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

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-Understand how soil conservation methods can protect the soil and its fertility
-Explain how modern farming practices replaced the traditional methods of farming

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

Materials:
Gloves
Goggles
**Materials needed when using LaMotte N-P-K Soil Kit*
Distilled Water (400 mL/1 pint for 10 tests)
Stopwatch
Plastic spoon
1 cup each of various soil samples (3 samples)
Extraction Tube
Pipette
3 square test tubes
6 Floc-Ex tablets
3 Nitrate WR CTA tablets
3 Phosphorus tablets
3 Potassium tablets

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.

1. Use a clean trowel or spoon to collect your soil samples. At least 1 cup should be collected from each site.
2. If time allows, spread soil samples out on a sheet of plastic wrap and allow to dry overnight. Pick out larges leaves, stones or sticks. Crush any lumps. The dried soil may be passed through a sieve or a piece of screen.
3. Fill the round extraction tube to the 30 mL line with distilled water.
4. Add two Floc-Ex tablets to the extraction tube. Cap the tube and mix until the tablets have disintegrated.

5. Remove the cap and add one teaspoon of soil to the extraction tube.
6. Cap the extraction tube and shake for one minute.
7. Let the extraction tube sit until the soil settles out. The clear solution above the soil will be used for testing.

Phosphorus Test

8. Use the pipette to transfer 25 drops of the clear solution from the extraction tube to a square test tube. Label this test tube P.
9. Fill the square test tube to the shoulder (the 10 mL line) with distilled water.
10. Add one phosphate tablet to the square test tube.
11. Cap the square test tube and mix until the tablet disintegrates. Wait 5 minutes for the color to develop.

Nitrogen Test

12. Use the pipette to transfer the clear solution from the extraction tube to a square test tube. Fill to the 10 mL line. Label this test tube N.
13. Add one nitrate tablet to the square test tube.
14. Cap the square test tube and mix until the tablet disintegrates. Wait 5 minutes for the color to develop.
15. Compare the pink color of the solution to the nitrogen color chart.
    L (low)= 40 lb A/6" soil
    M (medium)= 160 lb A/6" soil
    H (high)= 320 A/6" soil

Potassium Test

16. Use the pipette to transfer the clear solution from the extraction tube to a square test tube. Fill to the 10 mL line. Label this test tube K.
17. Add one potassium tablet to the square test tube.
18. Cap the square test tube and mix until the tablet disintegrates. Wait 5 minutes for the color to develop.
19. Hold the square test tube over the black boxes on the chart on the left and compare to the shaded boxes on the right.
    L (low)= 40 lb A/6" soil
    M (medium)= 80 lb A/6" soil
    H (high)= 160 A/6" soil

Data/Observations:

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

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 LaMotte's N-P-K Soil Kit CODE 3-5880 and
Lawrence Hughes' Phosphate Content in Peace River Basin soils and soil additives
Lesson Plan (FIPR Institute Publication) and
Indira Sukhraj's Soil Analysis Lab