Topic 13: Allergic responses within school science

This Topic has been updated to reflect that, as incidences of allergies of all sorts have increased, dealing with them has become a whole-school issue rather than just of concern to the science department.

The incidence of allergies, and its reporting, have become increasingly common. Some research suggests this is because we live in increasingly clean environments and so children do not build up immunity at a young age.

Allergy results initially from exposure to a sensitiser. Respiratory sensitisers cause asthma. Once sensitisation has occurred, individuals will respond to much lower exposures in the future. There is no way of determining the threshold concentration for sensitisation or for subsequent triggering of an allergic reaction in sensitised individuals. Sensitisation usually takes months, or even years, of exposure to the sensitiser. Allergy symptoms may occur immediately after exposure, or may be delayed for several hours. There is some evidence to suggest that individuals with one significant allergic reaction may be more likely to develop allergy to other substances.

A school should have an agreed policy and set of procedures to know about and deal with allergic responses in both children and staff.

13.1 Advice for science departments

Science, departments should ensure that they:

- have a mechanism for receiving, and recording, whole school information about individuals (students, teachers, technicians) who are allergic to particular substances;
- draw to the attention of those who may need to know (including new or temporary staff) information about individuals' allergies;
- identify those practical activities in which there is a known, significant risk (see 13.2 & 13.3);
- have a policy that risk assessments should highlight the possibility of an allergic reaction, where there is a significant, known risk for a particular practical activity;
- monitor that the above policy is being implemented, including the adoption of suitable control measures;
- have a mechanism for reporting back to the school on new or unexpected allergic responses which occur in science;
- report to ASE, CLEAPSS or SSERC any unexpected cases of alleged allergy.

There is an, often mistaken, concern that in science lessons children will be exposed to a greater range of allergens than other lessons. This is because in science, we explore a range of chemicals, chemical reactions, and biological materials. However, exposure to allergens in foods is more likely in food lessons, the school canteen and during break times, and an asthmatic attack is as likely to be a consequence of vigorous exercise in PE as anything in science.

13.2 Allergy to chemicals

Ultimately, all allergic reactions are the result of exposure to chemical substances. However, it is convenient to separate out those found in biological materials (see section 13.3) from chemicals in general (this section).

Under the Globally-harmonised system of classification (CLP in the UK) for chemicals, those which may cause sensitisation will be identified by one of the following hazard statements:

- H317: May cause an allergic skin reaction.
- H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled.

In addition, within the European Union the following additional hazard statements will be used:

- EUH203: Contains chromium(VI). May produce an allergic reaction.
- EUH204: Contains isocyanates. May produce an allergic reaction.
- EUH205: Contains epoxy constituents. May produce an allergic reaction.
- EUH208: Contains <*name of sensitising substance*>. May produce an allergic reaction.

It is important to put these into perspective. Nickel metal carries the hazard statement H317. However, nickel metal is often used in cheap jewellery, which will certainly be in close skin contact over long periods of time. Indeed, 'nickel rash' is quite well known but this does not stop people using it in jewellery, nor indeed, alloyed with other metals, in UK coins.

In a similar way, cobalt chloride carries the hazard statements H317 and H334. Students often handle paper impregnated with cobalt chloride as a test for water. Sometimes, they put a small strip of paper onto their skin to show the formation of sweat. This has been done over many years and there is no evidence that it has ever caused a problem. Quantities are tiny and duration of exposure is very limited. Even so, sensitisation is possible so care should be taken to minimise handling by using small pieces, washing hands after handling, etc. Technicians, handling larger quantities when preparing the papers, might wear protective gloves, especially as they will be exposed repeatedly, year after year.

Gloves should not be seen as the ideal way of dealing with the risk of skin sensitisation. Rubber gloves are commonly used, although pvc and nitrile alternatives are available and satisfactory. Latex (rubber) allergy is not uncommon and in fact is a serious problem in the health service. It is normally associated with the use of surgical gloves, especially powdered gloves. During manufacture of the gloves, corn starch is added in order to make them easier to remove from the mould and easier to put on the hand. The powder absorbs latex protein which may then be dispersed when the gloves are removed. The problem is particularly severe with gloves because of the large area of contact and the added effects of the powder. A technician might well develop an allergy to latex and should be alert for any signs of a reaction. We have heard of cases of latex allergy amongst students. One school reported that it was not difficult to reduce exposure, e.g. by using neoprene Bunsen-burner tubing, cork stoppers in test-tubes, etc.

Some chemicals used in schools which may cause sensitisation are shown in the following table. Note, however, the list is not exhaustive, and some of these chemicals present other hazards, which may be more immediately serious than the risk of allergy. The fact that they are sensitisers is not a reason to avoid their use. It is a reason to ensure they are used carefully. This may include allowing students to handle only dilute solutions, using solutions as dilute as possible, working on as small a scale as practicable, wiping up spills, washing hands, etc. Technicians, whose exposure may be greater, may need to wear protective gloves, dust masks (if the sensitiser is supplied as a fine powder), and/or use fume cupboards, etc.

Examples of chemicals which may cause sensitisation

Chemical	**H317** *(skin reaction)*	**H334** *(asthma or breathing diffs)*
Ammonium dichromate(VI); sodium and potassium dichromate(VI), sodium chromate(VI)	✓	✓
Ammonium persulfate *[(di)ammonium peroxydisulfate(VI)*], sodium persulfate [*disodium peroxydisulfate(VI)*], potassium persulfate [*dipotassium peroxydisulfate(VI*)]	✓	✓
Cobalt, cobalt(II) nitrate(V)-6-water, cobalt(II) chloride-6-water (hydrated cobalt chloride), cobalt(II) sulfate(IV)-7-water (hydrated cobalt sulfate), cobalt(II) carbonate	✓	✓
Nickel(II) carbonate, nickel(II) chloride-6-water, nickel(II) nitrate(V)-6-water, nickel(II) sulfate(VI)-7-water, nickel(II) ammonium sulfate(VI)-6-water	✓	✓
Dyes, indicators and stains (usually the solids but not the solutions used in science)	✓	✓
1,2-diaminoethane [*ethylenediamine*]	✓	✓
Phthalic anhydride [*benzene-1,2-dicarboxylic anhydride*]	✓	✓
Iodoethane [*ethyl iodide*], 1-iodopropane [*n-propyl iodide*], 1-iodobutane [*n-butyl iodide*]	✓	✓
Benzene-1,4-diol [*quinol, hydroquinone, 1.4-dihydroxybenzen (p-dihydroxybenzene*)]	✓	
Benzocaine [*ethyl 4-aminobenzoate, ethyl 4-aminobenzene carboxylate*]	✓	
Benzoyl chloride, [*benzenecarbonyl chloride*], dibenzoyl peroxide [*dibenzenecarbonyl) peroxide, benzoyl peroxide*]	✓	
Copper(II) chromate(VI) [*cupric chromate*, potassium chromate(VI)]	✓	
Nickel metal, nickel(II) oxide	✓	
Hexamine [*methenamine, hexamethylene tetramine*], phenylamine and its salts [*aminobenzene, aniline, benzenamine*], sulfanilic acid [*4-aminobenzenesulfonic acid*]	✓	
Phenylhydrazine, phenylthiocarbamide [*N-phenylthiourea, PTC*]	✓	
Propenamide [*2-propenamide, acrylamide*]	✓	
Maleic acid [*cis-butenedioic acid*]	✓	
Methyl 2-methylpropenoate [*methyl methacrylate*]	✓	
D-(+)-dipentene [*limonene*]	✓	
Hydroxylammonium chloride [*hydroxylamine hydrochloride, hydroxyammonium chloride*], hydroxylammonium sulfate(VI) [*hydroxylamine sulfate, hydroxyammonium sulfate*]	✓	
Hydrazine hydrate and its salts	✓	
Mercury(II) sulfide [*mercuric sulfide, cinnabar*]	✓	
Methanal [*formaldehyde, formalin*]	✓	
Phenyl benzoate [*phenyl benzenecarboxylate*]	✓	
Tetrachloroethene [*tetrachloroethylene, perchloroethylene*], tetrachloromethane [*carbon tetrachloride*]	✓	
Enzymes (see 13.3)		✓

13.3 Allergy to biological materials

Allergic reactions may develop (sensitisation), or be triggered, in response to exposure to a wide range of biological materials. These include the following.

- Small mammals.
- Insects (notably locusts and the brown tail moth).
- Plant material such as hyacinth bulbs, primulas, pollen, some natural oils, peanuts and giant hogweed (which promotes skin disorders, with photo-sensitisation developing after exposure to sunlight).
- Fungal cultures (especially those such as *Penicillium* or *Aspergillus* species) which produce abundant airborne spores.
- Powders and dusts such as enzymes, antibiotics and agar.

Avoiding all exposure to any allergens in the first place, so that no sensitisation can develop, is one solution that has commonly been adopted, with the offending animals, plants, fungi, etc., banished from the laboratory. This is, however, usually an over-reaction. Allergies may develop only after prolonged exposure to significant amounts of the allergen. Thus, keeping a small number of, say, gerbils in a laboratory may never cause students to develop allergies since they do not come into contact with sufficient amounts of the allergens for long enough. Teachers and technicians may, however, be at greater risk because they handle the organisms or materials more often or are in a laboratory or prep room, where the organisms, etc., are located, for much longer periods. Control measures involve reducing exposure to the fine hairs and faeces from animals, spores from fungi, powders from enzymes, etc. When cleaning out animal cages, as far as possible staff should avoid generating dust which could then be inhaled. (Note that the bags in most vacuum cleaners are permeable to fine particles, permitting the spread of these into the air.) Weighing out enzyme and agar powders requires particular care to avoid raising dust, for example, in a fume cupboard with the sash window well down but the fan NOT switched on. Fungal cultures are best investigated or transferred before they have sporulated. Disposable gloves should be worn to avoid direct skin contact when handling, e.g. hyacinth bulbs or other organisms which have a history of provoking allergic reactions. Ensure a room is well ventilated to help prevent the build-up of airborne particles. If it is impossible to avoid generating dusts, it would be sensible to wear a face mask able to filter out small particles[1].

Locusts are now rarely kept in schools in colonies of live animals. They are best *not* kept in *continuous* culture, particularly since they are often required only at certain times. Maintaining a cage of locusts throughout the year adds to the exposure of staff to their allergens and there has been a sufficient number of cases of locust allergy in science department staff to indicate that this is an unwise practice. When required, locusts can be purchased most cheaply from pet shops or by post from specialist companies which breed them to provide food supplies for reptiles and amphibians.

Burning-peanut investigations have been frequently replaced with the burning of a range of other snack foods. A secondary school should know if any of its students have a severe allergy to peanuts, and could theoretically decide whether or not to burn peanuts in science. However, the allergen is found in the oils in peanuts and these have been known to linger for a long time in a lab after a class activity. So schools with only one or two known allergic students would still be wise to avoid burning peanuts altogether. Teachers report success in the use of a variety of snack foods or

[1] Dust masks to the British European Standard EN149 which are marked FFP3 will filter out airborne spores, bacteria, enzymes and other fine dusts., Masks marked FFP2 will be effective against a range of fine dusts including hay and wood, but not bacteria.

pasta as substitutes for peanuts. For more guidance on safe procedures and alternatives to peanuts, refer to CLEAPSS leaflet PS10 or SSERC Bulletin 209.

13.4 Asthma and school science

Asthma is now so prevalent among both adults and school students that it cannot be considered a particular issue in science lessons. Although science makes use of a range of chemicals and biological materials known, or suspected of being, triggers for asthma, it is more likely that a student will suffer an unanticipated asthma attack from general air pollution on the way to school, or taking part in PE or sports, particularly on a cold day.

A school should have a set of guidelines for preventing, where possible, and dealing with asthma attacks in adults or children. The links below offer further help with this task.

https://www.asthma.org.uk/advice/child/life/school/

https://www.gov.uk/government/publications/emergency-asthma-inhalers-for-use-in-schools

https://www.asthma.org.uk/get-involved/campaigns/successes/school-inhalers/

https://www.gov.uk/government/publications/supporting-pupils-at-school-with-medical-conditions--3