pH Potential

GRADE LEVEL: Middle – High School

TIME: 20-30 minutes

MATERIALS:
5 different soil samples
large coffee filters
ten 500ml containers
rubber bands
wide-range pH indicator paper
rainwater (collect in clean buckets)
distilled water
2 liters of acid rain solution -
(to make acid rain solution: 4ml of 1M sulfuric acid added to 196ml of distilled water)
WARNING: Wear goggles! Pour acid into water to dilute!

OBJECTIVES

The student will do the following:

1. Predict the potential impacts, both positive and negative, of human activities on long-range changes to the environment.

2. Determine how physical and biological agents and processes affect characteristics of soil. (Decomposition, Physical and chemical weathering)

BACKGROUND INFORMATION

In this activity, students will measure the pH of water after it soaks through different soil samples. Students will conduct this test using normal rain water and acidic rain water in order to investigate how the pH of soils affects the pH of groundwater and ultimately the plants which use it.

Different types of sediment and vegetation have an effect on the pH of soil. This in turn affects the ecosystem of the area. The texture and composition of sediment in soil are very important physical characteristics. The pH is one of the most important chemical components of soil. The pH will determine what may or may not grow in an area. The pH is also critical in determining what nutrients, such as nitrogen and phosphorus, will be available to the plants. If the pH of soil is above 5.5, nitrogen is made available to plants, while phosphorus is available to plants when soil pH is between 6.0 and 7.0.

Bogs are a unique ecosystem, defined by the vegetation present, the hydrology or groundwater available, and the sediment. Alteration of a bog due to changes in the hydrology can have drastic impacts on this fragile habitat.

Bogs occurring in the northeastern states are different from those found along the Atlantic and Gulf Coast plains. For instance, bogs located along the Gulf Coast are often referred to as Pitcher Plant Bogs because these carnivorous plants are dominant. The bog in the Weeks Bay Watershed in Baldwin County, Alabama is unique. Not typical of other bogs in the area, the Weeks Bay Bog is located in the flood plain of the Fish River. The groundwater (which is fresh) flows through sandy soil deposited thousands of years ago by high waters of the Gulf of Mexico. Once

through the sand, the water reaches an impervious layer of sediments which prevents the water from moving through the system quickly. This keeps the bog wet for extended periods of time. The sandy loam bog soil is acidic (pH 3.5-5.0) and low in nutrients.

While you may not be able to visit a bog with your students, discuss which of the soils you've sampled might be good for bog plants. Suggested questions:

Discuss where you might find a bog and why. (Soil Survey Maps of your area are available through your Soil and Water Conservation District)

What is a good soil pH for different types of ecosystems?

What effect might acid rain have on an ecosystem?

ADVANCED PREPARATION

1. Collect equal amounts of soil from each of the following locations: (Zip-lock sandwich bags work well.)

    a. under a pine tree.
    b. under an oak tree.
    c. in an open area.
    d. from a wetland area.
    e. from a garden.

2. When collecting soil, be sure to include material on top of the soil as well as its contents.

3. Pour 100ml of rainwater into 5 beakers.

4. Measure and record the pH of the rainwater in the beakers using wide-range pH indicator strips (Dip pH paper in water then match the color of paper with color on color chart.).

5. Secure two large coffee filters over each beaker with rubber bands.

6. Label each beaker with the soil type then carefully place 250g of each type of soil on the coffee filters.

PROCEDURE

1. Divide students into groups of 5 or 6.

2. Pour 20ml of rainwater over the soil and allow it to drain through the soil.

3. Carefully lift the filter paper; test and record the pH of the water with an indicator strip.

4. Replace the filter paper.

5. Repeat steps 2 and 3 using the acid rain solution.

6. Record results.

7. Create a bar graph comparing the pH of groundwater after normal rain and groundwater after acid rain.

Extensions

1. Run the test again using calcium carbonate (antacid tablet) as a buffer in the water and compare the results with the original experiment.

2. Put some pond water in an aquarium with duck weed. Test the pH of the pond water with pH paper and record results. Treat the duck weed with normal rainwater and then acidic rainwater. Observe the plants and record the results over several weeks. Discuss the effects on a wetlands' food chain if the duckweed is affected.

pH Scale

	pH Scale	Examples of pH
Acidic	pH 0	Battery Acid; Strong Hydrofluoric Acid
↑	pH 1	Hydrochloric Acid secreted in stomach lining
↑	pH 2	Lemon juice; vinegar
↑	pH 3	Grapefruit, orange juice, soda
↑	pH 4	Tomato juice, acid rain
↑	pH 5	Soft drinking water, Black coffee < 5.5 = Nitrogen bioavailability
↑ increasing	pH 6	Urine; Saliva 6.0 – 7.0 Phosphorus bioavailability
Neutral	pH 7	"Pure" water
↓ increasing	pH 8	Sea Water
↓	pH 9	Baking Soda
↓	pH 10	Great Salt Lake; Milk of Magnesia
↓	pH 11	Ammonia Solution
↓	pH 12	Soapy Water
↓	pH 13	Bleaches; Oven Cleaner
Basic	pH 14	Liquid Drain Cleaner

Plant Type Growth and Soil pH

Vegetation Type	Soil pH
Corn	5.5 – 7.5
Peanut	5.6 – 6.6
Rice	5.0 – 6.5
Carrot	5.5 – 7.0
Onion	5.8 – 7.0
Spinach	6.0 – 7.5
White Cedar	4.5 – 5.0
Sphagnum moss	3.5 – 5.0
Loblolly Pine	5.0 – 6.0
American Aspen	3.8 – 5.5
Dandelion	5.5 – 7.0
Goldenrod	5.0 – 7.5
Milkweed	4.0 – 5.0
Large Cranberry	4.2 – 5.0
Apple	5.0 – 6.5

RESOURCES:

This activity was adapted from:

Walker, S.H., Caylor, R.E. ed. Global Environmental Education Resource Guide for Middle School Teachers. Fairhope, Al.: Calagaz Digital Imaging and Printing. 1996.

WEBSITES

Weeks Bay Reserve Foundation http://www.weeksbay.org/index.htm

National Estuarine Research Reserve System http://nerrs.noaa.gov/WeeksBay/welcome.html

Mobile Bay National Estuary Program http://www.mobilebaynep.com

University of South Alabama Earth Science Department
http://www.southalabama.edu/geography

Soil Science Education Homepage http://www.soil.gsfc.nasa.gov

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