

What is the smallest amount that you can smell?

Time

1–2 h.

Curriculum links

Concentration, solubility of compounds, vapour pressure.

Group size

2– 4.

Materials and equipment

Materials per group

- nice smelling substances – *eg* Muguet, Honeysuckle, Jasmin perfumes (all mixtures)- or ethoxyethane (diethyl ether) (Extremely flammable, respiratory irritant, harmful if swallowed)
- ethanol (Highly flammable)

Equipment per group

- 10 and 25 cm³ measuring cylinders
- dropping pipettes
- 10 cm³ volumetric flasks
- 1 cm³ pipettes
- watch glasses
- access to a balance
- safety glasses.

Safety

Keep away from sources of ignition. Eye protection must be worn.

Risk assessment

It is the responsibility of the teacher to carry out a suitable risk assessment. Including the hazards from any substances being smelled.

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

There are several different ways of tackling this problem. Each will give a different volume that is the smallest that can be smelt. This volume is also dependent on the individual performing the experiment. In addition, care is needed because continuously smelling the same substance diminishes the sense of smell. If micropipettes are available, they can be used directly to give the smallest volume that can be smelt.

A known amount of the perfume can be dissolved in ethanol, and then diluted until it is just not possible to smell it. Fresh ethanol must be used to ensure an odourless solvent. This is good practice in performing close sequential dilutions. A known volume of the perfume can be placed on a pre-weighed watch glass in the centre of an enclosed room of known volume. When the perfume can be smelt throughout the room (by students already in position in order to minimise air turbulence) then the change in mass of the perfume and the volume of the room can be used to calculate the concentration of perfume vapour.

Extension

Pure fragrances may be used. An example is *cis*-3-hexen-1-ol which smells of cut grass. It is insoluble in water but can be dispersed by using an odourless detergent such as 'Tween 40'.

From data on the vapour pressure of water and the vapour pressure of pure fragrances it is possible to estimate the concentration of fragrance molecules in the air above the aqueous solution.

During trialling it was found that different people have different sensitivities to odours. The differences between people can be a factor of 10 or greater.

Credits

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