Soil Analysis

Background:
Nutrient rich soil is needed to grow healthy crops to provide food for humans and animals. Nutrient rich soils contain phosphate and other nutrients such as nitrogen and potassium. Unfortunately, not all soils are naturally nutrient rich. In the early 1800s, it was learned that phosphorus promotes growth in plants and animals. At first, bones, which contain the element phosphorus, were used as an agricultural fertilizer. Today, phosphate rock provides the phosphorus element of the nitrogen-phosphorus-potassium mix that fertilizer provides for plants.

Soils need phosphate and other nutrients. When farmers apply nutrients, either in organic or mineral form, it is to fertilize the soil, not the plant. The soil then acts as a conversion system for the crops, receiving, storing, transforming, transporting and exchanging plant nutrients. The key to growing crops that are plentiful and that contain the nutrients we need is to assure that the local soil has the nutrients it needs.

Mineral fertilizers are needed to maintain the level of soil fertility needed to meet the nutritional needs of the world's population. There is an ongoing discussion on the matter worldwide in the agricultural community, and agronomy and soil experts agree that the use of fertilizers, both inorganic and organic, needs to be tailored to the local soil needs. Soil testing and other diagnostic tools should be used. If the nutrients in the soil are already sufficient, adding fertilizers is more likely to be damaging environmentally, as well as economically wasteful.

Having sufficient amounts of phosphate and other nutrients will improve agricultural production in order to provide enough food for the world's population. Phosphate is a vital nutrient for plant growth, development, and reproduction.

Grades:
6-8 9-12

Standards:
SC.6.L.14.1 SC.7.E.6.6 SC.7.L.17.3 SC.8.N.4.2
SC.G.1.4.3 SC.B.1.4.2 SC.B.1.4.11 SC.912.L.17.4 SC.912.L.17.8 SC.912.17.12

Objectives:
The student will be able to…
-Identify the components of fertile soil
-Understand how soil conservation methods can protect the soil and its fertility
-Explain how modern farming practices replaced the traditional methods of farming

1855 West Main Street • Bartow, FL 33830-7718
(863) 534-7160 • Fax (863) 534-7165 • www.fipr.state.fl.us

Vocabulary:
Soil
Nitrogen
Phosphorus
Potassium
Silt
Clay
Fertilizer
Organic
Inorganic
Trace elements
Macronutrients
Micronutrients

Materials:
Gloves
Goggles
Trowel or spoon
Clean dry cup
2 liter container, beaker or bucket
Soil sample(s) - 2 cups each
Rapitest Soil Test Kit:
pH comparator
Nitrogen comparator
Phosphorus comparator
Potassium comparator
pH capsules
Nitrogen capsules
Phosphorus capsules
Potassium capsules
Pipette
Distilled water
Stopwatch or timer

Procedure:
Note: Lab safety at all times. Reagents are considered to be a potential health hazard- gloves and goggles should be worn at all times.
Preparation

1. Using the trowel take a soil sample from 2-4" below the ground surface
2. Take several samples from the same area
3. Place the samples in a clean container

4. Break the sample up with the trowel or spoon and allow it to dry out naturally (not necessary but makes working with the sample easier)
5. Remove small stones and organic matter such as grass, weeds, roots or hard particles
6. Set aside a small sample (1/4 cup) of soil in a cup
7. Fill a clean container with 1 cup soil and 5 cups of water (larger or smaller quantities may be tested as long as the 1 part soil and 5 parts water proportions are maintained). For best results use distilled water
8. Thoroughly shake or stir the soil and water together for at least 1 minute then allow to stand undisturbed until it settles

pH Test

1. Remove the cap from the green comparator
2. Fill test chamber to soil fill line with soil sample
3. Carefully separate the two halves of the green pH capsule and pour powder into the test chamber
4. Using the pipette, add water (preferably distilled) to the water fill line
5. Replace the cap on the comparator making sure the cap is on tightly
6. Shake thoroughly
7. Allow soil to settle and color to develop for about a minute
8. Compare the color of the solution against the pH chart. For best results allow natural light to illuminate the solution.

Nitrogen Test

1. Select the purple nitrogen comparator. Remove the cap
2. Using the pipette fill the test and reference chambers to the fill mark
3. Carefully separate the two halves of the purple nitrogen capsule and pour powder into the test chamber
4. Replace the cap on the comparator making sure the cap is on tightly
5. Shake thoroughly
6. Allow the color to develop in the test chamber for 10 minutes
7. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

Phosphorus Test

1. Select the blue phosphorus comparator. Remove the cap
2. Using the pipette fill the test and reference chambers to the fill mark
3. Carefully separate the two halves of the blue phosphorus capsule and pour powder into the test chamber
4. Replace the cap on the comparator making sure the cap is on tightly
5. Shake thoroughly

6. Allow the color to develop in the test chamber for 10 minutes
7. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

Potassium Test

8. Select the orange potassium comparator. Remove the cap
9. Using the pipette fill the test and reference chambers to the fill mark
10. Carefully separate the two halves of the orange potassium capsule and pour powder into the test chamber
11. Replace the cap on the comparator making sure the cap is on tightly
12. Shake thoroughly
13. Allow the color to develop in the test chamber for 10 minutes
14. Compare the color of the solution in the test chamber to the color chart. For best results allow natural light to illuminate the solution.

Data/Observations:

SAMPLE NUMBER	pH	Phosphorus (P)	Nitrogen (N)	Potassium (K)
1 Location:				
2 Location:				
3 Location:				

Observations:

Analysis/Conclusion:

1. What are the components of fertile soil?
2. How can soil conservation methods protect the soil and its fertility?
3. What causes soil degradation (soil becomes unfertile)?
4. What would happen to crops if they were grown in unfertile soil? What would happen to the organisms that consume them?
5. How have modern farming practices replaced the traditional methods of farming?
6. What are the foods produced in the greatest amounts throughout the world?
7. How has the demand for food worldwide affected the demand for fertilizers for soil?
8. How has the green revolution increased yields of new crop varieties through modern agricultural techniques?

Extension:

1. Students may write a persuasive essay addressing the question: which is better for plants, organic or chemical fertilizers?
2. Students may develop a fertilizing plan to improve the nutrient value of the soil in the school garden.
3. Students may get involved in the school composting procedures and worm farm processes in order to improve the school garden soil.
4. Students can research genetic engineering in plants and animals and discuss if genetic engineering can compensate for nutrient poor soils.
5. Students can be given a future situation in which they are the last hope for human survival. Split students into groups of 4 or 5. Due to the over-use of nutrients in the soil each group has a hypothetical farm that is responsible for producing enough food to feed the world. Furthermore, the amount of phosphorus, nitrogen, potassium, and other important minerals and trace elements on the earth are very scare. First the students must identify the impact that human activity has on the earth, specifically the depletion of nutrients in the soil due to agriculture and other human activities. They then must come up with a feasible plan to replenish nutrients to soil and conserve.
6. Students can have a debate over the "hot topics" related to agriculture. The scientists concerned with soil having the perfect composition as their main concern vs. politics vs. society vs. economics.

Adapted from Rapitest Soil Test Kit (Fisher Scientific) and
Phosphate Content in Peace River Basin soils and soil additives
Lesson Plan (FIPR Institute Publication) and
Indira Sukhraj's Soil Analysis Lab