and outputs to this system focusing on rainwater input and stormwater runoff as an output. Have students label inputs and outputs on their drawing using sticky notes.
7. Using information from the reading “Making Connections: Percolation and Pollution” have students identify where the most pervious surface would be in their School Campus System area that they drew and explain why.

Part 2-Permeability Investigation

1. Tell students that they are going to do a field investigation to inform the Focus and Problem questions:

* “Which types of land surfaces allow water to percolate (soak in), and which cause water to run off the ground?”
* “How can we improve percolation of water on our school campus and our watershed to reduce stormwater runoff?” and answer the investigation question. (See “Does It Soak Right In” worksheet)

The field study question that they will be answering is: **What effect does land surface type (grass sod v. mulch v. bare soil) have on percolation time through the soil?**

1. Students develop and record hypothesis
2. Go over the procedure (possible demonstrate), especially the methodology for measuring the percolation rate.
3. Divide students into groups of 3-4 students. Explain that each group will do the experiment exactly the same way to control variables. Explain that each group represents a trial. Give each group a trial number. Possibly assign roles to members of groups.
   1. **Timekeeper**- times the water as it soaks into the surface
   2. **Data Recorder**- records results in the Data Chart
   3. **Keeper of the Can**: pushes the can into the testing surfaces
   4. **Observer of soils:** records observations and pushes nail into soil and records depth (optional)
4. Inform students that each group will measure and record percolation data at each of the 3 sites in the data table under the trial number they were given.

**Field Study Procedure:**

1. Go outside and record description of overall study site.
2. Find a sample location on the grass sod and describe.
3. Push the soup can into the grass sod 2 cm into the ground using the trowel to dig the circle if needed..
4. Measure 250 ml into the measuring beaker and prepare stopwatch.
5. Pour 250 ml of water into the can and start stopwatch.
6. Record the time for the water to completely disappear as Percolation Time for your trial number

on the data table.

1. If water is not completely gone after 5 minutes, stop and record 5 minutes.
2. Find a sample location on the mulch and describe.
3. Repeat steps 4 through 8 for the mulch.
4. Find a sample location on the bare soil and describe.
5. Repeat steps 4 through 8 for the bare soil.

SYNTHESIZING: FIELD STUDY

1. Have students calculate means for the 3 land surface types.

Have students write a conclusion answering the investigation question, “What effect does land surface type (grass sod v. mulch v. bare soil) have on percolation time through the soil?

Students should remember to:

1. Limit conclusion to place, date, and time of investigation (this is new for field investigations-not on test, but would be nice to use in classroom)
2. Write a conclusive statement clearly answering the investigation question Or answering whether or not the prediction was supported
3. Give supporting data for **Grass Sod**
4. Give supporting data for **Mulch**
5. Give supporting data for **Bare Soil**
6. Explanatory Language
7. Have students follow-up the field study activity with a Student Reading **“*Healthy Soils and Stormwater Percolation*”**, about the characteristics of healthy soil and the role of healthy soils in minimizing the impact of stormwater pollution. Help students draw connections between their field study data, the reading and the focus and problem question through the analysis questions.

**Reading Discussion Questions:**

* 1. Name 3 functions of soil
  2. Name 3 ways that soil helps the problem of surface runoff.
  3. What is the role of soil in the water cycle?
  4. Why is it important to reduce the amount of runoff?
  5. What is the role of vegetation in surface runoff?

1. Have students go back to their drawings and add information from their investigation and their readings to share new knowledge of the interactions going on in their schoolyard system in terms of stormwater runoff.
2. Now have students answer the analysis questions 1-4 on pages 4 and 5. Go over Claim, Evidence, and Reasoning before they start.