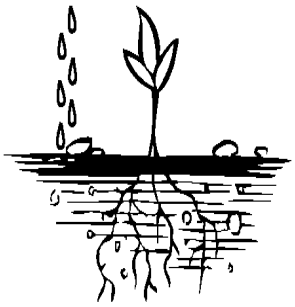


SAVVY ABOUT SOIL

IN-CLASS LESSON

OUTCOMES:

1) Students will understand how water moves through different soil textures in specific ways and why this is important to the growth of trees and other plants.
2. Students will learn about the pH of the soil, how to measure it and why pH is important to the growth of trees and other plants.
3. Students will become aware of biosolids (recycled solids from the wastewater treatment plant) as a fertilizer.

GRADE LEVEL: 5th – 8th

TIME: 1 hour and
10 minutes for clean-up

ESSENTIAL ACADEMIC LEARNING REQUIREMENTS:

Please see SUPPLEMENTS section.

MATERIALS:

- ❑ **Water**
- ❑ **Regular school clock on the wall**

ITEMS PROVIDED BY THE GREENWAY EDUCATION PROGRAM:

- ■ **Jar with water/soil**
- ■ **30 ml tube**
- ■ **Floc-Ex tablets**
- ■ **Five two liter bottles/screen**
- ■ **Baking soda/lime/vinegar**
- ■ **Soil samples**
- ■ **Teaspoons**
- ■ **600 ml beakers**
- ■ **pH overheads**
- ■ **Jar for 300 ml distilled water**
- ■ **Distilled water**
- ■ **pH dip sticks**

INTRODUCTION:

1 Introduce self and briefly describe Mountains to Sound Greenway Trust. The scientists who help manage and protect the Greenway need to understand how soil, water and forests work together in order to keep the land healthy. Ask students what soil is made of? (Minerals 45%, Air 25%, Water 25% and Organic Material 5%) Show picture of jar with water and soil separated into layers. How does it separate and why? (Heaviest and biggest particles on the bottom so the order is sand, silt and clay with organic material floating on top) Ask what students remember about the different textures of soil from the Introductory activity.

When scientists study soil they can examine the structure, color, consistency, texture and amount of organic material present. *We are going to look at the texture of the soil and try to answer this question: "What is the relationship between soil, water and forests?"* Mineral nutrients enter the soil from decomposing plants, animals and rocks. Water enters the soil and absorbs the mineral nutrients in the soil. Trees/plants then absorb the water along with the mineral nutrients. Define nutrient. If the water moves through the soil too quickly, then the trees lose their chance to "drink" the water and the mineral nutrients. Break the class into five groups and have them clear their desks to make a work area.

Today we are going to do some experiments to actually see how water flows through different textures of soil and measure the pH of the soil. Each group will receive an identical set-up consisting of a plastic cone, a measuring cup, a pie plate and 300 ml of distilled water. The only difference will be which soil texture you receive. It will be clay, silt, sand, loam or mystery. Different soil textures hold water for different amounts of time due to their different particle sizes.

DEMONSTRATION:

2 *To give you an idea what you will be doing in your small groups, I will demonstrate the procedure of pouring water through the cone. My soil is a combination of textures, so let's hypothesize what might happen when I pour 300 ml through the soil. What is a hypothesis and how do we write one? A hypothesis is a tentative statement that proposes a possible explanation to some phenomenon or event. A useful hypothesis is a* ***testable*** *statement which may include a prediction. Your prediction lets you get specific about how you will demonstrate the hypotheses is true or not true.* If particle size of soil is related to the rate at which water moves through soil, then in (clay, silt, sand, loam or mystery) the water will travel fast (more than 150 ml in one minute), medium (between 50 and 150 ml in one minute) or slow (less than 50 ml in one minute). *What will happen when I pour the water on the soil? Will all the water run out? Will some stay in the soil? What color will the water turn as it comes out?* Write their answers on the overhead.

Ask for three volunteers to help with the demonstration: a holder, a pourer and a timer. Demonstrate for the volunteers how to hold the cone, how to pour the water and tell the timer to call time after one minute and announce the amount of water that traveled through. Thank the volunteers and then discuss the results.

TEAM EXPERIMENTS:

3 *Now your five groups will be testing how water flows through soil. Each group will be given a different texture of soil. As a group you will develop a prediction and record it on your worksheet. (Show worksheet) You will be answering the questions: How much water will run through in 1 minute? How much will run through in 5 minutes? What color will the water turn as it mixes with the soil? How much water will be absorbed by the soil? Once you have answered those questions and written your prediction, raise your hand and the 300 ml bottle of distilled water will be given to you. At that point you may begin pouring and timing.*

After one minute, the holder can put the cone into the measuring cup and the timer will continue timing for 4 more minutes. After a total of 5 minutes have elapsed, the holder will pick up the cone and the final amount of water drained through will be read and recorded. While this is happening, the students measuring the pH of the soil can begin. You will be investigating how acidic or basic the soil is. This is measured on a scale of 0 to 14 with the lowest readings being acidic and the highest being basic. Plants require different amounts of acidity, with most plants preferring neutral levels (between 6-8). The pH level is important because it affects the plants' ability to absorb mineral nutrients from the soil. So if the pH is not the right level for the plants, they will not be getting the correct nutrition for their health and growth. Use the overhead on pH to help explain the concept. Review how to perform the pH test.

Students perform experiment and complete Data Worksheet.

PRESENTATIONS:

4 A representative from each group will present the results noting: soil texture, amount of water at one minute, amount of water at five minutes, amount absorbed after 5 minutes, color of water and pH level. Compile all the reported information on overhead grid. *What patterns do you see? Which texture holds the most water? Which holds the least? Which has the highest pH? Which would be the best soil for forests?* Explain that the mystery sample is biosolids (recycled solids from the wastewater treatment plant). It is used as a fertilizer on farmers' fields (wheat, hops and orchards) in Eastern Washington and tree farms in Western Washington to help enrich the soil. It also improves the capacity of the soil to retain water. Class B biosolids are 95% pathogen free, high in mineral nutrients that the plants need and is a renewable and recycled resource!

FURTHER STUDY:

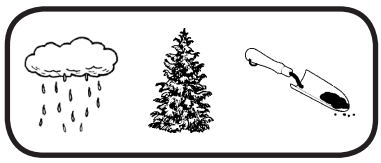
5 What might happen if the soil in an area is largely clay and silt and it rains hard for a couple of days? What happens if a forested area has sandy, rocky soil? What happens in a farmer's field or a forest if the pH is dramatically changed? How might that happen?

CONCLUSION:

6 What ideas do the students have about improving the health of our soil? Tell the students that on the field trip they will be examining multiple soil samples to determine the texture of the soil in the forest, measuring the pH levels and testing for mineral nutrients in the soil.

VOCABULARY:

Particle, hypothesis, prediction, pH, acid, base, mineral nutrients, organic material, biosolids, loam, sand, silt, clay.



SAVVY ABOUT SOIL
IN-CLASS WORKSHEET

Student names _____

PREDICTION:

1. What texture of soil do you have? Sand, Silt, Clay, Loam or Mystery? _____
2. Write your prediction for how much water will drain through in 1 minute. You are starting with 300 ml of water.

3. How much will drain through in 5 minutes?

4. How much will be absorbed into the soil (the difference between what went in and what came out)?

5. What color will the water turn?

(When these questions are answered, raise your hand and you will be given 300 ml of distilled water to proceed with your experiment.)

Begin pouring and timing.

RESULTS

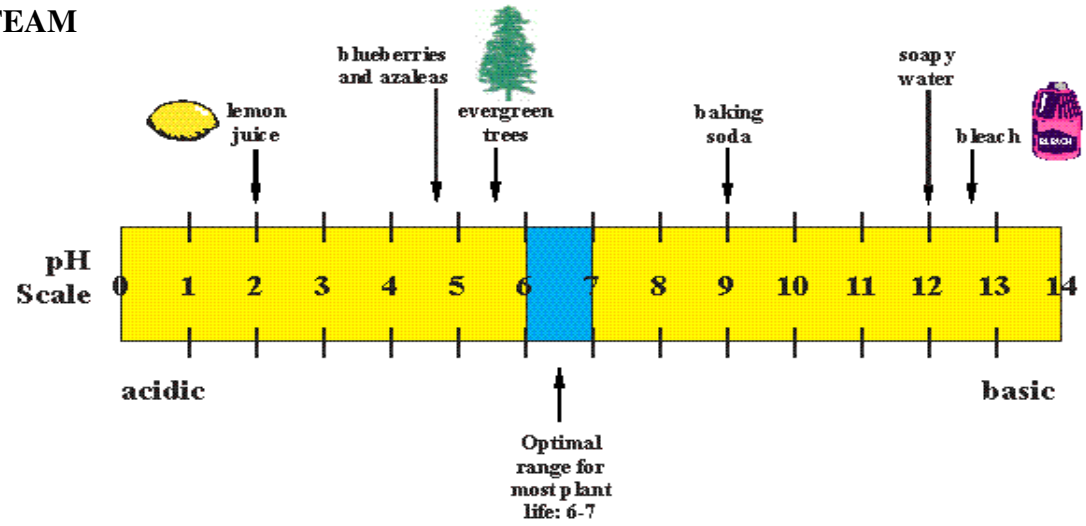
1. Amount of water at one minute _____
2. Amount of water at five minutes _____
3. Amount of water absorbed into the soil _____
4. Record observations on the color of water and how soil looks when it is wet.

_____

_____

Turn Over

pH TEAM



1. Perform the test. What is the pH? _____

2. What are you measuring when you measure pH? _____

_____

3. How does pH affect the growth of plants/trees? _____

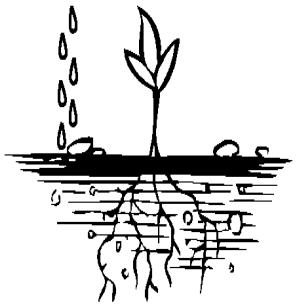
_____

_____

See below for help with these questions.

pH determines how acidic or basic the soil is on a scale of 1 to 14. A result of 7 is called neutral since it is exactly in the middle of the scale. Neutral is neither acid nor base. The pH level of soil is important to know because it helps determine whether or not plants can use the nutrients in the soil. If the pH is too acidic or too basic the nutrients stay locked in the soil and are unavailable for the plants to use. pH levels also help determine if microorganisms which are helpful to plants can grow in the soil. pH also has a direct effect on root cells and their ability to absorb nutrients and water. Most plants like garden vegetables, flowers, grass and shrubs do best in soil between 6 – 7.5 pH. Some plants (called acid lovers) grow best in acidic soils with a pH between 4 – 6. These acid lovers include blueberries, rhododendrons, azaleas, potatoes and evergreen trees. If you want to change the pH to a higher number (less acid), you can add lime (from limestone) to the soil. If you want to change the pH to a lower number (more acid), you can add pine needles or peat moss. Soil that gets a lot of rainfall is usually acidic and areas of light rainfall are generally basic.

Conclusions and presentation: Report on your prediction and whether or not you were accurate, how much water flowed through in one minute, in five minutes, how much was absorbed and any observations on color or flow. What was the pH? Did you encounter any problems? If so, explain.



SAVVY ABOUT SOIL

DIRECTIONS FOR IN-CLASS EXPERIMENT

Divide your group into two teams.

TEAM #1 (five students)	**TEAM #2** (two students)
Holds the bottle	Prepares soil for pH test and performs test
Pours the water	Records results
Times the water	
Measures the water	
Records results	

1) Use jeweler's loupe to look at soil particles and hypothesize what texture of soil you have. Discuss with group. Record on worksheet. DO NOT PROCEED WITH ANY WORK UNTIL PREDICTION IS RECORDED.

2) After the prediction is recorded, Team #2 (pH testers) should find baggie with materials and start working. Team #1 should continue to read these directions.

Team #1

READ ALL DIRECTIONS BEFORE STARTING

3) Pour 300 ml of water gently but quickly over the soil while the bottle is positioned over the beaker. Start timing immediately.

4) At one minute measure how much water has flowed through the soil. Record on "Final Data Sheet".

5) At five minutes measure how much water has flowed through the soil. Record on "Final Data Sheet".

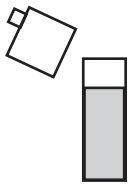
6) Figure out how much water has been retained by the soil. Check your prediction! What do you think now after doing the experiment?

7) Work with the pH team to prepare a two-minute presentation to the class. Report on your prediction and whether you were accurate, how much water flowed through the soil and how much was retained, color of water, the pH and anything else significant.

DIRECTIONS FOR SOIL PREPARATION AND pH TEST

SOIL PREPARATION - DIRECTIONS:

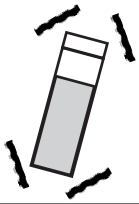
1 Fill the 30 ml clear plastic tube to the 30 ml line with distilled water.



2 Add two Floc-Ex tablets. Cap the tube and shake hard until the tablets have dissolved.

3 Remove the cap. Add one teaspoonful of soil from the soil sample.

4 Cap the tube and shake for one minute.



5 Let the tube stand until the soil settles. The clear solution above the soil will be used for testing the pH.

You are testing the pH of the soil, not the water.

pH TESTING DIRECTIONS:

When you test for pH you are testing how acidic the soil is. See Soil Guide sheet for more information.

DIRECTIONS:

1) Dip the yellow end of the paper stick into the solution you just prepared.

2) Remove at once and shake off extra water.

3) Compare with color chart.