



Soil Science: Testing pH

SUMMARY

The health and success of the garden depends on the the soil. Plants have preferences. Vegetables tend to 'prefer' a more alkaline or basic soil, with a pH level between 6 and 7. Blueberries thrive in a more acidic soil with a pH of 4 to 5. Preparing and testing the soil for pH (and nutrients) are first steps to take when planning a garden. In this lesson we test the pH of our garden soil. We can then add lime or wood- ash to change the pH if needed for our crops.

FOCUS QUESTION

What is the pH of the soil in our garden beds? Is our soil suitable for the crop(s) we're planning (e.g. potatoes)?

OBJECTIVES

Introduce students to soil testing using individual pH test tube kits.

SPECIFIC OUTCOMES

Practice the Scientific Method: hypothesizing, testing, recording and sharing results.

Practice doing field research

Learn that farming requires scientific study and knowledge.

Introduce the concept of "growing" soil instead of adding to it.

MATERIALS

For Teams of Students: 1 pH kit. Clipboard, pencil and paper.

For The Teacher: Pre-drawn pH scale to copy to board.

Cups of lemon juice, baking soda, soap, vinegar, chalk, milk, etc.

Measuring cups or droppers to add bottled water to test tubes.

Bottled water.

MAKING CONNECTIONS

In Sustainable Agriculture, farmers focus on creating systems which run without input of outside resources. Soil fertility is a critical component of a sustainable farm. The objective in Sustainable Agriculture is to build the soil rather than adding to it. By knowing the pH preferences of plants, farmers can adjust the sorts mulches they use, for example, and effect pH.

PROCEDURE

ENGAGE (5 minutes)

What do you think are the most important ingredients in a healthy garden? (Sun, water, soil). How do we know if our soil is healthy? (run tests). Have you ever heard of "sweet soil" or "sour soil?".

Grade Level

Grade 3, 4,5

Subject Areas

Science, Chemistry, Environmental Science, Writing.

Key Concepts

pH, the Scientific Method, Farming as a scientific and ecologically responsible career.

Key Cognitive Skills

Gathering information (collecting); Organizing (matching); Analyzing and Interpreting results.

Group Size

Teams of 3

Duration

Set up - Clipboards with paper and pencils. Buy pH kits from garden supply store(\$1.00 each) for teams.

Hands-On Time

10 minutes for indoor orientation.

20 minutes for soil sampling

10 minutes to share findings

Setting

Fall: Indoors and out for soil tests.

Vocabulary

pH (Power of Hydrogen)

Acid, Base, acidity, alkaline

"Sweet soil"

Those words help describe the soil. We're going to take some soil samples today from the beds outside and test them. But before we head out, let's get a handle on this. (Offer a student something to taste such as a bit of lemon juice, without identifying it). Ask them how it tastes. Have another taste baking soda. Ask them to describe it. "Sour" and "Bitter" might be the words used for acid, and "salty" might describe Baking Soda. Have them sniff vinegar and quickly pass ammonia on a sponge under their nose (Use Caution!). Then, try water.

EXPLORE (15 Minutes)

"As it turns out, we can measure how bitter and sour on a scale known as the pH scale. On this scale, which goes from 1 - 14 (draw the pH scale on a portable board) where do you think water falls? Right in the middle. Water is about half way in between the sour or "acidic" end and the bitter, "basic" or "alkaline" end. Distilled water is pH 7, Lemon juice is pH 2, vinegar is pH 3, baking soda is pH 8 and ammonia is pH 12. Let's test a couple of different kinds of soil. Where do you think these will fall on the scale? (This will also demonstrate how to use the soil kits.) Proceed to add the soil to the line in the tube, add water using the dropper and then shake. Let settle. Try a few different kinds. Sand, clay and ash might be good to test. Ask: Where on the scale do you think plants prefer to live? Mark guesses on the scale.

EXPLAIN (10 Minutes)

On the back of your kits you'll find the pH preference for potatoes. (Find.) The Research Question for today is, 'Do you think our soil beds are suitable for potatoes to grow in?' (Write on board and Hand out Circle of Science sheets) (See Appendix) Fill in first part of sheet together; under 'Research Question' record the question of the day.

When we get outside, we'll form a hypothesis based on what we have just learned about pH. We'll go over the procedure of the test too. It's important that everyone follows the same steps. Why? (So we can compare results.) Head outside; bring the results on the portable board from the indoor tests of clay, sand, and ash. Have teams look at the soil in the raised beds and make a "best guess" of the garden's pH. Teams record hypotheses in sentences. "I think the soil will be ___ (a little too acid) for potatoes". They then justify their guess, with a reason WHY the team is making this guess.

Review the procedure of the test. Stress the importance of everyone following the same steps. Have teams test the soil.

EXPAND (Optional) "Let's Take it One Step Further"

Gather back indoors to share results. 'So, we know that some soil is pleasant for plants and some is not. Let's find out about our soil, and whether it is pleasant for potatoes.' Have them share results. Ask them if their hypothesis was proven right or wrong.

EVALUATE (20 Minutes) "You Tell Me"

Journal Questions: Are farmers scientists? Why might farmers want to avoid adding to their soil? (Save time, money, and conserve natural resources). Why is pH important in planning a garden? (Plants have preferences) Why might some farmers call good growing soil "Sweet soil"? (NOT acidic, and opposite of sour is sweet).

EXTENSIONS

- Lime and wood ash help balance pH. Run some tests and alter the pH of some soil samples.
- Research which plants need acidic soil and which need more basic soil?

Background Information

This lesson focuses on how soil interacts with organic matter through studying soil pH. The pH range of natural systems under typical conditions usually falls between 6.0 and 8.0. pH stands for "Power of Hydrogen", or, the number of hydrogen ions (H⁺) in a solution. The more hydrogen ions, the more acidic, and the closer to zero. 7 is neutral and 14 is extremely basic. The pH level in soil is important to plant life. Changes in pH levels can alter the lives of plants (and animals). The presence of nutrients (calcium, magnesium, potassium, nitrogen and phosphorous) is measured through other soil tests, but nutrient *availability* depends on pH.

Curricular Goals (NC Standard Course of Study, Science Objectives)

Competency Goal 1: Develop an understanding of the nature of science

- Science is inquiry based learning. By making guesses about our soil samples, we practice making inferences based on our observations and forming hypotheses based on background information.

- The presence of real, practicing scientist farmers greatly enhances the student's understanding of the nature of science and agriculture as a career.

- Demonstrate that Scientific Knowledge is Replicable: by all students doing the same experiment, we demonstrate replicability.

Competency Goal 2: Develop the ability to use science process skills

- Demonstrate the Ability to Classify.

Students observed and then classified their sample along the pH color scale.

- Demonstrate the Ability to Measure.

The skills exercised in the soil experiment included measuring. Each student team figured how much soil and water would be needed. Not only did we measure out, we also used test tubes marked with incremental lines.

Competency Goal 4: The learner will develop a positive attitude towards science.

- Exhibit a positive attitude for the need for conservation, preservation and wise use of natural resources. Each member understands the importance of providing healthy soil for plants. In testing the soil for their potatoes, the students have a chance to care for living organisms.

- Exhibits a positive attitude toward learning and experiencing science. This is fun for all.