14 GOOD LABORATORY PRACTICE

14.1 Before the lesson

14.1.1 Lesson planning

Teachers should give adequate notice of their requirements so that technicians have enough time to check risk assessments and prepare materials and equipment. When planning lessons, allow sufficient time to distribute and set up equipment at the start of the lesson and for clearing away and wiping down benches, where necessary at the end of the lesson.

14.1.2 Emergency facilities

The location of fire extinguishers, emergency cut-offs, eye washing facilities and fire exits should be known to the teacher.

14.1.3 Distribution of equipment

This should be planned in advance, with several distribution points to avoid congestion and the risk of indiscipline. Alternatively, you may wish to entrust the distribution of equipment, where appropriate, to a small number of reliable pupil helpers. Whatever strategy is adopted, it is important to minimize the movement of pupils and equipment around the laboratory.

14.1.4 Personal protection

Eye protection should be worn by pupils, teachers and technicians whenever the risk assessment for the activity requires it. Other protective or control equipment, such as safety screens or fume cupboards, should be used when required.

14.2 In the laboratory

14.2.1 Class control

Inattentiveness or poor behaviour leads to accidents. Staff should not feel inhibited about seeking help from more experienced colleagues or about modifying or abandoning planned practical activity if pupil behaviour may compromise health and safety.

14.2.2 Reminders

Pupils need to be reminded frequently of safe techniques, even when these should be familiar. Often a quick demonstration by the teacher will suffice. Do not allow pupils to crowd together, either for individual practical work or teacher demonstrations.

14.2.3 Coats and bags

These should be put well out of the way. Pupils will need frequent reminders. Use coat hooks if available and do not allows bags to clutter the floor.

14.2.4 Eating, drinking, and chewing

These should not be permitted in the laboratory. If, exceptionally, a tasting activity is to take place, teachers must stress the special nature of this event and should adopt strategies to ensure that contamination cannot occur. Ideally, a food technology room or dining area should be used.

14.2.5 Hair
Long hair should be tied back and pupils should be warned that loose, flowing hair can make the hair more vulnerable to catching alight.

14.2.6 Clothing
Check that pupils' clothing is suitable for the activity and does not, for example, present a fire hazard. Ties, scarves, as well as other items of clothing, such as baggy shirts, should not be allowed to hang freely, as they could be a fire hazard or catch in machinery.

14.2.7 Electrical switches
These should never be operated with wet hands and pupils should be taught to switch off appliances before unplugging them. Pupils should be warned against meddling with switches. Electric cables should not be allowed to trail dangerously when being used, transported or stored.

14.2.8 Bunsen burners
Bunsen burners should be positioned carefully to avoid igniting wall fittings or blinds and so that pupils are not tempted to lean across them., They should be adjusted to give a yellow flame when they are lit but not being used. Pupils should also be warned against meddling with gas taps.

14.2.9 Containers
Containers should be clearly labelled, with an appropriate name, any hazards identified (for example by a symbol) and, where necessary, with the date of acquisition or preparation. When containers are labelled, it is important to remember that the hazards of a solution are likely to be different from those of the substances from which it was made. Remove old labels, which can be confusing and hence dangerous.

14.2.10 Extended practicals

Practical activities extended over a period of time should always be clearly labelled and dated, with any hazards identified. Equipment which is left running should have an appropriate warning notice (the one in Topics in Safety may be photocopied).

14.3 Using chemicals

The following guidance applies to all chemicals, and not just those used in chemistry lessons. A number of substances sometimes found in schools, for example Procion dyes, fumes from solder flux and some materials of biological origin, are sensitisers. Once exposed to them, some people will in future react to much lower doses.

14.3.1 Manipulating chemicals
Chemicals should not be touched by hand. Older students should be taught to remove the stopper from bottles of liquid with one hand, and keep it in their hand while pouring from the bottle. They should be told to pour on the opposite side to the label, so that it does not become damaged by corrosive chemicals. Solids should never be handled with the fingers. Instead, train pupils to use a spatula or equivalent.

14.3.2 Heating chemicals

Heating chemicals safely is a skill that pupils need to be taught, and, once taught, pupils need frequent reminders of the technique. Small quantities of a solid can be heated in test tubes; the solid should not be tightly packed and there should be an air space above the slope of the solid. Liquids present greater problems, because of the risk of `spitting'. Boiling tubes are safer than test tubes because of their greater volume. Even so, they should not be more than about one-fifth full; anti-bumping granules may be useful. Pupils should be taught to point test tubes away from their own face and away from those of their neighbours.

Flammable liquids should not be exposed near sources of ignition such as Bunsen burners. In particular, they should not be heated over a naked flame. If, for example, hot ethanol is required, it is most easily obtained by standing a test tube or boiling tube containing ethanol in a beaker of hot water, the hot water having been obtained directly from a tap, or from a kettle. Heating or pouring activities should be conducted standing up, so that the pupil or teacher can move quickly out of the way if necessary.

14.3.3 Identifying gases by inhalation

Identification of gases by their odour is an important technique and pupils should be taught how to do it safely. The gas should be contained in a test tube, not a larger vessel. The lungs should be filled with air by inhaling deeply. The test tube is held about 10-15 cm from the face, pointing away from it, and then the contents of the test tube cautiously sniffed, by using a hand to waft the vapours gently to the nose. Pupils should practise the technique with low hazard gases under supervision, and those who cannot reasonably be trusted to follow these instructions should not be permitted to progress to more hazardous substances. Teachers should discreetly check whether there are, for example, asthmatics in the class, and those affected should not smell gases such as chlorine or sulphur dioxide.

14.3.4 Spills

Spills should always be cleared up immediately. While a few may need absorption and/or chemical neutralisation using a spill kit (or disinfection or similar treatment) most minor spills can be dealt with by a damp cloth. For large spills of chemicals producing hazardous fumes, there may be a need to call the fire brigade. Pupils should be encouraged to report spills and breakages, so that they can be cleared up immediately, and not left to cause injury to the next class, or to a technician or cleaner.

14.3.5 Personal cleanliness

Pupils should always wash their hands after practical work with chemicals or with soil or material of living origin and facilities should permit this.

14.4 Glassware

14.4.1 Broken glass

Glass vessels, such as test tubes, flasks and beakers, should be checked for cracks and chips before use. Particular care should be taken when glass containers are evacuated; use round-bottomed or pear-shaped vessels, check for cracks, and protect observers by one or more safety screens. Broken glassware should be placed in a specially labelled container. It should be wrapped in newspaper or sealed in a non-perforatable container, such as a box or metal can, before disposal with normal waste.

14.4.2 Handling glass

When inserting corks, stoppers or bungs into test tubes or specimen tubes or pipettes into safety fillers, pupils need to be shown a safe technique (see Safeguards or Handbook) that will reduce the risk of breakage. Inserting glass tubing or thermometers into bungs is generally best left to technicians, who may themselves need training

14.5 Safety equipment

14.5.1 Using safety equipment

A risk assessment is necessary to determine what type of PPE is appropriate.

14.5.2 Eye protection

Up to date advice on eye protection can be found in the CLEAPSS Handbook and corresponding SSERC publications. There is a detailed discussion of the legislation and a comparison of available products in the CLEAPSS guide R135 (March 2005) and in the ASE publication Topics in Safety (3rd Edition, 2001).

Table 14.1 Eye protection for different activities

Operation	Type of eye protection
Dispensing large volumes of concentrated acids, alkalis and other corrosive substances; opening containers that may be under pressure. Pupils with visual impairment or with other disabilities that require them to work closer to chemicals than most pupils; those with limited motor control.	Face shields meeting BS EN 166
Activities using alkalis of molar or greater concentration; concentrated mineral acids and ethanoic and methanoic acids; bromine; corrosive solids; toxic chemicals.	Goggles meeting BS EN 166 3 S (indicating protection against chemical splash and low energy impact)
Activities involving other chemicals which are classified as irritant or offer less risk to the eye.	Spectacles meeting BS EN 166
Activities with other risks: glass working, breaking up rocks, stretching wires or cords; some dissection.	Any eye protection; for example, spectacles meeting BS EN 166.
Use of lasers.	No protection is advised for school-type lasers (which should be classed as 1, 2 or 2M)
Use of ultra-violet radiation	The most appropriate protection is to arrange equipment so that UV cannot reach the eye (or skin). Use UV attenuating screens if necessary

Eye protection must conform to the relevant European Standard BS EN 166. The code also gives information on the impact resistance, optical quality and splash protection. Table 14.1 suggests appropriate eye protection for different situations. While goggles generally offer better protection than safety spectacles, pupils often find them difficult to wear: the goggles can be heavy, can press against the face and often mist up. In some circumstances safety spectacles may be a safer practical option.

Eye protection needs careful storage to minimise the risk of scratching the lenses. Safety spectacles and other eye protection should be cleaned regularly, and checked for scratches. Scratched lenses obscure vision and tempt pupils to remove their eye protection.

14.5.3 Gloves

Gloves protect hands but are also a source of hazards: they reduce manual dexterity; can be slippery when wet and some materials used to make gloves (e.g. latex) can trigger allergic reactions. Gloves may sometimes induce a false sense of security and careless handling of hazardous materials. Gloves must be worn whenever the risk assessment requires them. For pupils this will be rare at Key Stages 3 and 4 but more frequent at Advanced level, particularly when handling organic chemicals and some biological materials. Technicians will need to wear gloves frequently. Different types are needed for different purposes. Heat-resistant gloves may be needed in some situations. Disposable poly(ethene) gloves protect the skin from contamination by radioactive substances, while not providing protection from the radiation itself. It is important to remember that disposable gloves should not be re-used. In A-level chemistry, rubber or (preferably) nitrile gloves may be needed to prevent some chemicals being absorbed by the skin. Kitchen gloves are often used in place of specialised gloves. While these are perfectly satisfactory for routine tasks such as washing up in the Prep Room or wiping down surfaces, and provide adequate protection from over-exposure to water and detergents, they will not offer protection against organic solvents, concentrated acids or other corrosives. Heads of Science need to be wary of issuing kitchen gloves to pupils who will assume that they offer a much higher level of protection than is the case.

14.5.4 Laboratory coats

Laboratory coats can stop ties or scarves from hanging loosely and getting into Bunsen burner flames or entangled with machinery. In most school science activities, however, they mainly serve to protect the person's clothing, rather than the person. Exceptions to this are in work with radioactive materials and in microbiology, where removal of the laboratory coat removes the contamination. Teachers, technicians and students on A-level or equivalent courses are likely to be handling chemicals frequently so that wearing a laboratory coat is common sense. A school may well encourage younger pupils to purchase their own laboratory coats to prevent claims about damaged clothing. However, it would be difficult for a school to provide laboratory coats in a sufficient range of sizes without causing major storage and washing problems and it is unlikely that the exposure to chemicals at this level would justify the effort involved. Some schools encourage pupils to wear art aprons during science lessons although the protection provided is relatively slight. Where laboratory coats are worn they must fit and they will only offer protection if buttoned up; teachers should set a good example in this respect.

14.5.5 Impervious aprons
These should be worn when large quantities of corrosive liquids are being dispensed.

14.5.6 Protective footwear
This is not normally necessary in school laboratories, but neither staff nor pupils should wear open-toed sandals or similar shoes, which give no protection at all against spills or broken glass. Speed of removal is important, as ordinary shoes will admit spilt chemicals.

14.5.7 Protective headgear
This is unlikely to be necessary in school laboratories, but may be needed on some outside visits.

14.6 Control equipment

14.6.1 Safety screens
These are likely to be required by most risk assessments whenever:
- there is any risk of explosion or implosion;
- nylon filaments or wires are stretched to breaking point;
- fast-moving objects such as airgun pellets could go in unintended directions; or
- there are other reasons for preventing observers from getting too close to equipment.

During demonstrations two or more safety screens are likely to be necessary, so that both pupils and teacher are protected. Some safety screens are unstable and may need clamping to the bench. Screens should be regarded as back-up equipment; full precautions should be taken to avoid explosions or other accidents. Safety screens are not a substitute for eye protection. See Safeguards and Handbook.

14.6.2 Fume cupboards
Fume cupboards should be used whenever the risk assessment requires it. (See Section 10)

14.7 Emergency equipment

14.7.1 Fire-fighting equipment
This should be checked regularly. Generally the whole school will have an arrangement with an outside contractor. Heads of science should report in writing any obvious deficiencies in provision. Schools are likely to be advised by a fire prevention officer on appropriate alarms, fire extinguishers and fire blankets. Extinguishers require an annual service in accordance with the appropriate BS standard

14.7.2 Eye washing facilities
These will be needed for use in emergencies, and staff will need training in how to use them. Plumbed-in eye washing stations are probably too expensive for school use. Eyewash bottles contain only small volumes of water, and are therefore not generally suitable unless the sterility of the water can be guaranteed, for example, by changing it weekly. A good alternative is to attach a short length of clean, soft flexible plastic tubing to a cold-water tap. The tubing should be kept in a labelled transparent container hung on the wall adjacent to the tap designated for use as an ‘eye washing station’. A transparent plastic document holder is a suitable container

14.7.3 Spill kits

These should be available to deal with likely eventualities. They should contain materials for absorbing spills and, if necessary, neutralising and emulsifying them before disposal. See Handbook and Safeguards.

14.7.4 Respirators

These are useful in school laboratories for clearing up large spills of toxic and volatile chemicals in areas where the ventilation is poor. However, as such spills are rare in school, and full-face respirators are expensive and the filters must be replaced every two years, the cost is difficult to justify. It is more practicable to summon the fire brigade, making it clear that by their standards the spill is very small.

14.8 Investigative science

Open-ended, investigative or project work is required in most science courses. Whenever and in whatever context such open-ended activities take place, there is a need to plan carefully for the safety aspects.

In the first instance pupils should be encouraged, as part of the planning exercise, to assess the risks and devise suitable precautions. However, since teachers cannot rely on pupils having carried this out adequately, they must always check the plans, whether written or otherwise. Sometimes, the implications of the plans may not be clear, either to the pupil or to the teacher, and in any case plans may change as the investigation or project proceeds. Teachers' supervisory skills will be tested to the full when pupils in a class are all working on different investigations. It is therefore best to set investigations in the context of relatively safe activities, avoiding, for example, the use of particularly hazardous chemicals, dangerous equipment, or harmful micro-organisms.