Classroom Teacher Preparation

Earth Science 13: Soil Nutrient Cycles and Soil Chemistry

Please use the following to prepare for the next SfS lesson.

Description:

Plants get much of what they need from sunlight, air, and water, but they also need nutrients that come from the soil. In this lesson, students perform tests of the concentrations of the soil nutrients nitrogen, phosphorus, and potassium (NPK), and, time allowing, a test of soil pH. The activity is a multistep process that allows students to practice measuring, following directions, and evaluating their results by comparing to a standard. Both tests use commercially-available kits, and students may bring in their own soil samples to test.

Lesson Objectives – SWBAT ("Students Will Be Able To…"):

6^{th}-8^{th} (only recommended for 6^{th} grade classes with an hour or more class time)

- Understand that plants need mineral nutrients from the soil as well as air, water, and sunlight
- Understand that these mineral nutrients each have a cycle in which they are removed from and returned to the soil
- Understand that the amounts of mineral nutrients available to plants are affected by the pH of the soil
- Recognize that human activity can affect the cycling of these nutrients through ecosystems

Disciplinary Core Idea (DCI):

ESS3 Earth and Human Activity – ESS3.A Natural Resources

- (6^{th}-8^{th}) Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.

Science & Engineering Practice (SEP):

Planning and Carrying Out Investigations

Preparation:

This activity may be performed on soil samples brought in by the students. However, the kit provides materials for a maximum of **8 groups** per class, so only 8 samples can be tested. If students are bringing in samples from home, please account for this limitation ahead of time. Only a few tablespoons of soil are needed. For best results, the soil should be dry; students could bring in their samples a day ahead of the visit and leave them to dry on a paper towel overnight in the classroom.

Student understanding of the activity will be enhanced if they are familiar with the concept and names of some elements, and with the concept of pH, at least at the level of "acidic", "neutral", "alkaline" (though these terms will be defined).

Room Set Up for Activities:

Students will work in groups of 3-4 (8 set ups are available). Each group will need a workspace (table or cluster of desks) that can handle the occasional spill, since the activity involves water.

The tests are not difficult to perform, but they do have several steps that need to be performed in the correct order. Talk with your instructor about how best to structure the working groups, so that the jobs can be distributed in such a way that students can finish the activity in the available time.

Safety:

Other than the standard admonition not to consume any part of the materials, there are no safety issues with this lesson.

Related Modules:

This lesson could be paired with:

Earth Science 14: Soil Properties – Students examine the physical properties of soil – color, texture, and field capacity (ability to hold water), as opposed to the chemical properties examined in this module.

This lesson could also be taught to accompany other **Chemistry** lessons, particular about acids and bases:

Chemistry 5: Introduction to Acids and Bases – This lesson introduces students to the Arrhenius theory of acids and bases (H+ acids and OH- bases), focusing on the meaning of pH. Students use color indicators and pH strips to test the pH of various common household liquids. This lesson is aimed at 4^{th}-6^{th} grade students.

Chemistry 6: Acid-Base Titration – This lesson introduces students to the Brønsted-Lowry theory of acids and bases (hydrogen ion donors/acceptors) and students perform a simple titration to neutralize a base. This lesson is aimed at 7^{th}-8^{th} grade students.

For other module sequences and groups, look here: www.sciencefromscientists.org/sequences

Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state: http://www.sciencefromscientists.org/standards/

Lessons are matched to both national NGSS and local state standards.

After Our Visit:

Extend this lesson by testing the pH of local soils using only household chemicals (vinegar and baking soda).

Access this Extension activity by visiting the Classroom Post found on our website at sciencefromscientists.org/cohorts. Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at sciencefromscientists.org/open-response-questions. They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

Additional Resources:

- The Great Plant Escape has much more extensive introduction to plants and soil, that includes a discussion of soil nutrients, in an interactive quiz format. “Case 2” is the most relevant to this lesson: http://extension.illinois.edu/gpe/case2/index.html
- This video features students introducing information on soil nutrients as they work on their school garden (2:26) http://mass.pbslearningmedia.org/resource/thnkgard.sci.ess.soilcomp/think-garden-soil-composition/
- How farmers put their knowledge of what plants need to practical use, taking care of the soil so that it is able to nourish the plants (3:06): http://mass.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.organic/organic-farming-conserving-topsoil/