Soil and Water Experiment Lesson Plan

Beckman Center Collection Area: pH Meter
Grade: Middle School (recommended 8th grade)
Subject Area: Science, English Language Arts
Duration: 1.5 hours in class for first day; 30 minutes on second and third days (can be decreased by shortening experiment time)

Objectives:

1. Students will be able to define pH scale and share common acidic and basic substances with their pH number
2. Students will be able to conduct an experiment to measure, record, and analyze the pH levels of soils using a variety of methods
3. Students will be able to explain how different soil types affect water runoff pH level

Standards:

Next Generation Science Standards:

MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-ESS2.C Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred

Common Core State English Language Arts Standards:

CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)

Materials:

1. Three samples of soil from separate areas
2. Small shovel or trowel for gathering soil samples
3. Ruler, metric
4. Gallon ziploc bags (3)
5. Large Tupperware (9)
    a. Small deli containers, like the kind sour cream or cottage cheese come in, also work.
6. Permanent marker

7. Small containers or cups, at least 3-oz. (3). They need not be identical.
8. Tap water
9. pH paper, with resolution of at least ±0.3 pH units and a range from 3 to 8 *or* a pH meter for liquids
    a. You may need more than one set of pH paper to cover this range of pH values at ±0.3 pH unit resolution. See Table 2 in the Acids, Bases, & the pH Scale for more help.
10. Soil pH meter, with a pH range of at least 3.5 to 9 and a resolution of ±0.1 pH units
11. Facial tissues *or* cotton balls (10)
12. Clock, timer, or stopwatch
13. Duct tape
14. Coffee filters (18)
15. Lab notebook

Classroom Activities:

1. Warm-up Discussion: What value of pH is neutral? What ranges are acidic and basic? Can you think of examples of ways in which the geosphere, biosphere, and hydrosphere interact with each other? What is **runoff water** and why might it matter what the pH of that water is? How do scientists identify different soil types?
2. Pass out the Acids and Bases Experiment Student Handout and read as a whole class or in pairs. Have students try to define in their own words the following terms:
    - pH
    - Neutral pH
    - Acidic
    - Alkaline or basic
    - Geosphere
    - Biosphere
    - Hydrosphere
    - Runoff water
    - Soil types
    - Soil texture

3. Run through the experiment to demonstrate how to use the pH meter on the soils and pH paper on the water runoff.

4. In groups, have students follow the instructions and complete the lab recording their results in the table and answering the questions.

5. As a whole class, discuss results and share as a class:

    - *What surprised you today?*
    - *What is something new you learned?*

Extension Ideas:

- Students list what types of soil would be best for growing plants and vegetables, whether or not they think more acidic or basic soil is best.
- Introduce fertilizer into the soils to see if the pH levels change.

Additional Beckman Center Resources:

- Arnold & Mabel Beckman Foundation Acidimeter/pH Meter Reading https://www.beckman-foundation.org/about-foundation/inventions/ph-meter/
- Beckman Foundation pH Meter Video https://youtu.be/7cHa2wHrhQk

Sources:

How Does Soil Affect the pH of Water?
https://www.sciencebuddies.org/science-fair-projects/project-ideas/EnvSci_p013/environmental-science/how-does-soil-affect-the-ph-of-water#summary