Soil pH

When you think of pH, you probably think of liquid acids and bases. But soil can be acidic or basic, too. Soil pH, sometimes referred to as soil acidity, can be expressed using the pH scale. The pH scale ranges from 0 to 14. Soils with pH above 7 are basic or sweet. Soils with pH below 7 are acidic or sour. A soil with a pH of 7 is neither acidic nor basic, but is neutral.

Plant Nutrients	
Macronutrients	**Micronutrients**
Nitrogen	Iron
Phosphorus	Manganese
Potassium	Zinc
Sulfur	Copper
Calcium	Molybdenum
Magnesium	Cobalt
	Chlorine

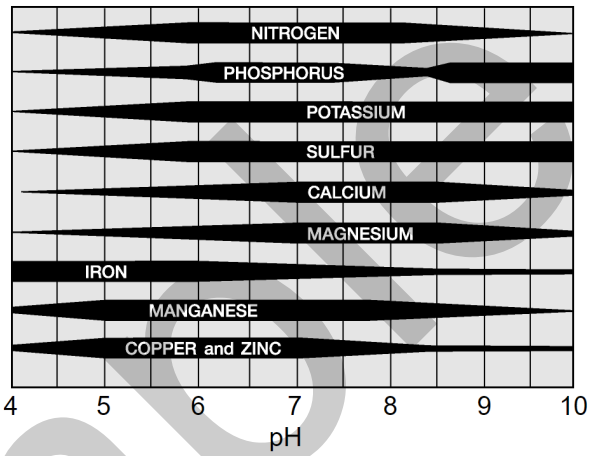

Figure 1 pH and nutrient availability

The pH of soil is an important factor in determining which plants will grow because it controls which nutrients are available for the plants to use. Three primary plant nutrients—nitrogen, phosphorus, and potassium—are required for healthy plant growth. Because plants need them in large quantities, they are called *macronutrients*. They are the main ingredients of most fertilizers that farmers and gardeners add to their soil. Other nutrients such as iron and manganese are also needed by plants, but only in very small amounts. These nutrients are called *micronutrients*.

The availability of these nutrients depends not only on the amount but on the chemical forms of the nutrients that are present as well. The pH of the soil and the rate at which the nutrients are released from the soil also affect availability. In general, macronutrients are more available in soil with high pH and micronutrients are more available in soil with low pH. Figure 1 shows the effect of pH on the availability of nutrients in the soil.

OBJECTIVES

- Use a pH sensor to measure the pH of soil samples.
- Identify any nutritional problems plants would have in that soil.

MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis app
Go Direct Tris-Compatible Flat pH Sensor
100 mL graduated cylinder
waste cup
distilled water
2 soil samples
two 250 mL beakers
wash bottle with distilled water
2 plastic spoons or glass stirring rods
paper towels

PROCEDURE

1. Prepare the water-soil mixture in a 2:1 ratio.
   a. Label two beakers "A" and "B".
   b. Place 50 g of Soil A into Beaker A. To avoid cross-contamination of the soils, leave this spoon in the beaker.
   c. Using a new spoon, place 50 g of Soil B into Beaker B. Leave the spoon in the beaker.
   d. Add 100 mL of distilled water to each beaker.
   e. Stir both mixtures thoroughly.
   f. Stir once every 3 minutes for 15 minutes.
   g. After the final stirring, let the mixtures settle for about 5 minutes. This allows the soil to settle out, leaving a layer of water on top for you to take your pH measurement as shown in Figure 2. Continue with Steps 2–4 while you are waiting.

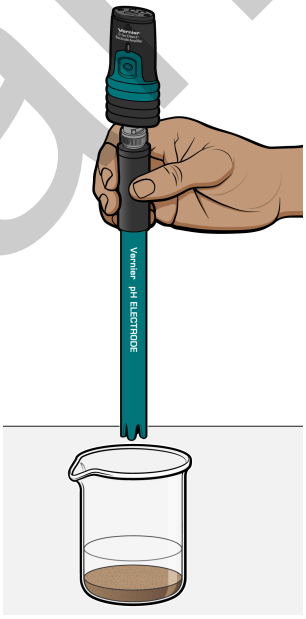

Figure 2

2. Launch Graphical Analysis. Connect the Go Direct pH Sensor to your Chromebook, computer, or mobile device. **Important**: For this experiment your teacher already has the sensor in pH soaking solution in a beaker.

3. Set up the data-collection mode.
   a. Click or tap Mode to open Data Collection Settings.
   b. Change the Mode to Events Based.
   c. Change Event Mode to Selected Events.
   d. Select the check box next to Average sensor reading over 10 seconds. Then, click or tap Done.

4. Measure the pH.
   a. Click or tap Collect to start data collection.
   b. Rinse the tip of the sensor with distilled water, and place the tip of the sensor into the liquid in Beaker A.
   c. Click or tap Keep. **Important**: Leave the probe tip submerged while data are being collected for 10 seconds.
   d. Repeat data collection by again clicking or tapping Keep. Leave the probe tip submerged for the full 10 seconds.
   e. Click or tap Stop to stop data collection.
   f. Record the averaged pH values for readings 1 and 2 in your data table, then calculate and record the average value of the two readings.

5. Repeat Step 4 for the sample in Beaker B.

6. Rinse the sensor with distilled water and return it to its storage container.

7. Your teacher will tell you whether you should keep the soil for further testing or clean up at this time.

DATA

	Sample A pH	Sample B pH
Reading 1		
Reading 2		

Average		

PROCESSING THE DATA

1. Is the soil acidic, basic, or neutral?

   Sample A _____

   Sample B _____

2. Plants growing in these soils might have trouble obtaining enough of some essential nutrients. According to Figure 1, which nutrients might be in short supply?

   Sample A _____

   Sample B _____

EXTENSIONS

1. Research the function of each nutrient and what symptoms a plant would have if they were not getting enough.
2. Test soil samples from your backyard or another environment and compare to your first results. Are the results the same or different? Try to explain why.
3. Research how farmers adjust the pH of soils. Design and conduct an experiment to test the effectiveness of their methods.