

Homemade Acid-Base Indicator

GLOBE		Associated SDG	Type of Activity
Spheres	Associated Protocols		
Hydrosphere	pH.	6. Clean Water and Sanitation	Exploratory
Pedosphere	PH.		

Overview

pH measurements directly indicate the habitability of a body of water for aquatic life. It is interesting to follow the parameters of the water cycle and the pH annually and then compare different bodies of water.

Time

Two classes

Prerequisites

Basic knowledge of ecosystems, food webs, populations, meteorology, marine currents, water quality, and ICT. Ability to interpret satellite images and maps. Ability to locate points using latitude and longitude.

School level

last years of primary, secondary.

Purpose

Develop students' skills through chemistry lessons involving the topic of pH.

Student outcomes

- ✓ Identify the methodology for obtaining acid-base indicators from purple cabbage and red rose petals.
- ✓ Classify different substances or products of everyday life as acidic, basic, or neutral, employing an acid-base indicator.

Background

Various techniques and instruments are used to indicate the pH value of a solution, some more precise than others, but which allow characterizing an acidic, basic, or neutral substance. Among the procedures and instruments used are universal indicator paper, pH meters, colorimeters, and those that are homemade as homemade pH indicators.

pH is a chemical property that measures the degree of acidity or alkalinity of aqueous solutions. By definition, pH is the negative logarithm of proton activity (H^+) in an aqueous solution.

The pH uses a measurement scale whose fluctuation ranges from 0 to 14. It is based on the principle that the equilibrium constant of water dissociation is 10^{-14} .

Acids and bases are important in the pharmaceutical, food, and biotechnology industries, among others. A specific pH conditions many processes, and some variation would cause its alteration. All substances have a specific pH value, and their usefulness is derived according to this.

In soils, pH is a significant chemical property because it indicates how acidic or alkaline the soil solution is, where the roots and soil microorganisms take their nutrients.

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Many natural and synthetic substances have a coloration that depends on the pH of the solutions in which they dissolve. Some of these compounds, which have been used for centuries to determine the acidity or alkalinity of water, are still used as acid-base indicators.

The acid-base indicators are weakly acidic or basic organic substances which present different colors when they are in their protonated or deprotonated form; this means that they change their color depending on the pH.

Guiding Research Questions

How do pH indicators or meters work?

What is the correct way to measure pH?

What does the coloring on the meter indicate?

Scientific concepts

- Ecosystems
- Changes in the populations of some species
- Interrelationships of matter and energy in ecosystems
- Ocean currents
- Environmental risks and vulnerability

Materials and tools

- 1) 200 grams of cabbage.
- 2) 200 grams of red roses. (5 or 6 roses)
- 3) 2 beakers of 500 ml.
- 4) 2 mortar and pistil.
- 5) 5 glass glasses.
- 6) 2 pipettes of 10 mL.
- 7) 1 filtration funnel.
- 8) 1 filter paper.
- 9) 1 thermometer.
- 10) 2 flasks.
- 11) 2 jars or dark bottles.

What to do and how to do it**1. Beginning**

Each group of students, of about four members, will be organized to perform this practice. The teacher can manage the number of members of the groups depending on the number of students per course and the conditions available in the classroom or laboratory of the institution.

2. Development

1. With the help of the scale, weigh the amount of purple cabbage indicated above.
2. Cut the cabbage leaves into small pieces and add them to the mortar.
3. Wet the cabbage leaves by adding 20 ml of water; with the help of the pistil macerate.
4. Place 200 ml of water in the beaker and heat to a boiling point.
5. When the water reaches the boiling point, add the contents of the mortar and boil for 15 minutes.
6. Subsequently, the beaker's contents are lowered from the flame and left to stand until the contents reach room temperature.
7. Filter the contents to separate the solid substances from the extract obtained.
8. Store in a glass or dark plastic container in a refrigerator for use in the next session.

For the preparation of the acid-base indicator of red rose petals should be repeated the process used with purple cabbage

1. Ending

Each group shall take the test tubes with the help of the masking tape list or the test tubes from one to twelve according to the order of the substances used. Next is the order of the substances:

1. Vinegar
2. Aspirin
3. Baking soda
4. Liquid soap
5. Toothpaste
6. Hydrogen Peroxide
7. Sodium Hypochlorite – (Clorox)

- Each group takes 3 ml of each substance and adds them to the above tubes.
- Add 3 ml of water to each of the marked tubes.
- Add 3 ml of the acid-base indicator from purple cabbage in each tube.
- Discuss the following scenarios and answer the following questions:
- What colors do the different substances present?
- When water is added to each tube, do the substances undergo any changes?
- What does the color of homemade acid-base indicators depend on?
- When is the acid-base indicator added in each of the tubes that will be colored?
- Does the type of coloration depend on the substance in which the indicator is located?

Suggested Resources

To learn more about this phenomenon, the following resources are suggested:

The pH Game https://www.globe.gov/documents/10157/381040/hydro_chap_es.pdf

pH https://www.globe.gov/documents/10157/381040/hydro_chap_es.pdf protocol

Bibliography

Rincon C, Harol. Didactic proposal for learning the concept of pH in elementary school students, National University of Colombia, 2020.