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Health and Safety in Practical Science in Schools: A UK Perspective 2, Using Model Risk Assessments

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The previous article in this series explained the difference between hazard (something which could cause harm) and risk (a combination of the likelihood and magnitude of harm actually being caused by the hazard). If the risk is too high, steps must be taken to reduce it to a sufficiently low level by adopting suitable protective (control) measures. If a practical activity in a science lesson has some risk associated with it then one way of reducing the risk might be to avoid the activity altogether. In that case, very little practical work would ever take place. If you are using glass apparatus, there is always a possibility of breakage and hence cuts. If you are using hot apparatus, there is always the possibility of burns. We accept a low level of risk because the benefit of practical science outweighs the risks. Teaching students how to handle safely fragile or hot objects under the relatively organised conditions of a science lesson may teach them something of value about risk management for life outside the laboratory and when they have left school.

One of the most serious science accidents in a UK school in recent years resulted in a 12 year old student suffering serious burns to his arms and chest. What dangerous experiment was he carrying out? Burning a candle! He was comparing how long candles continued to burn when placed under beakers of varying sizes. The teacher had carried out a risk assessment. He knew that hundreds of thousands, perhaps millions, of children across the UK handle naked flames every day, usually on Bunsen burners, without accident. Even so, he had given the class a set of laboratory rules and had sought to reinforce them by asking the class to complete a hazard-spotting exercise based around a cartoon showing a nightmare laboratory. The class was quite small, well-supervised and well-behaved. Laboratory tests showed that it was in fact quite difficult to ignite the material of which his shirt was made. In spite of this, the student's shirt caught fire and he suffered burns. He was very unlucky but accidents do happen. An accident happened under almost ideal teaching conditions with an everyday object. It is very difficult to see what else the school or the teacher could have done to avoid this accident, other than not use candles at all. Candles are used safely in everyday life – on birthday cakes, in

churches, during romantic suppers. If there are naked flames there is always some residual risk. The benefits accruing from using naked flames in the laboratory outweigh that small risk.

Whilst everyone knows that naked flames present some risk, it is not reasonable to expect most science teachers to know all the hazards of every chemical or piece of equipment they might handle or every scientific procedure they might want to adopt. Nor, generally, are they in a position to evaluate the risk from such hazards. They know the experiment could wrong – but how likely is it to go wrong in schools? What is the track record? And how serious would it be anyway? Certainly, science teachers need good training in health and safety before they start teaching and on-going professional development once in post. The reality, however, is that much pre-service training is very limited in scope and in-service training may be non-existent or focus on whole-school issues such as special needs or assessment. Only rarely is there hands-on training in health and safety matters for science teachers. They therefore need guidance which they can rely upon and access easily. Such guidance is called a model (or general) risk assessment. This model assessment may need slight adaptation to the situation in a particular school, class or room. The UK enforcement agency, the Health and Safety Executive (HSE), accepts the use of model risk assessments provided that the employer checks that they are appropriate for the type of work, after any necessary adaptation.

To see how model risk assessments work, let us take some specific examples. Two commonly used sets of model risk assessments are known as *Hazcards*® (a set of A5 size cards) and the *Hazardous Chemicals Manual*® (see below). Both cover hundreds of chemicals likely to be used in school science and are available in (printer-friendly) electronic form. A teacher, unsure about how to safely drop sodium into water, for example, would check the current edition of *Hazcard 88, Sodium* or click on the entry for *Sodium* in the *Hazardous Chemicals Manual.* In both resources, one side gives information about the hazards of sodium, how to deal with various emergencies which might arise during its use and the arrangements for storage and disposal. Of course some of this information will be given on the Safety Data Sheet (in the USA, Material Safety Data Sheet) which accompanies the sodium when purchased. However, both *Hazcards* and the *Hazardous Chemicals Manual* are selective and interpretative – they target the information that teachers will need, bearing in mind the quantities of sodium they are likely to have, the uses to which it will be put in school and the facilities expected to be available. The reverse side of the *Hazcard* and the second page of the entry for *Sodium* in the *Hazardous Chemicals Manual* give guidance on typical school uses. In particular, it tells the teacher the protective measures to reduce the risk from the known hazards to acceptable levels. So, for example, the teacher is told to use pieces of sodium no bigger than 4 mm and to have students 2 – 3 m away. Teacher and students are told to wear eye protection. In addition safety screens are to be used, with the screens placed as close to the reaction vessel as possible, and the sodium is not to be constrained in any way. These exemplify typical protective measures; work on a small scale, form a barrier between the experiment and the spectators but assume, even so, that something might go wrong and have all involved at a safe distance and wearing eye protection.

A class might be investigating the efficiency of hand-washing procedures. They could do this by pressing their fingers, before and after washing, onto sterile agar plates. The plates are then incubated and the bacterial growth compared. Clearly, there are hazards here – pathogenic bacteria might be present and their numbers increased by incubation. If the plates are examined carelessly after incubation the bacteria could become dangerously dispersed. A model risk assessment for this activity can be found, for example, in the CLEAPSS *Laboratory Handbook* or in the SSERC *Safety in Microbiology: A Code of Practice for Scottish Schools and Colleges* (see below). Whilst there is not space here to go into the full details of aseptic (sterile) technique, one of the recommendations is that incubation should be avoided under the conditions most likely to promote the growth of human pathogens, ie avoid incubating at body temperature of around 37 °C (use a maximum of 30 °C) and do not incubate under anaerobic conditions. The latter potentially causes a dilemma. It would be tempting to seal the lid onto the Petri dish to minimise the risk of the bacteria escaping but that would give anaerobic conditions, promoting the growth of the very bacteria we want to avoid. The secret is to fasten the lid on with a couple of pieces of adhesive tape. The lid cannot fall off but air is not excluded.

A model risk assessment gives generalised guidance, applicable across a range of schools. However, an individual school and/or teacher then needs to consider whether any slight modification is required for the particular circumstances of that school, class or room. So in the example just considered, the teacher needs to consider what the students are likely to do when the incubated agar plates are returned to them for examination. At a relatively elementary level the lids should not be removed because this could expose the students to potentially hazardous bacteria. (At a more advanced level, of course, students could be taught the details of how to do this safely.) But removing two small pieces of tape would be easy and perhaps too tempting to the enthusiastic, and possibly misbehaved, student. In that case, after incubating the tapes under aerobic conditions, the teacher might decide to make it much more difficult to remove the lid, by wrapping a lot of tape around the periphery of the Petri dish. The teacher might decide that it was not necessary to do this with all the classes – only the less well-behaved ones, or the ones taught on Friday afternoon! The teacher has then modified the model risk assessment, taking account of her or his professional knowledge of the classes taught.

Model risk assessments are occasionally produced in the UK by particular education employers but most are available nationally from respected science education organisations. The most comprehensive are those produced by CLEAPSS[1] and SSERC[2]. Both these organisations provide an advisory service supporting practical science and technology in England, Wales and Northern Ireland (CLEAPSS) and

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2. SSERC, 2 Pitreavie Court, Pitreavie Business Park, Dunfermline, Fife, KY11 8UB, UK. *Tel:* +44 (0)1383 626070; *fax:* +44 (0)1383 842793; *web site:* www.sserc.org.uk; *e-mail:* sts@sserc.org.uk.

Scotland (SSERC). Other widely used model risk assessments are those published by the Association for Science Education[3].

CLEAPSS produces a range of model risk assessments for different contexts, including *Hazcards®*, the *Laboratory Handbook* (over 1000 pages on all aspects of practical science), *Recipe Cards* and other more specialist documents. These are now all available both on the *CLEAPSS Science Publications CD-ROM*, which is updated and re-issued to members annually, and also on the Members-Only (password-protected) part of the CLEAPSS website. SSERC publications are obtainable on CD-ROMs but mostly are now available on SSERCSafetyNet web site which provides the *Hazardous Chemicals Manual* and risk assessments for a wide range of activities covering radiation and display screen equipment. The most relevant ASE publication is *Safeguards in the School Laboratory*, now in its 11th edition. CLEAPSS and SSERC publications are available only to members but both accept overseas schools and colleges, including teacher-training establishments, as members. The ASE has many overseas members although *Safeguards in the School Laboratory* is also available to non-members, at a higher price.

3. ASE, College Lane, Hatfield, Herts, AL10 9AA, UK. *Tel:* +44 (0)1707 267411; *fax:* +44 (0)1707 266532; *web site:* www.ase.org.uk; *e-mail:* info@ase.org.uk.