Eye-Protection & practical work

One of the main bottlenecks causing problems with getting practical work up and running in school, is that of eye protection. Many schools donated their eye-protection during the peak of the pandemic and above and beyond that, the need for disinfection between uses can put in a significant time delay.

Dealing with this needs a two-pronged approach:

1. Reduce the need for eye-protection
2. Clean as effectively and rapidly as possible.

# Reducing the need

Eye protection is required for quite a few procedures in school science but mainly in practical chemistry.

Our guidance (along with CLEAPSS and ASE) is that for work with chemicals that are either toxic (as opposed to harmful) or Irritant (as opposed to corrosive), indirect vent goggles (to BS EN 166 3) are needed. The 3 is the important bit – signifying splash resistance. For chemicals that are irritant or harmful, safety spectacles are fine. Other eye protection will be needed in separate areas and may have their own specifications: working with uv, impact protection when using machinery in technology etc.

The biggest problem seems to be in science. We are in the process of putting together some more extensive guidance on this but from looking at a few S1/2 science courses that schools have published details of, over 90% of the practical work at this level can be done with no need for eye protection at all. That may not currently be the case but some slight tweaks in practicals can usually bring this about:

1. Change the reagents – copper sulphate for instance causes eye damage at 0.12 mol l-1 and above and is an irritant down to 0.04 mol l-1. For many experiments, you can substitute something safer: magnesium sulphate, Iron II sulphate or many others. Granted they aren’t the same pretty blue colour but actually being able to do the practical should outweigh this.

Similarly, sulphuric acid needs eye protection above 0.5 mol l-1 and goggles above 1.5 mol l-1 but hydrochloric acid doesn’t need anything up to 2.75 mol l-1 and goggles aren’t needed until 6.85 mol l-1.

1. Reduce concentration – 1 mol l-1 sodium hydroxide needs goggles, below 0.5 mol l-1 safety spectacles are OK and below 0.1 mol l-1 no eye protection is needed. So if your experiment will work at 0.1 mol l-1 and below then all is fine.
2. In some cases, doing a demonstration might be the best option. Pupil practicals are better than demos but a demonstration is better than a video.

If you reduce usage in one part of the school, it takes pressure off elsewhere – by reducing usage, lower down in the school, it might perhaps then be possible to issue each Higher/Advanced Higher student with their own eye protection– which would then remove the problems relating to sharing.

However, that won’t solve everything so some sort of sanitising of eyewear is likely to be needed. Where possible, lessons should be managed (regarding content and timetabling) to reduce the need for rapid changeover. If, for instance, the timetable were tweaked so that each class had all their practical chemistry (let’s face it, chemistry is the main problem here) in one block each week, that would mean less need for disinfecting than if it were split into two or three sessions.

# Sanitising eye-protection

Even with this, though, there will still be a need for some rapid-ish turnaround sanitising. There are two main approaches to this: chemical and physical.

**Chemical methods**

From a chemical point of view, although there are various substances that will work, realistically we looking at a much smaller number due to practicability and cost.

1. **Chlorine based reagents** – either diluted domestic bleach or Milton’s fluid/tablets (or Own brand alternatives)
	1. The **bleach** dilution will depend on the concentration. Most thin bleaches are only 1% sodium hypochlorite and will need to be diluted 1:20 whereas the thick ones are about 5% and so will only need a 1:100 dilution (based on WHO guidance). This gives a concentration of about 0.05%. According to research I can find, a 1:100 dilution of a 5% solution will ‘kill’ all the coronavirus within 5 minutes. In fact, thick bleaches are 4.5% or so but rather than tweak the concentration, it is probably easier to just leave them in for 10 minutes. (Though there is guidance in some places recommending up to 30 minutes immersion. 15 minutes is a good compromise and probably what we would recommend).
	2. **Milton’s** fluid is actually just a 1% bleach solution with 17% salt. They have revised their guidance on their website so that the recommended concentration is significantly higher than on the packets. The new figures of 60 ml per litre gives a concentration of 0.06%. This is almost the same as bleach. Interestingly, they suggest soaking for 15 minutes.

The tablets use sodium dichloroisocyanate instead that releases chlorine into the water – the end result is the same. There is no simple, comparison I can do here but the change in the Milton guidance is in proportion to the change for the fluid so I have no reason to doubt their recommendations.

1. **Virkon** – This is certainly going to be effective and has long been the go-to disinfectant in microbiology work. It is, however, expensive and there is no real evidence that it is any more effective than bleach. Use according the the manufacturer’s specifications.
2. **Ethanol** – A 70% solution of this can be sprayed on and wiped off after 5 minutes (assuming any is left). Alternatively, the surfaces could be wiped down with a cloth/tissue etc soaked in it. There are problems with flammability but care and good sense should mitigate these, This is not really viable for regular large-scale disinfection although it could be a possibility if a rapid turnaround were needed.
3. **Hydrogen peroxide** – a 3% (10 vol) solution will also ‘kill’ the virus within about 5-10 minutes. This is the same strength used in contact lens solutions so there are no issues there.
4. **Soap and water** – just immersing items in soapy water seems to be effective against the virus but less so that the other reagents. When handwashing, the mechanical action is just as important – as is the presence of heat – see dishwashers below.

***Potential disadvantages***

**Ethanol** is flammable and, if being prepared within the school from their own supply in the chemistry department, there is a limit on what can legally be bought so large scale use will cause this to run out fairly soon.

**Virkon** is expensive. I can see no evidence for sensitisation (or any other health effect) of the 1% solution recommended. Looking at the MSDS, at 1% according to CLP classifications it will be of no significant hazard. It would be useful to know if people are suggesting sensitisation is a problem, where that data has come from.

**Bleach/Milton’s** can release toxic gases (chlorine) but the dilute solutions are not likely to be a problem here – though there is a possibility of respiratory issues in a few sensitive individuals. However, even at low concentrations chlorine-based detergents can lead to corrosion of metal items. Public Health England did a review and found no good evidence for skin sensitisation, though it can cause irritation – at higher concentrations that this though.

**Physical methods**

1. **UV** - We have had quite a few enquiries recently about uv goggle sterilising cabinets.  We are not actively recommending them but from what I can manage to find out the 254nm uv will destroy the virus pretty effectively (it smashes up DNA and RNA). You do need the virus to have direct contact with the light - the combination of transparency and internal reflection within the cabinet should mean it is fine. A slight caveat would be that the light might not penetrate the elasticated straps of goggles. That said, the high-risk area (is as far as any are high) is the plastic part in contact with the face.

At SSERC, we would have no issues with using one were it to be provided: they are probably effective but do not seem to be very good value for money.

1. Temperature – A study in the Lancet showed that the virus is ‘killed’ by exposure to a temperature of 70C in less than 5 minutes. At 56C, the same effect was observed in less than 30 minutes. This has a couple of implications
	1. Dishwashers – Given the combination of detergent and temperature, there seems no reason at all why items passed through a dishwasher (unless on a very low heat) will not be suitably disinfected. We can find no guidance suggesting more than normal dishwashing is needed for cleaning crockery, glassware and cutlery. So in SSERC’s view, putting safety specs or anything else through the dishwasher will be effective.
	2. Ovens/drying cabinets – given the data, we are confident that if it is possible to achieve a temperature of 70C for 5 minutes (or 56C for 30) that this will be sufficient to disinfect any equipment. Just to check for damage, we put a few different pairs of our eye protection in an oven at 75 for 40 minutes and there was no damage done at all. This may or may not be useful but the effect of temperature is certainly important. If anyone did want to use this, we would suggest they give 15 minutes rather than 5, to make sure that everything gets up to temperature.

# Rapid turnarounds between classes

With some tweaking of courses, as mentioned above, and good organisation, it should be possible to minimise the need for a set of goggles to be passed on from one class to another.

However, it should be possible to manage this without too much difficulty. If learners place their eye protection into a bath of detergent as soon as they have finished then there should be enough time before the next use for them to have the 15 minutes required – there will be a plenary at the end of the first lesson and an introduction at the end of the second.

The disinfecting solutions are of low hazard so learners can simply take a set out and dry with paper towel.

The elasticated straps of goggles are problematic in that they do not dry easily. Safety spectacles are easier as far as this goes but are not suitable for all practicals. Again, adapting experiments to reduce requirement for goggles will help.

An solution for some designs of goggles, as mentioned elsewhere, could be to give each learner their own strap – made from a strip of elastic and a couple of bulldog clips.

In a worst case scenario, as long as it is not happening on a regular basis, if need be it would be acceptable to wipe the eye protection between users with antiviral wipes, as long as there is good hand hygiene.