How can you tell what chemicals are in soil?

Teaching and Learning Focus

You can help your students investigate some of the chemicals in soil that affect plant growth.

Materials Needed

For each group of four students:

- 3 soil samples in baggies, labeled A, B and C
- soil test kits from gardening supply store that test for pH, phosphates, nitrates and potassium
- two seed packets per group
- safety goggles for everyone
- distilled water supply
- spoons for transferring soil
- eye dropper
- paper towels for cleaning up
- bag of commercial potting soil

Safety

This investigation is considered generally safe to do with students, but they all must wear goggles and wash their hands when they finish. As always, please review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Bring in a bag of commercial potting soil and ask students to examine some of it briefly. Its texture is the result of a variety of particle sizes, just right for making sure that plants get what they need to grow. Tell the students that the soil has been mixed to include many of the chemicals that plants need. Read the names of a few of these chemicals from the label on the bag (potassium-K, nitrogen-N, phosphorus-P) and pH (a measure of how acidic or basic the soil is on a scale of 0-14). Since it would be very expensive to grow lots of plants in potting soil, farmers and gardeners test the soil they have for the chemicals that plants need. When they find that the soil is low in one chemical, they buy a supply of that chemical and work it into the soil.

Presenting the Investigation Question

After the scene is set, introduce your students to the investigation question: "*How can you tell what chemicals are in soil?*"
Tell your students that they will be investigating this question and that at the end of their investigations, they will be able to provide reliable answers.
Have your students brainstorm ideas about how this investigation question could be investigated.

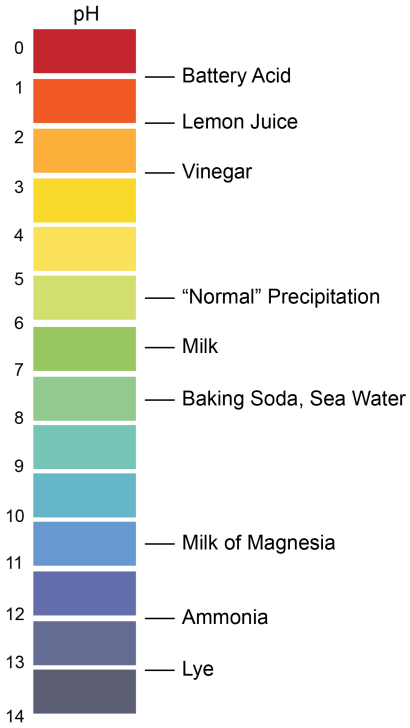
1. Design an experiment that could be used to test the investigation question.
2. What materials would be needed?
3. What would you have to do?
4. What would be measured?
5. How long would the experiment take?

Assessing What Your Students Already Know

At the elementary level, chemical explanations are best kept at the macro or observational level. At this stage, it is appropriate to

talk about the fact that whether a material is an acid or a base is an important *property* of the material. Operational definitions constructed from observations are useful. For example, “An acid is a material that makes a cabbage juice indicator solution turn more ‘orange-ish’.” is a reasonable definition for a student to construct based on immediate experience. Most soil testing kits include an acid-base indicator with a range of pH levels to reflect and sort out those most likely to be found in samples. Be sure to introduce pH as a number scale that expresses how acidic or how basic a material is.

Exploring the Concept



1. Provide each group with a soil testing kit, two seed packets, soil samples, spoons, water supply and enough safety goggles for each student. Ask them to examine the soil testing kit and figure out how they will know if a particular chemical is in the soil sample. Demonstrate how to use the kit.
2. Help the students make a data table for each chemical. The table should identify the sample and have data on what chemicals are present in each sample. It should also have a place to describe each soil sample.
3. After you have reviewed the kit instructions and safety rules, have the groups perform the tests on all the samples.
4. Next, have each group write a full description for each of their soil samples. They should include any interesting observations about the sample in the description, for example: sticky, fine, coarse, rocky, dark, light, shiny, etc.
5. Ask each group to look at the soil information on their seed packets. Which of their soil samples would be the best to grow their plants? Why is that?
6. As a class, ask students to look for patterns that might link certain types of plants with certain types of soil. If these patterns become clear, suggest that groups look up the plant using online or library resources to find out what soil chemicals help the plant to grow.

Applying Students' Understanding

Once again, show students the bag of potting soil, but this time show them the label so that they can see what the ideal levels are for the soil chemicals. Ask the students to add a recommendation to their soil sample descriptions. Ask, “What would you add to make your sample more like this potting soil? Would this potting soil work for your seeds? Why or why not?”

Revisiting Investigation Question 4

Complete this investigation by asking your students to reflect on the investigation question and how their answers may have changed as a result of what they have learned. Ask them why they think it’s important to test for chemicals in soil. Remind the students that different plants need different types of soil chemicals to grow and thrive. Some plants do well in acidic soils, for example, while others grow best when the soil is more basic.

Digging Deeper

What is the source of the chemicals found in the soil? Students should think about the materials they identified in their investigation of a soil mixture. The various rocks and minerals, the organic material that is present in the soil, and even the rain that falls on the soil all contribute to the types of chemicals in that soil sample.

Most soils take a long time to form. They form from rocks and sediments (parent material) that have disintegrated and decomposed through the action of weather and organisms (a process called “weathering”). The rate of soil formation is largely controlled by rainfall, temperature, and the type of parent material. High temperature and abundant rainfall speed up soil formation, but in most places a fully developed soil that can support plant growth takes hundreds of thousands of years to form. (From *AGI Environmental Awareness Series: Sustaining our Soils and Society p8*).

Soil Unit Sections
