**Soil pH**

**Topics:** Soil Composition, Biogeochemical Cycles

**Length:** 60-70 Minutes

**Grade Level:** 9-12

**Summary:** Students explore what determines soil pH and why soil pH is important to plant growth in their school garden. After an introduction to acid-base relationships, students collect soil samples from the garden and measure the pH. Students also examine the effect of different pH on plant growth using plant cuttings from the garden and various acidic or base solutions in the classroom.

**Research Question:** How does pH vary among soil types?

 How does pH affect plant growth?

**Pre-Lab**

In order to complete this lab you will need to understand the definitions of the following vocabulary. Make sure to ***record the definitions*** and feel free to add any helpful drawings.

 **pH Scale:**

 **Acid:**

 **Base:**

 **Alkaline:**

 **Neutral:**

Please ***list and explain the ways that soil pH can affect plant growth***:

Use the number line below to ***create a pH scale***. Label which sections of the pH scale are ***acidic****,* ***basic****,* and ***neutral.*** Your teacher will help you identify the pH of several common objects that you will write on the pH scale.

**Materials List:**

* Soil Core or Shovel
* Container For Soil Samples
* Deionized Water
* pH monitor or Litmus Test Strips
* Acid, Base, Neutral Solutions
* Plant Cuttings From Garden (Green Onion Suggested)

**Procedure:**

1. Collect 100 ml soil samples from inside the garden and an area just outside the garden using a soil core or hand shovel.
2. Record observations about the soil samples.
3. Mix 50 ml of distilled water into each soil sample and stir. Make sure the water is completely mixed into the soil.
4. Place a Litmus Strip into the soil and water mixture. Following the directions on the Litmus Paper, use the color of the litmus paper to measure the soil pH.
5. Take a small cutting from a plant in the garden. If you grow Spring of Green Onions in your garden, we suggest taking 3 onions as your samples.
6. Return to the classroom, and pour 300 ml of distilled water into 3 beakers. Mix 100 ml of white vinegar into one beaker. Place 100 mg\* of baking soda into the second beaker, stir until dissolved. Do not add anything to the third beaker this is our control. (aim for 2, 2.5, 3, 3.5)
7. Use Litmus Paper to test the pH of each of the Beakers. Record your data.
8. Place a plant cutting or Green Onion into each of the beakers, making sure that the plant is partially underwater. If possible, place the beakers near a sunny window.
9. After 3-5 days, remove the plant cutting or Green Onion. Using a dissecting scope or magnifying glass, make observations about the root growth. Use a ruler to measure 3 roots or areas of new growth that you pick at random.

**Data Collection**

**Prediction**: What do you think the pH of the garden soil will be? How will the pH of the garden soil compare to soil not from the garden?

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**Observations**:

Record two *qualitative* observations about your soil sample from the garden.

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Record two *qualitative* observations about your soil sample from outside the garden.

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**Record Your Data:**

pH of the Garden Soil: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pH of Non-Garden Soil: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Hypothesis**: How will placing plant cuttings in distilled water with vinegar or (other vinegar samples) affect root growth?

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**Record Your Data:**

Label each beaker with either: **Distilled Water (pH 7)**, **Vinegar (pH 6)**, and **Vinegar (pH 4)**.

Include a drawing of how each of your beakers look with the plant cutting.

 Beaker 1 Beaker 2 Beaker 3 Beaker 4 

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pH of Beaker 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Root Growth of Beaker 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

pH pf Beaker 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Root Growth of Beaker 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

pH of Beaker 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Root Growth of Beaker 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

pH of Beaker 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Root Growth of Beaker 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Observations:** After 3-5 days, make ***1 quantitative*** and ***1 qualitative*** observation about each.

Beaker 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Beaker 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Beaker 3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Beaker 4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Post-Lab**

1. What does pH measure? What does it mean if a soil is acidic?

2. Why is it important to know the pH of soil when planting a garden? What was the pH of the soil samples taken from our garden?

3. Create a bar graph comparing the root growth of the plant samples in distilled water and water with vinegar or baking soda. (water type on the x-axis, root length in mm on the y-axis)

4. Evaluate your hypothesis about placing plant clippings in different pH solutions. Were you right? Give one piece of evidence that either proved you were right or wrong.

5. Using the table below of optimal soil pH for common garden plants, decide if each plant could grow in the CHS school garden.

What was the average soil pH for the CHS School Garden? **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |
| --- | --- | --- |
| **Garden Plant** | **Optimal Soil pH** | **Should We Plant It In The CHS Garden? (Yes or No)** |
| **Strawberry** | **6.0-6.5** |  |
| **Cucumbers** | **5.5-7.0** |  |
| **Potatoes** | **4.8 - 6.5** |  |
| **Beets** | **6.5 - 8.0**  |  |
| **Tomatoes** | **5.5 -7.5**  |  |
| **Lettuce**  | **6.0 - 7.0**  |  |