HOW ACID IS SOIL?

TOPIC:

Soil pH

INTRODUCTION:

The pH of soil—how acid or alkaline it is—is very important. Many plants are sensitive to pH and will only grow in soils that are suitably slightly either acid or alkaline. The pH scale ranges from 1 to 14. Low values from pH 3 to 6 show the soil is acid; high values from pH 8 to 10 show the soil is alkaline; pH 7 is neutral. Few plants will grow under very acid conditions; this is why some farming areas with sensitive soils are hit so hard by acid rain. Lime (calcium carbonate) can be added to acid soils to make them more alkaline; sulfur can be added to alkaline soils to make them more acid. In ecological surveys it is very interesting for the investigator to know the soil pH—this may give her or him some clues as to why certain plants grow in that area. In this investigation you will learn how to measure soil pH accurately, then use the method to compare soils from different sites and measure the effect of adding lime and sulfur.

TIME NEEDED:

1 hour to test the pH
samples with calcium carbonate or sulfur added to be left for 1 week

MATERIALS:

trowel
5 small plastic bags
masking tape
felt-tip marker
15 test tubes
15 stoppers for the test tubes*
15 small self-adhesive labels to fit around the top of test tubes
test tube rack
metric ruler
teaspoon
100g barium sulfate
100g calcium carbonate
100g sulfur
250 ml distilled water
universal indicator solution
universal indicator pH chart
dropper
stirring rod (*e.g.*, a chopstick)

* Note: five tubes are needed for each student for Part I of the experiment; ten are needed for Part II. If fifteen tubes each are not available, wash out the five tubes after completing Part I and use them again, along with five new ones, in Part II.

Safety Precautions

Please click on above link to view our safety guidelines.

PROCEDURE:

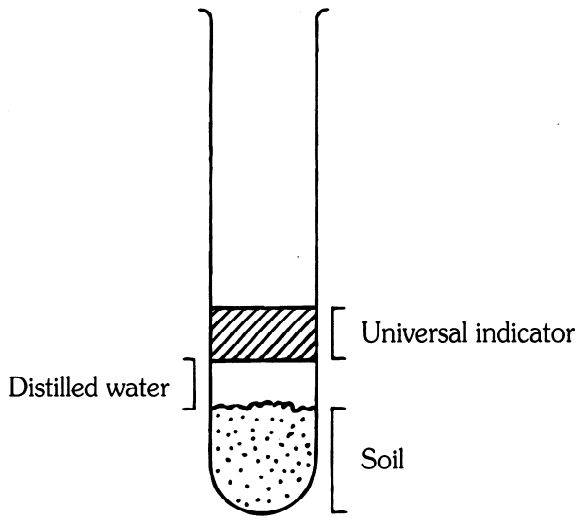
Outdoors

1. Collect small soil samples (two handfuls) from five different sites, using the trowel and plastic bags. Using the masking tape and marker, label the samples "A", "B", "C", "D", and "E"; note on each the location where the sample was taken.

Measuring pH

2. Label the five test tubes "A", "B", "C", "D", and "E". Make three marks on each test tube: the first 2 cm above the bottom of the test tube, the second 2 cm above the first, and the third 2 cm above the second.

3. Take test tube A. Add some soil from sample A up to the first mark on the test tube with the teaspoon. Clean the teaspoon.
4. Add distilled water with the dropper to the second mark in test tube A. Put the stopper in the test tube and shake.
5. Repeat steps 3 and 4 with test tubes and soil samples B to E.
6. Add $^1/_4$ level teaspoon of barium sulfate to test tube A (barium sulfate removes the cloudiness from the water by clumping soil particles together). Shake the test tube very gently—do not disturb the soil at the bottom of the test tube—and allow the particles to settle.
7. Repeat step 6 with test tubes B to E.



8. Add universal indicator solution to test tube A to the level of the third mark. Leave for one minute, then check the color against the pH chart. Record the pH in the Data Table under "No additions."
9. Repeat step 8 with test tubes B to E.

Adding calcium carbonate and sulfur

10. Label two test tubes "A Lime" and "A Sulfur." Make three marks on each test tube: the first 2 cm above the bottom of the test tube, the second 2 cm above the first, and the third 2 cm above the second. Add soil from sample A to both test tubes up to the first mark using the teaspoon. Clean the teaspoon.
11. Add $^1/_4$ level teaspoon of calcium carbonate to A Lime; stir the mixture using the stirring rod. Clean the teaspoon and the stirring rod.
12. Add $^1/_4$ level teaspoon of sulfur to A Sulfur; stir the mixture using the stirring rod. Clean the teaspoon and the stirring rod.
13. Using the dropper, add five drops of distilled water to both samples to moisten the soil. Stopper both test tubes.
14. Label eight additional test tubes as follows:

B Lime	B Sulfur
C Lime	C Sulfur
D Lime	D Sulfur
E Lime	E Sulfur

15. Repeat steps 10 to 13 with the eight additional test tubes and their respective soil samples. Leave all ten test tubes for one week.

Testing the samples with added calcium carbonate or sulfur

16. After one week, repeat steps 4, 6, and 8 with the ten samples. Record the pH values in the Data Table under "Calcium carbonate added" (for the lime samples) and "Sulfur added" (for the sulfur samples).

DATA TABLE

Soil sample and location	pH		
	No additions	Calcium carbonate added	Sulfur added
A Location:			
B Location:			
C Location:			
D Location:			
E Location:			

ANALYSIS:

1. Did you observe any differences in pH between soils from different locations? If you did, can you relate them to the places where you sampled the soil?
2. How were the pH values affected by the addition of: a) calcium carbonate or b) sulfur?
3. Which of the two—calcium carbonate or sulfur—would you add to a garden soil of a pH value of 5 to make it neutral?
4. How does pH affect the uptake of minerals by plants?
5. What other substances or materials can be added to the soil to alter pH?

OUR FINDINGS:

Click on above link to see what we found.

Our Findings

I. EARTH PROJECTS

1.008 How Acid Is Soil?

1. Results will vary.
2. a) With calcium carbonate, pH should increase slightly (soil becomes more alkaline).
   b) With sulfur, pH should decrease slightly (soil becomes more acid).
3. You would add calcium carbonate.
4. Each mineral (*e.g.*, iron, selenium, etc.) has an optimal pH range for absorption. If the pH is very high or very low, plants may be incapable of absorbing essential minerals. This explains why certain plants favor acid soils, others alkaline soils, and others neutral soils.
5. Manure, fertilizers, and natural compost can alter pH.

SPECIAL SAFETY NOTE TO EXPERIMENTERS

Each experiment includes a short list of special safety precautions that are relevant to that particular project. However, these do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note—The book assumes that you will read the safety precautions that follow, as well as those at the head of each experiment you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARE:
—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECT YOURSELF:
—Follow the directions step-by-step; do only one experiment at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USE EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Don't use your mouth to pipette; use a suction bulb
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not use reflected sunlight to illuminate your microscope
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

GOING ON FIELD TRIPS:
—Do not go on a field trip by yourself
—Tell a responsible adult where you are going and maintain that route
—Know the area and its potential hazards, such as poison plants, deep water, and rapids
—Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold)
—Bring along a first-aid kit
—Do not drink water or eat plants found in the wild
—Use the buddy system; do not do outdoor experiments alone

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES