Water Filtering & Soil

Grade Level: 3-12

Essential Skills: 1, 2, 4, 5, 9

NGSS: 4-ESS2-1, 5-ESS2-1, 5-ESS3-1, 5-PS1-3, MS-ESS2-4, HS-ESS2-4

CCSS: RI.3.7, RI.5.7, MP.2, W.3.7, 2.MD.D.10, RST.6-8.3,W.5.9

Social Sciences: 3.9, 3.11, 3.13, 4.12, 5.11, 6.15, 8.13

Math: MD.3

Time: 1 class period

Materials: Each team needs:
* 2 funnels or 9oz plastic cup with hole in the bottom
* 2 two-Inch squares of coffee filter paper
* ¼ cup clean, dry play sand (*Both the sand and soil in this experiment must be completely dry. This can be done by drying it in an oven*)
* ¼ cup dry, finely ground, soil *(may need to filter it to remove small pebbles)* Do NOT use potting soil.
* 4 10oz plastic cups that can fit the funnels
* 2 ½ cups of water
* 2 ½ cups grape Kool aid drink mix (regular strength mixed without sugar)
* worksheet - attached

AITC Library Resources:
Books: *Cycling Back to Nature; Caretakers All*
The Soul of Soil
More Lessons:
From Rocks to Soil
Source Relay
Earth as an Apple & Soil Conservation

3/17

Description:
This hands-on experiment demonstrates soil's function as a water filter, as well as other physics concepts like hydrophobicity, soil absorption, soil as a storage container for water, and the positive and negative charges of soil and contaminants.

Background:
Have you ever held two magnets together? You've likely experienced that one set of magnet ends (positive/negative) attract; while when similar charged ends are placed together they repulse each other. A similar attraction helps soil clean water. Most soils have a negative charge. Many water contaminants have a positive charge. As contaminated water infiltrates through soil, the contaminants are attracted to the soil particles, namely clay, and are trapped in the soil while the clean water moves down through the soil profile.

Directions:
Set the stage: Break students into six groups. Each group will perform the experiment together and compare results at the end, side-by-side.

Part I – Setting up the filters
1) Pass out supplies to each group. Make sure all teams work at the same pace and do not start the experiment ahead of others.

2) Each team needs to first create two filter systems. A completed filter includes a funnel or 9oz cup with hole, with a piece of filter paper at the base so that there is a small paper "tail" coming out of the end, and a cup to collect the liquid that passes through.

3) To fit the filter paper into the hole at the end of the funnel, twist (and slightly scrunch) the paper so there is a little bit of a tail. Push this tail through the hole in the bottom of the funnel and push the paper tail out to fit into the funnel. This will keep the sand and soil from pouring out the hole.

4) To make the sand filter – pour a 2oz paper cup of sand into the filter. To make the soil filter – pour a 2oz paper cup of soil into the filter.

Part II – Filtering Plain Water
1) Have the students refer to the worksheet and hypothesize what will happen when water is poured through the filter.

2) Each group will receive 2 - ½ cups of water. These will be poured ***simultaneously*** over the sand and soil filter. Observe the speed the water goes through. Which is faster/slower and why? Record.

Students should observe that the water does NOT want to be adsorbed by either the very dry sand and soil. In fact, it initially will simply float on top – as if there is a barrier between the two substances. Over time the water will go through. Make sure students do not push on the water/sand/soil to make it work its way more quickly through the filter. What is being observed is the ***hydrophobic*** qualities of extremely dry materials.

3) When the water does finally go through, measure the amount water collected in each of the cups. Are the amounts of water equal? The sand's water collection cup should have more water in it.

Note: The water will pour through the sand quicker than the soil because there are larger spaces between the sand particles and the sand does not have the capacity, like soil to ABSORB water. Also, students may notice that the water in the soil collection cup is darker, or "dirty." This observation will lead most students to think sand does a better job of cleaning the water. This is false as they will see when they filter the grape drink.

Part III – Filtering pollution; aka, grape Kool Aid

1) Empty out the collection cups for each of the filters. Ask the students to hypothesize about what will happen when they pour the grape Kool Aid drink mix (i.e. pollution/contaminants) over the two filters. What do they think will happen when the pollution filters through the sand and soil? Which will go faster? Have them observe when they pour liquid in the second time any similarities or differences than the first time.

2) After students have recorded their hypothesis, have each team pour, simultaneously, the ½ cups of grape Kool Aid drink mix over both the sand and soil filters. As the water is pouring through have students share what they see and why they think it is happening.

Students should observe the sand filter will pour through more quickly, but the purple Kool Aid is mostly the same color in the collection cup. The soil cup will run slower, but faster than the first time. The liquid will be clearer than the sand filter. You may observe the liquid is the same color as when you poured the water through the first time.

Students have just observed one of the important functions of soil, to filter and clean water!

5 Functions of Soil:

1. Supports plant growth
2. Recycler of nutrients & waste (decomposition)
3. Controls the flow and purity of water
4. Provides habitat for soil organisms
5. A building material for animals and humans

This lesson was adapted from the materials of the following groups:
Benton Soil & Water Conservation District, Soil Field Study
Dr. Dirt K-12 Teaching Resources, West Texas A&M University

Activity Page

Water Filtering Worksheet

Name: _____

Directions:

Complete the questions below and record your hypothesizes and findings from this experiment.

1) Before you pour any water - Predict what you think will happen with the water in the soil filter and sand filter? Then record what *actually* happened.

2) Describe the water that passes through the sand and dirt filters.

3) Measure the water that came through. Are the amounts the same? Explain what happened.

4) Predict and record what you think will happen when you pour in the Kool Aid, then record what *actually* happened.

5) How did the soil affect the Kool Aid? Why is that important?

	Predict Infiltration Rate (Fast/Slow/other?)	**Actual Infiltration Rate**	**Liquid Color <u>Before</u> Infiltration**	**Liquid Color <u>After</u> Infiltration**
Sand w/ Water				
Soil w/ Water				
Sand w/ Kool Aid				
Soil w/ Kool Aid				