

Activity N

Acids and pH

Introduction

This activity aims to show pupils that acids differ in their reactivity and that this difference is due to pH levels. The activity requires pupils to think about the evidence they would need in order to decide whether given statements about acids are true or false. A subsequent practical activity provides them with some evidence, but will it be sufficient to make decisions about all of the ideas presented?

Objectives

Pupils will learn:

- that the pH value of an acid is related to its reactivity;
- to plan for a safe investigation;
- to use evidence to formulate a conclusion/theory and justify it.

Outcomes

By the end of the lesson, pupils will be able to:

- suggest a link between pH, acid strength and reactivity;
- state how they made their investigation safe;
- draw a conclusion (that stronger acids, with a lower pH, are more vigorous in their reactions than weaker acids) and identify evidence to support their conclusions.

Notes for Teachers

Pupils will need to know about pH and how it can be measured using an indicator. For pupils who do not have a good understanding of pH, an alternative starter is to have a series of statements that are the more common 'feelings' about acids by the public.

Ensure that pupils understand the difference between acid strength and concentration. Strength is a technical term for the degree of ionisation, so you can have a dilute solution of a strong acid (hydrochloric, for example) or a concentrated solution of a weak acid (e.g. acetic). Both could have a pH of 2, with the HCl being 0.01M and the acetic being 1M.

Diluted HCl (0.01M) could be included to introduce the idea that some acids are ‘strong’ and therefore dangerous in high concentration, whereas others are weak, so less dangerous even in high concentration.

Teaching Sequence

- Set the scene. Tell the pupils that they are looking for patterns in the behaviour of acids.
- The starter activity is a card sort. Pupils discuss in small groups what evidence would be needed to support or refute the statements.
- The main activity is an experiment linking the pH of an acid with the reactivity of the solution with magnesium ribbon and sodium carbonate crystals. Pupils perform 3 tests:
 1. Test the pH of the solutions and record results. Could rank them from highest to lowest pH.
 2. Test each solution with magnesium ribbon, observing the reaction. There is a clear, observable difference. Ask pupils to consider how they will make it a fair test. Pupils record qualitative data, and can rank the reactions.
 3. Test each solution with sodium carbonate, observing the reaction. There is a clear, observable difference. Ask pupils to consider how they will make it a fair test. Pupils record qualitative data, and can rank the reactions.

Support work sheets available.

- Pupils then draw a conclusion (acids with a lower pH are more vigorous in their reactions than weaker acids). Encourage pupils to justify their conclusions.
- The plenary is a discussion. What are their ideas about the experiment? Re-consider the statements in the starter activity and decide whether the experiment provided evidence that it is true, evidence that it is false, or no evidence.

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Statements about acids

All acids are harmful.

The lower the pH, the less reactive the acid.

The lower the pH, the stronger the acid.

Acids have a pH between 1 and 6.

The higher the pH, the less reactive the acid.

The higher the pH, the weaker the acid.

Acids are the opposite of alkalis.

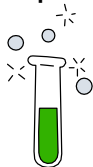
Alkalis have a pH between 8 and 14.

Substances of pH 7 are neutral.

All acids contain hydrogen.

When acids and alkalis react together, a salt is formed.

When acids and alkalis react together, water is formed.



What does pH mean?

You are going to do an investigation to find out how pH values relate to *reactivity* (how vigorous a reaction is). The apparatus and materials you will need are listed below:

Apparatus	Substances to be tested	Materials for the tests
1 set of test tubes	Hydrochloric Acid (1M)	Indicator Paper and colour chart Magnesium ribbon Sodium carbonate
1 test tube rack	Ethanoic Acid (1M)	
1 Spatula	Citric Acid (1M)	
	Soda Water (1M)	
	Distilled Water	

You will be testing the substances in different ways. First you will find out the pH of each substance using indicator paper. Then you will add magnesium ribbon to each substance and observe the reaction. Lastly, you will add sodium carbonate to each substance and observe the reaction.

Before you begin....

1. How are you going to make them fair tests?

2. How are you going to record your results?

3. What are the potential hazards and what will you do to avoid them?

Does pH have anything to do with reactivity?

Test 1: Indicator paper

Substance	Colour indicator paper goes	pH
Hydrochloric acid		
Citric acid		
Ethanoic acid		
Soda water		
Distilled water		

Test 2: Reaction with sodium carbonate

Substance	Observations	Rank position (1 = most reactive, 5 = least reactive)
Hydrochloric acid		
Citric acid		
Ethanoic acid		
Soda water		
Distilled water		

Test 3: Reaction with magnesium ribbon

Substance	Observations	Rank position (1 = most reactive, 5 = least reactive)
Hydrochloric acid		
Citric acid		
Ethanoic acid		
Soda water		
Distilled water		

