

Trickle Down With Filtration

Objective: Students will visually observe how particle size and shape affect the porosity and drainage of water through soil. More advanced students will explore how pore size affects water filtration.

Materials: Two liter bottles with neck and bottom removed (one per student group, plus demonstration bottles); window-gauge screen cut into 12x12" squares (one per bottle); pie tins (one per bottle); objects of different size and shape (At least three. Examples: Small - ground coffee, lentils, rice or sand. Medium – corn kernels, M&Ms, coffee beans. Larger – marbles, dice, gravel, lima beans.); water, food coloring (easy to see; blue, green); brightly colored glitter (coarse coffee grounds are a possible substitution); pencil and paper for notes.

ACTIVITY SUMMARY:

Soil is composed of particles of various shapes and sizes. These differences cause spaces between particles called pores. Collectively, the sum of the pores within soil is called the soil's *porosity*. The amount of porosity within a type of soil affects the drainage of water as well as potential run-off and erosion. This activity is designed for students to visually observe how different shapes and sizes of objects (soil particles) affect drainage and filter water.

Students observe water passing through space between objects of extreme difference in size and shape. (Dice, corn kernels, etc.) This enhances the visual aspect of watching water run through the cylinders.

More advanced students will observe "contaminated" water moving through our artificial soil. They will make predictions and conduct experiments on what types of soil particles filter out impurities. The advanced version is a more real-life situation, and allows for conclusion or further investigation into potential runoff and erosion.

SOME EXPERIENCE

IN THE CLASSROOM

Skills:

*Critical Thinking,
Observe/Compare.*

Subject/Discipline:
Science, Math

Science Standards:
S1, S3, S4, S5, S6, S8
Grades 4 – 12

Time:

Prep + 1 or 2 class meetings.

The Inside Track:

For more information about soil quality, contact the New York City Soil and Water Conservation District (NYCSWCD).
212-431-9676 x335
www.nycswcd.net



BACKGROUND INFORMATION:

See GETTING THE DIRT ON SOIL segment introduction. Try *Bronx River Soil Composition*. This works as an excellent prelude, and contains background information on soil.

PROCEDURE:

Prep: Dye approximately 600 ml of water (per student group) with bright food coloring.

Fill three plastic bottles with one type of “soil particles” each (large, medium and small particles). Place the bottle on top of the window screen, which in turn is on top of the pie tin to catch the water.

Slowly pour 200-250 mL of the colored water in the top of the cylinder. The students should be observing the speed at which the water moves through various objects. Taking notes here will help students report their findings to the class.

Repeat the process with the other objects.

Discuss why water passed through some soil particles faster than others. What happened to each size item?

For fun: Have a race!! Divide students into groups and allow them to select and compile materials of their choice. They should determine the shape, size and quantity of each layer (there must be three layers). Race away – see who wins – why?



ADVANCED:

Explain to students that soil particles can also filter out impurities in the water. Have the students divide into three groups and write down predictions about which soil particles will filter out the most pollution (glitter). Each student group will receive a small, medium, or large “soil particle.” Each student group will set up their soil column in the same way as the demonstration with the pie tin on bottom, the window screen on top of the pie tin and the plastic cylinder on top of the window screen.

Students should stir the colored glittery water, then pour 200 – 250 mL of the water through their soil and take down observations of how much glitter was caught in the soil. They should also note if there is glitter on the window screen that made it through the soil, but not through the screen.

The class can compare the data and use it to predict which soil particles are best suited for filtering impurities.

EXTENSIONS:

1. Using actual natural media, follow the same procedure with gravel, sand, clay and silt. Students should note if water pools at the top layer, as well as the previously mentioned observations. Discuss if this pooling of water could cause runoff and potential erosion issues in a real land surfaces. Please note: You cannot place sand or smaller particles directly on the screen, as they will drop through. It is best to use a coffee filter or square of cheesecloth to keep the particles from filling your pie tin.
2. Look up the composition of the soil in your area on the New York City Soil Survey Reconnaissance Map. Have the student predict how well or poorly the soil will drain. Read about the soil and its drainage properties in the Soil Survey Reconnaissance Manuscript (Both map and manuscript are available at: http://www.nycswcd.net/soil_survey.cfm)
3. Create a compaction layer by mixing white glue with some of your artificial soil particles. Place one of the plastic columns on to a pie tin and spoon the mixture into the column. Do not pack it down too much, because you keep some of the pores open for filtration (although you want to slow it down considerably). Remove the plastic column and let dry. Use this compacted layer to show students what happens to the filtration properties of soil when either bottom or middle layers become compacted. You should be able to use this piece on top to show runoff and in the middle to show lateral water movement.
4. Questions to Discuss:

How does soil compaction occur in the Bronx River Watershed?

How can we minimize compaction?

What pollutants might the soils filter out in the Bronx River Watershed?

Where do they come from?

What happens if these pollutants enter the river?



*Based on a lesson plan created by Deana Grimaldi and Jennifer Agnew.
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