Soil Infiltration: What is a Bioswale?

Description:

Experiment with soil infiltration measurements. Familiarize students with green infrastructure techniques, specifically bioswales, which are being constructed in sidewalks near schools, neighborhoods and around the city.

Objectives

- Discuss the motivations and benefits of the construction of green infrastructure techniques, particularly bioswales
- Introduce or increase understanding of the dynamics between water and soil

Vocabulary:

Absorption, green infrastructure, bioswale, infiltration, impervious surface, runoff, stormwater, wastewater

Recommended for:

4th – 12th grade students

Materials:

- 2-Liter Bottles
- Water
- Sand: Coarse and Fine, Silt, and Clay
- Pebbles
- Coffee Filter
- Worksheet
- *Optional: Food dye or markers*

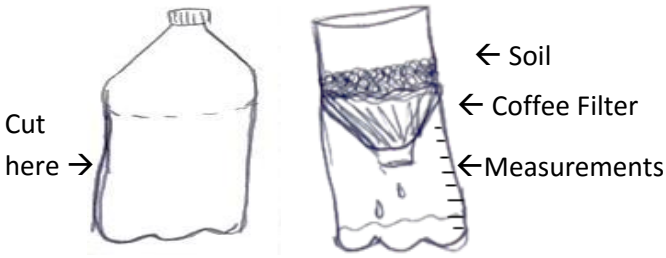
Background Information:

Most of New York City's sewer system is combined: sewer pipes intake both sanitary flow (used water from your home) and stormwater (rainwater that runs off streets and buildings). In areas with a separate storm sewer system, stormwater and potential pollutants (oils, chemicals, sediments and trash) will be carried through sewer pipes and discharged directly into local waterways.

Impervious surfaces, or surfaces that are not porous, such as concrete and asphalt, do not allow water to infiltrate. To help reduce stormwater runoff, engineered practices called green infrastructure act like a sponge to help absorb stormwater before it enters the sewers. Specifically, a bioswale is a planted area in the sidewalk designed to collect stormwater that runs off streets, sidewalks, or other impervious surfaces when it rains by serving as temporary storage. Rather than running directly into sewers, stormwater, which may contain contaminants, is naturally filtered through the bioswale by the soil, plant and root structure.

Preparation:

- Cut 2-Liter Bottles in half. (4 for each group)
- On the bottom half, create measurements for 1 – 2 cups.
- *Illustrated below*: Make sure cap is removed from top. Flip bottle so the spout is facing down, tucked within the bottom half. Place a coffee filter atop bottle's spout and secure it to the bottle (to hold soil from spilling through). One of the three soil types (sand, silt, clay) should be placed within the top section above the coffee filter. The last bottle should be filled with only pebbles within the top section above the coffee filter.



Part I. Soil Infiltration

- Have students break into groups and distribute bottles. (Either the students construct their bottles or teachers create them prior to class.)
- Students will pour 1 – 2 cups of water into the top of each bottle. Depending on class time, allow for 10-15 minutes to monitor and observe infiltration. They will then create a bar graph or double bar graph to show how much water is collected in the bottom of the bottle ("sewer") and calculate how much was absorbed by the different soils or surfaces. How much water ended up in the sewer?
    - Explain that different types of soils infiltrate water at different rates.
    - Rate of infiltration can be determined by how porous, compacted, or even saturated the soil type already is.
- Discuss how the absorption and infiltration rates of soils and surfaces vary for each. Did you notice "flooding" above the soil or a lack of immediate absorption occurring in any of the bottles? This would also demonstrate water that would have entered the sewer and was not absorbed.
- *Optional: Add pollution in the water (food dye, markers, or soils) to change water quality. After filtering through the soil types and compositions, how is water quality?*

Part II. Bioswales

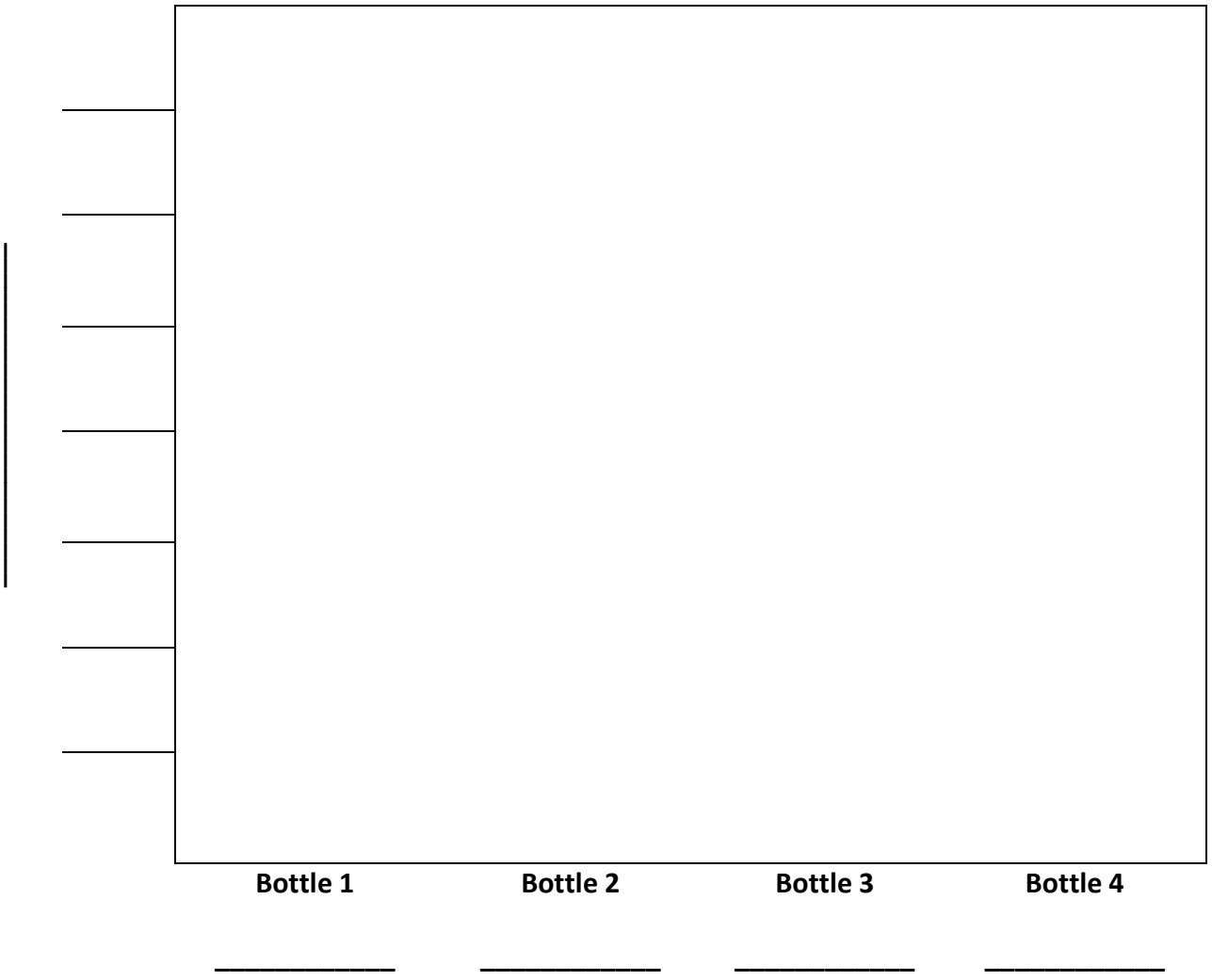
- Have students describe New York City streets. What kind of surfaces are there? Which surfaces are most common?
- Introduce the idea of green infrastructure.
- What happens when stormwater falls on impervious surfaces? It collects pollutants that either enter our sewer system or flow directly into surrounding waterways.
- Bioswales are planted areas in the sidewalks designed to collect and manage stormwater. They are composed of a vegetative layer, sandy soil layer (engineered soil), a coarser soil layer, and a stone bottom layer. Capable of holding as much as 2,000 gallons of stormwater, the bioswale acts as temporary storage that reduces stormwater runoff.
- *Optional:* With their groups, have students create a Bioswale in a bottle.
    - Bioswales are constructed through the filtration of four different layers. First, place the pebbles at the base, followed by coarse sand and topped with a layer of fine sand. You can also add topsoil or other for the vegetative layer.
    - Test this model to demonstrate water infiltration and filtering of pollution.

Discussion:

- What are the multiple benefits of the development of bioswales and other forms of green infrastructure?
- What can you do to conserve water and help our sewers during large storms?

For more information contact:
New York City
Department of Environmental Protection
educationoffice@dep.nyc.gov
Also visit DEP's website at: www.nyc.gov/dep

Graphing: What is a Bioswale?



How did the four soil samples differ? Describe how different soils play a role in a bioswale.

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