5. A neutral mixture

1 hour

Children investigate the classification of liquids using the pH scale, and try to neutralise a sample of alkaline water.

OBJECTIVES

- To classify liquids as acidic or alkaline and to understand that by mixing these liquids a neutral solution can be made.
- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

RESOURCES

(Per group of 4 children unless otherwise stated)

- Lemon juice, stomach settlers, cola, tap water, distilled water (optional)
- 100 ml vinegar
- 12 teaspoon bicarbonate of soda dissolved in 200 ml water litmus paper, red and blue (1-2 rolls of each)
- Pipette or medicine dropper
- Yoghurt pots or 100 ml measuring jugs
- Teaspoon
- Activity sheet 15 or 16

BACKGROUND INFORMATION

Tap water and rain water are usually slightly acidic, as are most liquids that we drink. Sea water is usually slightly alkaline and river or pond water is often slightly acidic.

Some industrial site treat the water they use to make it alkaline. This is to protect the pipelines and vessels from rusting, etc. (see background information on page 10). Adding zine phosphate to the water, to protect the pipeline,, makes the water slightly alkaline.

When the water is returned to the river, its alkalinity must be returned to neutral. This is done by adding sulphuric acid to the water. The salt products in low concentrations do not present a problem to humans or river life. However, dissolved metals such as zinc (added to protect the pipeline against corrosion), whilst beneficial in small amounts, can have detrimental effects on both humans and river life. The regulatory bodies set strict discharge limits for such substances, which are designed to ensure that environmental quality standards are met.

CARRYING OUT THE ACTIVITY

To introduce the classification of liquids, it would be useful for the children to test the acidity or alkalinity of a variety of everyday liquids. These might include lemon juice, stomach settlers dissolved in water, fizzy drinks, distilled and tap water, etc. Red litmus paper will turn blue when dipped into an alkaline solution and remain red when dipped in an acidic solution. Blue litmus paper will turn red when dipped in an acidic solution and remain blue when dipped in an alkaline solution. The results of these tests are recorded in a table with two columns, one labelled 'acids' and one labelled 'alkalis'.

The children test the vinegar and bicarbonate of soda, using both red and blue litmus paper. The children allow the pieces of litmus paper to dry and stick them onto Activity sheet 15 or 16 (depending on the approach taken.

The teacher then reminds the children, using the relevant points from the letter on sheet Sa, that the water leaving the industrial site is slightly alkaline and must be returned to a neutral pH before being returned to the river. The teacher discusses with the children ways in which they think this might be achieved. If the children do not think of mixing an acid with the alkaline water, the teacher introduces the idea. The activity can be left open-ended for groups of children to devise a test to find out how much acid should be added to an alkaline liquid to neutralise it. They are given resource Activity sheet 15 as a stimulus.

A structured approach is provided on Activity sheet 16. To simulate the process of neutralisation, the children gradually add vinegar to the solution of bicarbonate of soda, to obtain a neutral mixture. The container holding the bicarbonate of soda should be about twice the volume of the solution, as a gas (carbon dioxide, and therefore not harmful) is released when the vinegar is added, which creates a frothy head.

The children initially add 5 full pipettes (not 5 drops) of vinegar to the solution of bicarbonate of soda and stir the mixture, before testing its acidity with both red and blue litmus paper. These pieces of litmus paper are stuck on Activity sheet 16 above the appropriate number of pipettes of vinegar added to the mixture. This procedure is repeated until the red litmus paper does not change colour, and the blue litmus paper is starting to go slightly pink. As the litmus paper begins to change colour and to ensure the mixture does not become too acidic, the teacher can suggest that the children add fewer full pipettes of vinegar each time.

N.B. *The litmus paper must be left for a few seconds before the children make a decision about the neutrality of the solution. A clearer colour can then be observed.*

DISCUSSION QUESTIONS

- Discussion questions
- How can you decide whether a liquid is acidic or alkaline?
- How can you make an alkaline solution neutral?
- Does the liquid look clean enough to be put into a river?
- Do you think vinegar will be used in industry to neutralise alkaline water?