






## How Does Soil pH Affect Plant Growth?

### Overview:




Students will learn how to identify whether a solution or soil is primarily acidic, basic, or neutral. They will hypothesize what will happen to a plant in different soil pH conditions. Finally, students will test the pH of the damp soil in the garden and predict how plants will grow in a soil of that pH.

### Objectives:

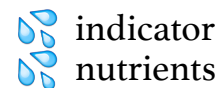
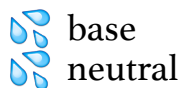
At the end of the lesson students will be able to:

-  **Describe** the physical and chemical characteristics of acidic, basic, and neutral solutions.
-  **Measure** pH in damp soil samples.
-  **Explain** how soil pH affects plant growth.

### Preparation:

-  Prior to the lesson, bring in a lemon (acidic), household soap (basic), and a glass of water (neutral).
-  Create three damp soil samples (acidic, basic, and neutral) from the garden using the liquids listed above.
-  Purchase pH indicator strips (litmus paper).

### Vocabulary:







### Learning Activities:



#### I. Warm-Up (5 min.)

- A. Introduce students to the concept of pH: a measure of how acidic or basic a solution or other item is, measured on a scale from one to 14. A pH between zero and six means that it is acidic, between eight and 14 it is basic. A pH of seven is neutral.


### Materials:

-  Handout: “How Does pH Affect Plant Growth?”
-  Examples of acidic, basic, and neutral everyday items (e.g. lemon, soap, water)
-  Soil samples from the garden with different pHs (see the Preparation section below)
-  pH indicator strips (three per group of students)

### On the Board:

-  Vocabulary
-  Student Reflection Questions

### Suggested Snack:

-  Lemonade (made with low sugar)

- B. Show examples of items that are primarily each of these (e.g., lemon, soap, water).
  - C. Remind students that acids and bases can be equally strong and dangerous. For example, an acid of one is just as dangerous as a base of 13. (A common misperception is that only acids are strong and dangerous.)
2. Presentation (15 min.)
- A. Divide students into groups of three-four.
  - B. Ask students to describe, in writing, the physical differences between lemon, soap, and water (i.e., appearance, smell, color). Complete the table in the handout.
  - C. Explain how we can identify the pH of a solution using an indicator. Explain that the pH litmus test strips are indicators because they tell us whether an item is acidic, basic, or neutral.
    - Explain that if red litmus paper turns blue when it touches an item, it is basic.
    - Explain that if blue litmus paper turns red, then it is acidic.
3. Classroom Activity: Testing pH(15 min.)
- A. Explain that the ideal acidity level for soil is between six and seven. When pH is above seven (basic), it is harder for plants to absorb nutrients that they need. When pH level is below six, the acidity can become toxic to plants.
    1. Provide each group with a soil sample and three pH litmus test strips.
    2. Have students record their observations in the handout.
  - B. Review their findings. Ask students:
    1. What happens to red litmus paper when it touches a basic solution or other item?
    2. How do you think the pH of the soil affects plant growth?
4. Snack: Serve lemonade made with low sugar. (5 min.)
5. Have students answer the Reflection Questions in their garden journals. (5 min.)

### Student Reflection Questions:

1. What do you think would happen to plant growth if we increased or decreased the pH of the soil?
  - If pH is above six or seven, it would be too basic. If it is below six, it would be too acidic.
2. What are some ways that the pH of the soil can change?
  - pesticides, fertilizers, acid rain

### Assessment Questions:

1. Is a solution with a pH = 10 considered acidic, basic, or neutral?
  - **basic**
2. Suppose you have a glass of water (pH = seven). What everyday household items could you add to the water to lower its pH level (i.e., make it more acidic)?
  - **add vinegar or lemon**

### Standards:

#### Next Generation Science Standards

#### NGSS-DCI-Disciplinary Core Idea

- MS-PS1.A. Structure and Properties of Matter

Each pure substance has characteristic physical and chemical properties that can be used to identify it.



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## Physical Characteristics

1. Complete the table below describing the physical characteristics of each item.

	Color	Consistency	Smell	Other features?
Lemon				
Soap				
Water				

	pH
Lemon	
Soap	
Water	

2. Guess whether each item is acidic, basic, or neutral.

## Litmus Paper Test

3. Complete the table below using the litmus paper test strips.

	What color does the litmus paper change to?	Base	Neutral	Acid
<i>Example: Soil #0</i>	<i>Blue</i>	X		
Soil #1				
Soil #2				
Soil #3				

4. Were your previous guesses correct? Are there certain physical characteristics (smell, color, consistency) of items that would reveal whether they are acidic, basic, or neutral?