ScienceCube

Measuring the pH of Various Solutions

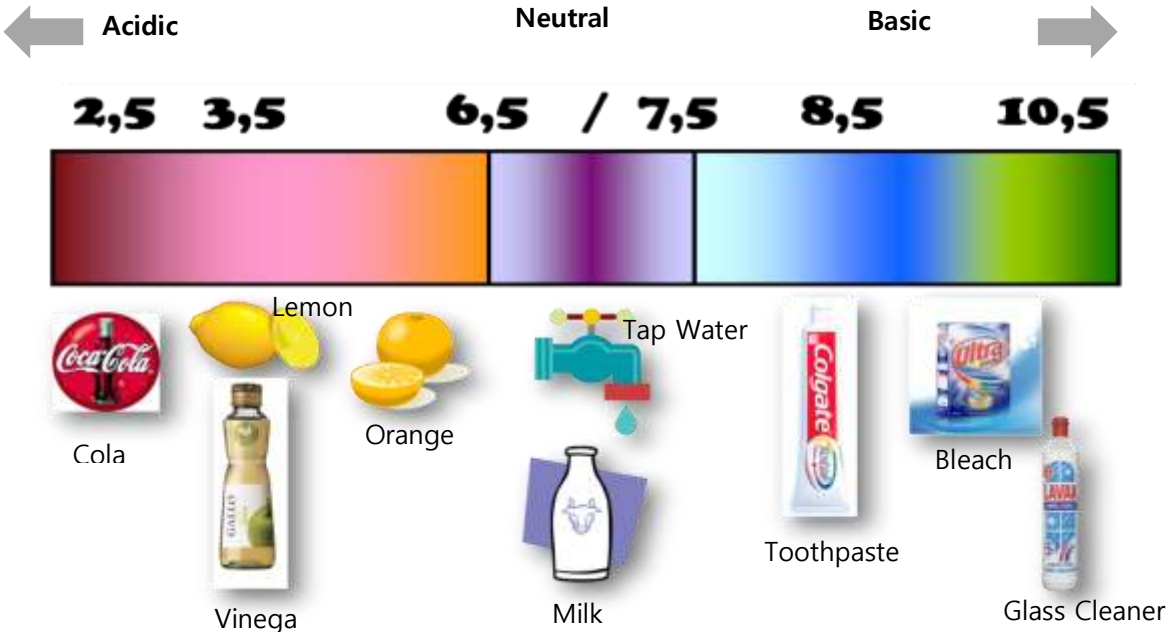
Measure the pH of liquids around us and classify the solutions according to their characteristics.

Fundamental Concept

1. Acids and Bases

Category	Acidic	Basic
Taste	Sour	Bitter
Litmus Paper	Blue → Red	Red → Blue
BTB Solution	Yellow	Blue
Phenolphthalein Solution	Colorless	Red
Feel	Sticky	Slippery
Characteristics	Reacts with metals to produce hydrogen gas	Dissolves proteins
Examples	Vinegar, soda, dilute hydrochloric acid, sports drinks, lemon juice	Glass cleaner, dilute sodium hydroxide solution, soapy water, bleach, toothpaste

2. pH Strips



3. Changes in Solution Properties When Mixing Acids and Bases

① Substances with acidic properties and substances with basic properties pair up.

② If substances with acidic properties are left unpaired, the solution remains acidic; if basic substances are left unpaired, the solution remains basic.

③ When acidic and basic solutions are mixed, the acidity and basicity are weakened compared to before.

4. Examples of Using Acidic and Basic Properties in Daily Life

① Uses of Acidic Properties

Adding lemon juice to fish dishes	To eliminate the basic substance that causes fishy odor, acidic lemon juice is added.
Adding acidic substances to toilet water	To remove basic stains in the toilet, acidic substances are mixed with the toilet water.

② Uses of Basic Properties

Adding basic substances to acidic soil	To weaken the acidity of acidic soil, basic substances are added.
Adding basic substances during acid rain	To prevent soil contamination from acid rain, weak basic substances are added when it rains.

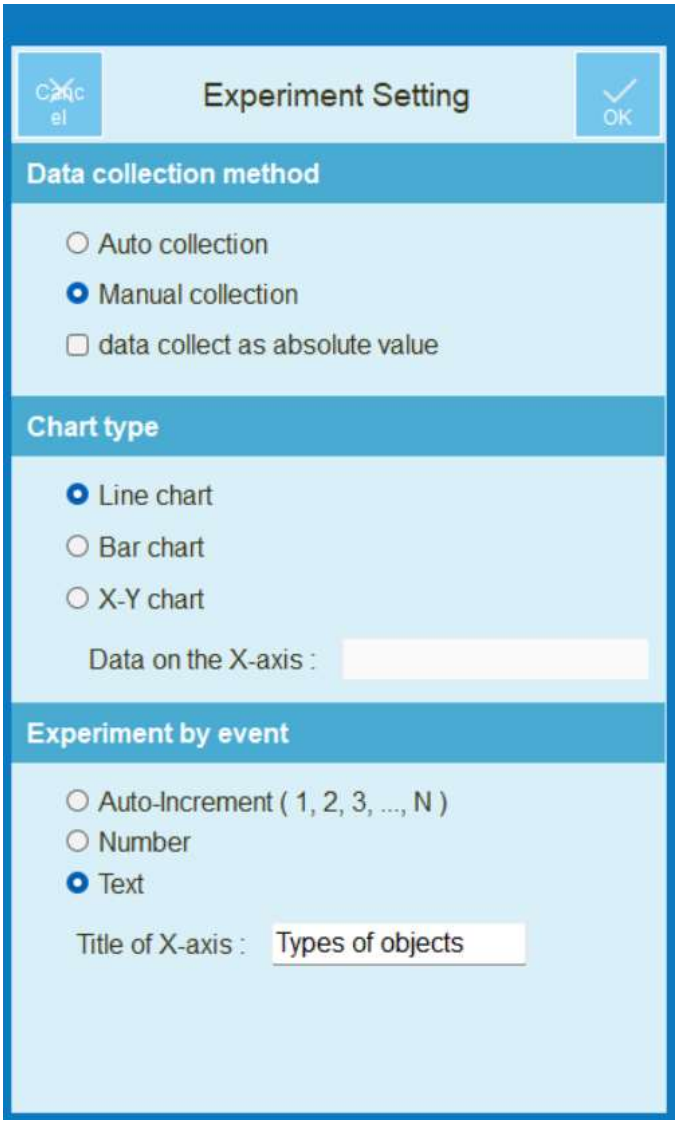
Experiment

Materials Needed

Interface, Science# Program, pH sensor, various types of liquids, two 250 mL beakers, paper towels, dropper, six test tubes, test tube rack, wash bottle, calibration solutions (pH 4.0, pH 7.0)

Interface Setup

1. Run the Science# program.
2. Connect the pH sensor to the interface.
3. Click to set up the experimental environment as shown below, or click to automatically set up.



automatically set up

[2-point Calibration]

1. Remove the pH electrode from the 3.3M KCl solution, rinse it with distilled water, and gently blot dry with filter paper.
2. Immerse the cleaned electrode in the pH 4.0 standard solution, open the calibration window in the Science# analysis program by clicking, and click the button Set to set once the data value stabilizes.
3. Rinse the electrode again with distilled water, immerse it in the pH 7.0 standard solution, and click the button Set to set once the data value stabilizes. Click Write to complete the process.

< pH Standard Buffer Solutions (4.0 and 7.0)>

<Rinsing the pH Electrode with Distilled Water >

<Removing Moisture from the pH Electrode>

[Experiment]

- Measuring the pH of Various Solutions

1. Add 5 mL of various pre-prepared liquids to each test tube..

2. Click to start data collection, insert the sensor into the test tube with the liquid, and gently shake the test tube.

3. Once the pH value stabilizes, click  to save the data and enter the name of the liquid.

4. Measure the pH of all prepared liquids using the same method.

< Preparing Various Types of Liquids>

< Measuring the pH of Solutions with a pH Sensor>

Data Analysis

Recording Data

1. Write down the names of various liquids in the table below and record the measured pH values..

Type of Liquid						
pH						

2. Measure the pH of various liquids and display the data in a bar graph.

3. Identify and write down the solution with the highest and lowest pH.

   Solution with the Highest pH ( )

   Solution with the Lowest pH ( )

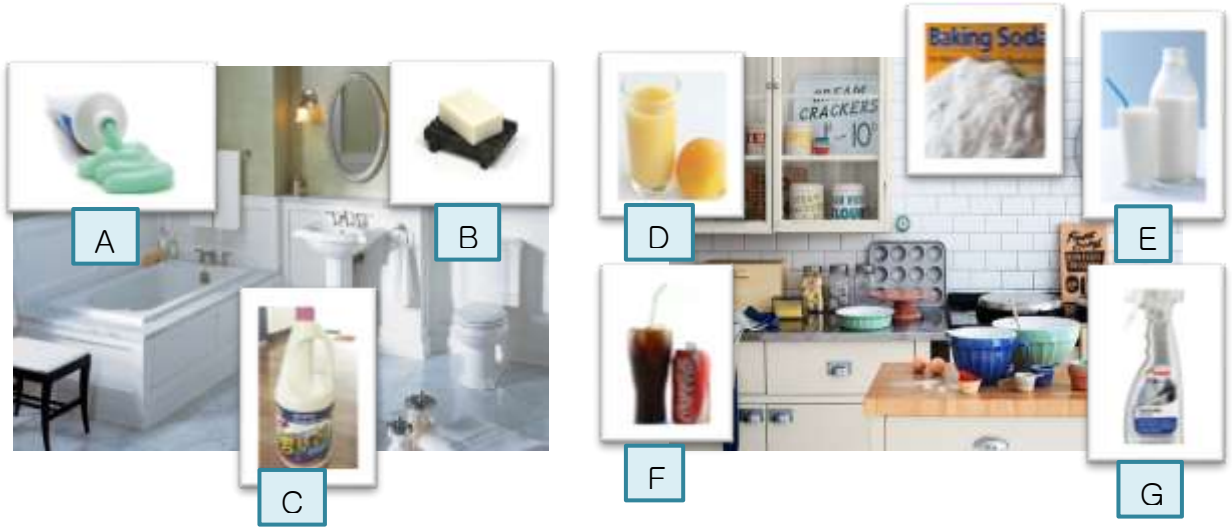
4. Measure the pH of various liquids and display the data in a bar graph.

←	Acidic				Basic	→
pH 1	pH3	pH5	pH7	pH 9	pH11	pH13

Data Application and Extended Activities

1. Besides using a pH sensor, think of and write down other methods to measure the pH of liquids.

2. The following shows the bathroom and living room in our daily environment. Predict the characteristics of the following substances in each environment and indicate whether they are acidic or basic.



A	B	C	D	E	F	G
Toothpaste	Soap	Toilet cleaner	Orange juice	Milk	Cola	Glass cleaner

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3. Mixing cold water with hot water makes lukewarm water. Predict how the properties of a solution will change when you mix an acidic solution with a base of different properties.