

Warning device

Time

It is suggested that either:

an entire morning be devoted to the problem (eg on the last day of term), which would allow 2 hours for practical activities and 30 minutes for judging

or

the problem be given to the class as a homework exercise 2 weeks or so before the judging. Judging could then take place in a normal double science lesson, allowing 45 minutes for repair and final adjustments, and 30 minutes for judging.

Curriculum links

Production of carbon dioxide gas.

Group size

3– 4.

Materials and equipment

Items from the junk list, for example balloons, surgical gloves – should be chosen to encourage creativity.

Materials per group

- sodium hydrogencarbonate (maximum amount = 3 level teaspoons)
- citric acid (maximum amount = 9 level teaspoons)
- access to water.

Equipment per group

- identical teaspoons (can be plastic)
- safety glasses.

Safety

Citric acid is an eye irritant. Eye protection must be worn.

Risk assessment

A risk assessment must be carried out for this activity.

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/>].

Commentary

Guidance may be needed for younger age groups to say that water is needed for the reaction. The reaction might be used to do the moving, or it could be used to start the movement – eg to trigger the movement of a counterbalance to light a bulb or rattle a tin. During trialling some students inflated a surgical glove while others used the reaction to complete an electric circuit and thus rung a bell. A variety of approaches were seen – some more elegant than others!

Evaluation of solution

These are suggestions only.

1. The final device should be loaded with chemicals, and be ready to start when the judge says so.
2. The judge will provide each group with the levelled teaspoons of chemicals for the test. (Judges may prefer to weigh out the relevant amounts.)
3. The winner is the team whose device gives the best warning.
4. In the event of a tie, the judge should take into account the elegance of the solution, given the requirement that the device shall be constructed mainly from junk materials.

Extension

To increase the chemical content the task could be extended by prior (or subsequent) experimentation, to select the best choice of gases/chemicals.

Credits

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