

# Soil Science: Testing pH

## SUMMARY

The health and success of the garden depends on the soil. Plants have preferences. Most garden vegetables prefer slightly acidic soil, and a pH between 6.0 and 6.8 will support just about any commonly grown vegetable. This includes beans, tomatoes, carrots, peppers, squash, onions and lettuce.

Some crops, such as potatoes, sweet potatoes and rhubarb, will also tolerate a pH as low as 4.5, but even these crops will still thrive with a pH between 6.0 and 6.8.

Blueberries thrive in a more acidic soil with a pH of 4 to 5. Preparing and testing the soil for pH (and nutrients) are the first steps to take when planning a garden. We can add amendments to the soil like compost or mulch to change the pH. In this lesson we test the pH of our garden soil.

## FOCUS QUESTIONS

What is pH? Power of hydrogen.

How does the pH help determine if we have suitable soil for the plants we are growing?

What is the pH of the soil in our garden beds?

Is our soil suitable for the plants we are growing?

## OBJECTIVES

Introduce students to soil testing using individual test tubes and PH strips.

## 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: Test tubes, pH strips, clipboard, paper and pencil
- For the Teacher: Pre-drawn pH scale to copy to board
- Lemon juice, baking soda, dish soap, vinegar, milk, bottled water
- Measuring cups or droppers to add bottled water to test tubes

## MAKING CONNECTIONS

In Sustainable Agriculture, farmers focus on creating systems that 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 of mulches they use, for example, and effect pH.

## **PROCEDURE: Day One**

### **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?”

Those words help describe the soil. We’re going to take some soil samples 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. Then, try water. Compared to the lemon juice and baking soda, how would you describe water? On a scale of sour – sweet – bitter?

Most garden vegetables like a sweet soil. That is, not sour and not bitter. Right in between. Like water – neutral. Have you ever heard of the expression “sweet spot?” That means just right.

### **EXPLORE (20 Minutes)**

We can measure how bitter and sour something is 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?
- Lemon juice?
- Baking soda?
- Dish soap?
- Vinegar?
- Milk?

In teams of 3, students hypothesize what the pH of the household liquids are and write down their predictions. Then they test the liquids with their test tubes and pH strips. Compare results.

### **CONCLUSIONS (5 Minutes)**

Water is right in the middle about half way in between the sour or “acidic” end and the bitter, “basic” or “alkaline” end – its pH 7

Lemon juice is pH 2

Vinegar is pH 3

Baking soda is pH 8

Dish soap is pH 10

Milk is pH 6.7

## Procedure: Day Two

Let's test a couple of different kinds of soil. Where do you think these will fall on the scale?

Each team of 3 will go to the garden with a garden map and three marked spots where they will test the soil.

Proceed to add the soil to the line in the tube, add water using the dropper and then shake. Let settle.

Using the pH scale, determine the pH of the soil samples and record.

### CONCLUSIONS:

Each team shares their results.

Explain to students that the ideal acidity level for soil is generally between 6 and 7. When pH is above 7, some nutrients (like phosphorus, nitrogen, and sulfur) are harder for the plants to utilize. When pH in the soil is below 6, some nutrient levels (like manganese) are higher and can become toxic to sensitive plants. Farmers use the pH scale to help them figure out what the soil needs.

Using a list of vegetables and their preferred pH, groups discuss whether the soil they sampled has the appropriate pH for which vegetables.

### 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.

**Name:** \_\_\_\_\_ **Soil location:** \_\_\_\_\_

| <b>Vegetables</b> | <b>Ideal Soil pH</b> | <b>Is Soil Sampled Appropriate?</b> |    |
|-------------------|----------------------|-------------------------------------|----|
| Arugula           | 6.0 - 6.8            | yes                                 | no |
| Asparagus         | 6.0 - 8.0            | yes                                 | no |
| Beans             | 6.0 - 7.5            | yes                                 | no |
| Beets             | 6.0 - 7.5            | yes                                 | no |
| Broccoli          | 6.0 - 7.0            | yes                                 | no |
| Brussels Sprouts  | 6.0 - 7.5            | yes                                 | no |
| Cabbage           | 6.0 - 7.5            | yes                                 | no |
| Carrot            | 5.5 - 7.0            | yes                                 | no |
| Cauliflower       | 5.5 - 7.5            | yes                                 | no |
| Celery            | 6.0 - 7.0            | yes                                 | no |
| Corn              | 5.5 - 7.0            | yes                                 | no |
| Cucumber          | 5.5 - 7.5            | yes                                 | no |
| Eggplant          | 6.0 - 7.0            | yes                                 | no |
| Garlic            | 5.5 - 7.5            | yes                                 | no |
| Horseradish       | 6.0 - 7.0            | yes                                 | no |
| Kale              | 6.0 - 7.5            | yes                                 | no |
| Lettuce           | 6.0 - 7.0            | yes                                 | no |
| Leek              | 6.0 - 8.0            | yes                                 | no |
| Mustard           | 6.0 - 7.5            | yes                                 | no |
| Onion             | 6.0 - 7.0            | yes                                 | no |
| Parsley           | 6.0 - 7.0            | yes                                 | no |
| Peas              | 6.0 - 7.5            | yes                                 | no |
| Pepper            | 5.5 - 7.0            | yes                                 | no |
| Potato            | 4.5 - 6.0            | yes                                 | no |
| Pumpkin           | 5.5 - 7.5            | yes                                 | no |
| Radish            | 6.0 - 7.0            | yes                                 | no |
| Rhubarb           | 5.5 - 7.0            | yes                                 | no |
| Shallot           | 5.5 - 7.0            | yes                                 | no |
| Soybean           | 5.5 - 6.5            | yes                                 | no |
| Spinach           | 6.0 - 7.5            | yes                                 | no |
| Tomato            | 5.5 - 7.5            | yes                                 | no |
| Turnip            | 5.5 - 7.0            | yes                                 | no |
| Watermelon        | 5.5 - 6.5            | yes                                 | no |

Name: \_\_\_\_\_

| <b>Liquid tested</b> | <b>Estimated pH</b> | <b>Tested pH</b> |
|----------------------|---------------------|------------------|
| Water                |                     |                  |
| Lemon juice          |                     |                  |
| Baking soda          |                     |                  |
| Dish soap            |                     |                  |
| Vinegar              |                     |                  |
| Milk                 |                     |                  |

| <b>Soil location</b> | <b>Estimated pH</b> | <b>Tested pH</b> |
|----------------------|---------------------|------------------|
|                      |                     |                  |