What is pH?

Introduction

This aim of the experiment is to familiarize students with basic knowledge on pH.

Preparation time:
30 minutes two to three days before the experiment
5 minutes just before the experiment

Activity time: 45 minutes

Application:
Link between the idea of acidity and pH
Introduction of pH indicators thanks to red cabbage juice
Making a pH scale with this pH indicator

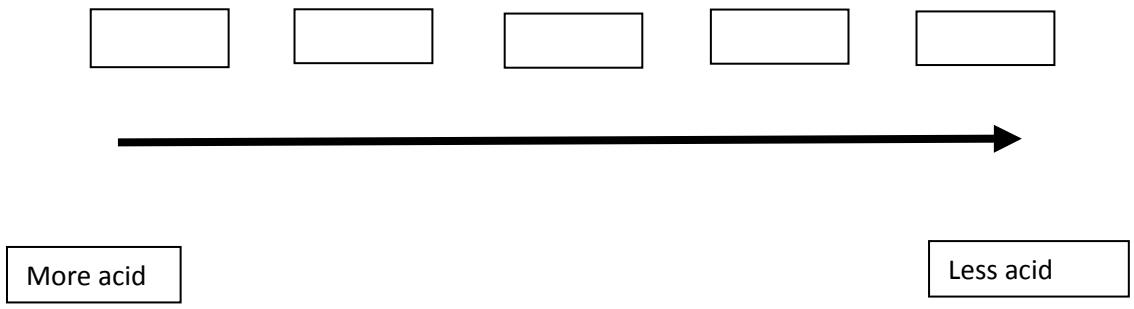
Time for data analysis and discussion: 30 minutes

Previous knowledge required: None

Preliminary questions

1) Place these daily life products on the following acidity scale.

Lemon – Apple juice – Distilled water – Sparkling water - Bleach



The pH is actually an "indicator of acidity". It is a number between 0 and 14 which quantifies the degree of acidity of a solution: a product is said to be acid if its pH is low (under 7) whereas a product is said to be basic if its pH is high (over 7). A pH equal to 7 corresponds to a neutral solution (fresh water for example).

2) From the acidity scale that you made, link each product to its pH

Product	pH
	3
	4
	5.9
	6.7
	12

How to determine the pH of a solution?

We will study different methods to measure the pH of a solution. First we will study a pH colour indicator. A colour indicator is a chemical element whose colour changes according to the environmental acidity. We will study cabbage juice which is a natural pH colour indicator. It is one of the red cabbage's natural constituents – cyadinin – which is responsible for this change in colour. Then we will use indicator paper. This is a paper soaked with chemical pH colour indicator. This is why it changes colour as well when dipped into solutions of different pH. The teacher can also use a pH meter so that his students can look at another measurement method.

Experiment

The aim is to approximately determine how the colour of red cabbage juice changes according to its pH.

Material

5 boiling tubes
Pipettes
Red cabbage juice (cf. preparation procedure)
Lemon juice
Shampoo
Distilled water
Baking powder
Bleach
Indicator paper

Procedure

Put each product in a boiling tube
Rank them from the most acid solution to the least acid solution
Add a few drops of red cabbage juice in each tube
Observe
Measure each solution's pH with indicator paper: Take a piece of indicator paper and put one drop of solution on it. Then compare the paper's colour with its colour scale.
Identify the pH of each solution

Results

What can be observed?
Link each colour with an approximate range of pH thanks to the measures realized with indicator paper.

What is the pH of sea water?

Repeat the previous experiment with sea water: add a few drops of red cabbage's juice in a sample of sea water. What do you observe?

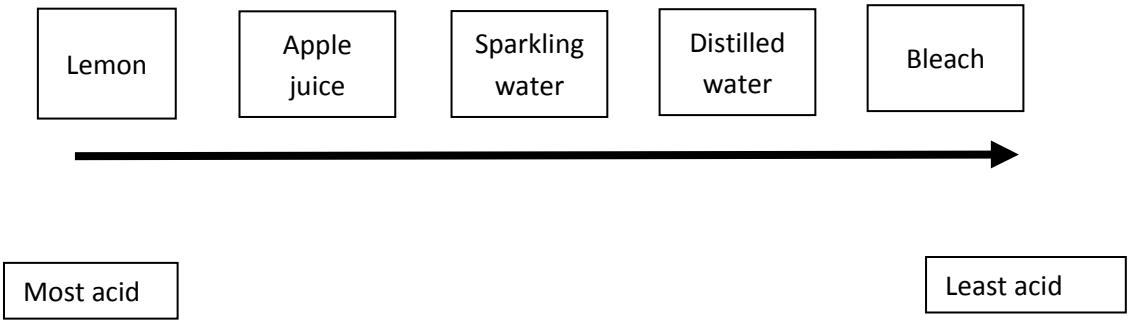
Here is the scale indicating the red cabbage transition pH ranges:

Red cabbage juice placed in boiling tubes filled with solutions with different pH:
(from left to right) 1 3 5 6 7 8 9 11 13 14
What is the pH of sea water? Check your answer with the indicator paper.

ANSWERS

Preliminary questions

1)



2)

Product	pH
Lemon	3
Apple juice	4
Distilled water	6.5
Sparkling water	5.5
Bleach	12

How to determine the pH of a solution?

A scale of colour is observed: each colour corresponds to a specific value of pH, red cabbage juice is indeed a pH colour indicator.

What is the pH of sea water?

Sea water mixed with red cabbage juice is turquoise. According to our previous observations, it corresponds to a pH around 8. It is confirmed by indicator paper. Thus sea water is not neutral but slightly basic!

How to prepare red cabbage juice?

Material

A saucepan
One red cabbage
Hotplates
A sieve

Procedure

Cut the red cabbage into pieces and put it in the saucepan, cover the pieces with water and bring it to a boil.
Filter, the juice should be blue

How to prepare sea water?

Material

Distilled water
Coral Reef salt
A beaker

Procedure

Mix water with the salt. Stir so that every piece of solid is dissolved.

This experiment has been designed by Marie Laurent, Pauline Malliart, Angeline Pelegrin, Clara Rodenbach and Hélène Tarissi, engineering students at Ecole Centrale de Lyon, for the EPOCA & CarboSchools projects.

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