Nutrients for Growth (I.B.ii.)

What are the nutrients required for plants to grow?

Farmers are continually focused on the presence of the right nutrients in their fields. Without the right nutrients, the crops will not grow properly or produce seeds, and that is part of the bottom line (profitability) for farmers. The other concern is soil health, the ability for the soil to continue to support growth of crops. There are two classes of nutrients: macronutrients and micronutrients. The macronutrients include Nitrogen, Phosphorus and Potassium, as well as calcium, sulfur and magnesium. The micronutrients occur (and are needed by plants) in much smaller amounts; they include boron, copper, iron, manganese, zinc, nickel and molybdenum.

Many farmers ask cooperatives or other companies to collect and analyze soil samples from their fields. They will sample across a grid (usually 2.5 acres between samples) to determine pH and soil nutrient readings that help determine the need for an application of lime or gypsum (which will increase pH if the soil is acidic, or add magnesium or calcium, if those nutrients are deficient) or the need for an application of fertilizer (if the nutrients are depleted from the previous year's crop). For the purposes of this activity, we will focus on three of the macronutrients: nitrogen, phosphorus and potassium. In reality, soil testing may reveal low amounts of other nutrients, and farmers may have to adjust those as well.

What do these macronutrients do for plants?

Nitrogen is usually applied in the form of ammonia (urea) or nitrate. The compound that is absorbed into the plant will be broken down to be used in DNA (Remember that mitosis is the process when a cell divides and makes an exact copy of its DNA in the form of chromosomes.), in amino acids and in the proteins that plants make. A plant that does not have enough nitrogen will not appear green and will not be able to absorb the same amount of sunlight as one with enough nitrogen.

*To better understand Nitrogen and how it cycles (and why it is not included in soil testing reports), use the *Nitrogen Cycle Model* activity.

Phosphorus is needed for photosynthesis, energy transfer, and DNA. In addition, seed formation is aided by the presence of phosphorus. Phosphorus can only be taken into a plant through the soil solution. If plants do not have enough phosphorus they show stunted growth, and flowering and root system development are slow.

Potassium is required in large amounts for proper growth of plants. It regulates the opening and closing of stomata, therefore controlling carbon dioxide and water uptake and release through the roots as well. Potassium is important in the production of ATP (the energy molecule created through respiration). Plants that are deficient in potassium may be stunted and not perform well in wet or drought conditions.

For more information on each of these nutrients, visit: http://www.smart-fertilizer.com/ and type the nutrient in the search box.

Materials
Soil test kit (i.e. LaMotte NPK Soil Test Kit, 3-5880)
Soil sampling tube

Procedure
Collect a soil core sample at a depth of 6-2/3 inches from a garden, flower bed, alongside a walkway, under a tree and a farm field, if available. Perform tests for the amounts of nitrogen, phosphorus and potassium in the soil following the procedure that is included with the soil testing kit. Choose a soil test kit that will give amounts of nutrients in ppm. For example, the LaMotte NPK Soil Test Kit, 3-5880 will give amounts of nutrients that can be compared to the amounts on a soil lab report by using the conversion below.

Have students create a data table for the source of the soil and each nutrient tested.

Smart Farming: Using data to make decisions

Draw your Data Table below:

> Soil testing laboratories often report the levels of nutrients in units of parts per million (ppm) or pounds per acre. If the sample represents soil cores taken to a depth of 6-2/3 inches, you can convert ppm to pounds per acre by multiplying ppm by 2.
> https://www.ipni.net/ppiweb/agbrief.nsf/5a4b8be72a35cd46852568d9001a18da/c0e2518d9e448ab08525690a0067b7b6!OpenDocument

Conversion: ppm * 2 = lbs/acre

Reflection

1. What differences did you find in nutrient levels from your various samples?

2. What are the reasons for the differences you found?

3. What modifications would you have to make to help the soils be more able to support growth of plants?

4. Look at the soil report from your assigned field. Go to; https://www.extension.purdue.edu/extmedia/AY/AY-9-32.pdf to read about the recommendations for fertilizer in soybeans. Based on the amount of phosphorus and potassium in your field, is there a need to add additional nutrients? Describe why or why not.

Go to the Decision Tracker (row I.B.ii.) to enter your decision [1-yes (variable rate-only where needed), 0.5 (same rate across the field), 0-none]