

The duck pond problem

During the night a flytipper has dumped a load of waste in the local duck pond which has made it too acidic to support life. The local Forensic Science Laboratory is too stretched at present to carry out a quick analysis and therefore they have approached our school for help.

- Your task

How can the pond be returned to a habitable condition?

Based on a suggestion by E. Grimble.

Time

70 minutes.

Group size

2–3.

Equipment & materials

Eye protection.

General

Titration apparatus. (Surveying equipment for the pond.)

A sample of muddy water with some acid added, sodium hydroxide solution (0.4 mol dm^{-3}). A suitable indicator.

Safety notes

This is an open-ended problem solving activity, so the guidance given here is necessarily incomplete. Teachers need to be particularly vigilant, and a higher degree of supervision is needed than in activities which have more closed outcomes. Students must be encouraged to take a responsible attitude towards safety, both their own and that of others. In planning an activity students should always include safety as a factor to be considered. Plans should be checked by the teacher before implementing them.

You must always comply with your employer's procedures and in some cases may decide that a particular activity is inappropriate in your situation. Further information on Health and Safety should be obtained from reputable sources such as CLEAPSS [<http://science.cleapss.org.uk>] in England, Wales and Northern Ireland and, in Scotland, SSERC [<https://www.sserc.org.uk>].

Sodium hydroxide solution, $0.4 \text{ mol dm}^{-3} \text{ NaOH (aq)}$, is an irritant.

At 0.4 mol dm^{-3} or below then eye protection will still be needed but can be safety spectacles.

Disposal: Any remaining acid/alkali (if not being kept for further use) should be neutralised with weak acid or alkali (as appropriate) before being washed to waste.

It is the responsibility of the teacher to carry out a suitable risk assessment.

Curriculum links

Acids and alkalis. Neutralisation.

Possible approaches

If you've got a local duck pond the teacher needs to set the scene by asking who walked in past the duck pond this morning? Did anyone notice all the dead fish floating on the surface? If not, you need to talk about the local river (relate to waste dumped in river).

The groups need to determine the equivalent amount of 0.4 mol dm^{-3} sodium hydroxide needed to neutralise the acid. The problem could then be developed to include estimation of the amount of water in the pond and the original concentration of acid dumped in the pond (assuming initial volume dumped is negligible in comparison to large volume of pond!). Finally students need to address the problem of how the pond can be returned to a habitable condition.

Suggested write-up

Students could write a newspaper article about the event ... their own scientific investigation and proposed restoration work ... in the style of a newspaper of their choice.

Extension work

- Consider biological aspects of pond/river/lake pollution What are the visible signs of pollution?
- What has happened to lakes in Scandanavia that have become polluted?
- Consider sources of pollution - *ie* might not be just liquid waste, *eg*
- sulphuric acid plant
- aluminium processing plant
- electroplating company

Students could then carry out other tests to identify the source of the pollution, *eg* sulphate tests. Would it be conclusive - sulphate positive test anyway? Could give background to processes.

Credits

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Health & safety checked May 2018

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