AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA | DEPARTMENT OF EDUCATION AND SCIENCE

# SAFETY

# IN

# SCHOOL SCIENCE

**2001**

**An Roinn Oideachais agus Eolaíochta**

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# Foreword

This code of practice `Safety in School Science' has been produced by my Department to provide information for teachers and school management concerned with health and safety in schools. Good health and safety practices in schools and colleges are worth achieving for their own sake. Such practices can also make a significant contribution to the future strength and growth of our nation's economy by reducing the risk of accidents, with their inevitable costs in human and financial terms.

The Safety Health and Welfare at Work Act 1989 demands a high level of co-operation between employers and employees to ensure that the work place is healthy and safe in so far as is reasonably practicable. This basic guide will be of benefit to school management as employers and teachers as employees in the attainment of a safe and healthy work environment and in meeting their moral and legal responsibilities in science class rooms under the 1989 Act.

I would like to sincerely thank all those who have been involved in the preparation of this guide.

Niamh Breathnach T. D.

Minister for Education

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## Emergency services

**FIRE . . . . . .**

**DOCTOR . . . . . .**

**HOSPITAL . . . . . .**

**GARDAÍ . . . . . .**

**WATER . . . . . .**

**ELECTRICITY . . . . . .**

**GAS . . . . . .**

**NATIONAL POISONS INFORMATION CENTRE**

**BEAUMONT HOSPITAL, DUBLIN 9.**

**(01)-8092566**

**Ring 999/112 for all Emergency Services.**

# Introduction

This publication is designed as a resource book for science teachers. It should instil greater confidence in teachers, who can use this book as an information source, when preparing Laboratory Safety Rules to suit their individual circumstances. It provides guidelines for teachers when they are developing safe ways to carry out practical work. This will enable practical work, a necessary part of the overall education in experimental science, to be carried out more safely in school laboratories. Some practical work in school science requires the use of potentially hazardous materials. Consequently, pupils must acquire the necessary skills to carry out such work in safety and with confidence.

Student safety is the moral and legal responsibility of the School Authorities, Principal and Teachers. If negligence is shown, they and they alone could be held liable for injuries suffered by pupils in their care. Precautions must be taken where necessary and the School Authorities must be informed of any hazards (actual or potential) that exist in the laboratory, which they are obliged to rectify. In the case of an accident, medical attention should be sought immediately. Adequate insurance is obligatory and School Management/Authorities should ensure that cover is provided both in respect of laboratory work and educational outings (Appendix I and N, pages 80 & 87).

Although accidents may occur in the best organised laboratory, most can be prevented by adequate forethought, due care and constant vigilance. The human factor is directly responsible for many accidents. Safety considerations are essential in the teaching of science and should be reflected in all syllabuses. Safety as a topic is always a compulsory component of any course in Science whether explicitly stated or not; it must permeate all aspects of the teaching of the subject and be included in all aspects of examining sciences.

## Legal obligations

This code contains guidelines for best practice in school science. However, these guidelines are **general** guidelines for the information and assistance of school management and they may not be definitive in all cases. It is the responsibility of each school and its management to ensure that any additional safety measures, which may be necessary given the particular circumstances of the school, are put in place. The Department of Education and Science and the authors of the Code will not be held responsible for any loss, damage or injury arising in the context of the implementation of the recommendations of the Code of Practice.

# CHAPTER 1

## Laboratory design and services

A science laboratory, in addition to being designed and constructed in such a way as to allow the efficient conduct of practical work, should be designed with a view to preventing accidents. Certain general principles and guidelines should be followed and these are outlined below.

### 1.1 Design and accommodation

#### Structural

- The design should be such that all pupils can be seen at all times. Benches should be a minimum of 700 mm deep and each student should have a minimum of 600 mm of bench space. Working surfaces should be 850 mm high. The Department of Education and Science Room Layout Publication should be consulted.
- There should be ample light (500 to 1000 Lux) and good ventilation ( 7 to 15 air changes per hour).
- Exits should comply with local Fire Regulations. Consult your local Fire Authority if in doubt.
- There should ideally be a glass panel in the door to enable you to see if there is someone on the other side when you go to open it.
- Floor covering should be made of impervious, non-slip, fire and chemical resistant material.

#### Organisational

- Numbers in practical classes should be such that supervision can be adequately undertaken.
- Areas should be available in the laboratory for on-going experiments, for wet and dirty work, and for permanent apparatus and specimens.
- There should be wall space for vertically mounted experiments.
- The fixed laboratory furniture (benches, presses, cupboards, etc.,) should be sturdy.

- Bench tops should be made of hard wearing, impervious, heat and chemical resistant material.
- Coats, schoolbags and other baggage should be kept outside the laboratory. For security reasons they may be stored on hangers and special baggage space provided in the laboratory. They should never be stored on the floor beside the bench or over the backs of chairs, or stools.

## 1. 2 General services

All fittings, piping, joints, cabling, earth case, etc., must conform to the various minimum standards laid down by regulatory bodies as appropriate for the purpose and should be of excellent quality as appropriate to the life span expected.

- Outlets for services such as gas, electricity and water should not be placed in such a way as to constitute an electrical or fire hazard.
- It should be possible to isolate the supply of gas and electricity. Ideally it should be possible to do this by emergency stop buttons (linked to a solenoid valve pressure proving system) at the teacher's position and at the exit or outside the class room.
- A mains isolating control for water should be conveniently placed near the exit.
- Each sink outlet should pass through a dilution trap.
- Gas taps should be such that they cannot be turned on accidentally.
- Fume cupboards which operate quietly and effectively are essential in laboratories where volatile/toxic/harmful/corrosive or irritant chemicals are used.
- There should be at least one properly ventilated general chemicals store outside the laboratories with 6 to 10 air changes per hour. The preparation room area may be used as a store (Appendix D, p. 67).
- There should be no steps in the laboratory or between the laboratory and preparation room. This will enable trolleys to be loaded up in the preparation room with the necessary materials for the practical and pushed into the class room without the need to carry them.

- Cupboards that can be securely locked should be provided for storing restricted chemicals (Appendix D, p. 67).
- An adequate fire warning system should be installed in all laboratories (p. 39).

- Suitable fire extinguishers and a fire blanket must be provided to comply with the fire regulations (p. 40 & 41).
- Provision should be made for removal of combustible waste on a daily basis (liquids and solids separately).
- Waste disposal should be as outlined in 2. 6 (p. 17).

## 1. 3 Electrical services and equipment

All electrical wiring and fittings should comply with the Safety Health and Welfare at Work (General Application) Regulations 1993 Part VIII[1] (S.I. No. 44 of 1993) and the Electro-Technical Council of Ireland National Rules for Electrical Installations Parts 1, 2 and 3.

- All electrical equipment must be constructed, installed, maintained, protected and used so as to prevent danger.
- Equipment must be suitably identified and marked, including the maker's name and its electrical rating.
- Earthing and automatic disconnection of supply or other means must be provided to prevent danger from exposed parts becoming live.
- Adequate protection must be given to equipment which is exposed to the elements, to adverse conditions such as damp, dust, flammable atmospheres, etc., or subject to risk of mechanical damage.
- Circuit breakers of the residual current device (RCD) type, tripping on 30 mA, should be used on all electrical socket supply circuits in the laboratory.
- Three pin mains electrical outlets, with independent isolation switches, should be vertically mounted (B S 1363).
- Plugs should comply to B S 1363, be made of a durable material and contain an appropriate fuse (in accordance with the specifications of the equipment and normally not greater than 5A). In all cases fuses of the correct rating should replace blown fuses, e.g. in plugs, power packs or other items of equipment. For this purpose a range of fuses should be retained.
- Plugs should be wired correctly (p. 61).
- Leads or plugs should be replaced immediately when they show sign(s) of damage. When replacing leads, approved 2- or 3-core cable (each conductor should be 0.75 $mm^2$ minimum cross section-area) and with adequate insulation of rubber, PVC, butyl rubber, etc., should be used. Cables passing through metal containers should be clamped internally and pass through suitable grommets.
- All mains-operated equipment must be properly earthed or doubly

[1] *Irish 1993 Electrical Regulations*

insulated and installed according to the manufacturer's instructions.

- Where possible such equipment should have a pilot light to indicate when it is switched on.
- All electrical equipment should be checked regularly (at least once per year) by a competent person to ensure that its case is earthed and not live, the cable is satisfactory and the plug is not broken or damaged.
- Portable electrically operated equipment should be inspected at regular intervals and a record kept of inspections made.
- All new installations must be tested by a competent person and certified before use.

## 1.4 Hygiene and first aid

- One or more fully trained first-aid persons should always be available on the school premises during normal class times. [Safety, Health and Welfare at Work (General Application) Regulations 1993 Part IX[2] (S.I. No. 44 of 1993)].
- A fully equipped first aid kit must be provided. In accordance with the Safety, Health and Welfare at Work (General Application) Regulations 1993 Part IX[2] (Appendix B, p. 64).
- A special hand basin with hot and cold water supply along with soap dispenser and disposable towels or hand drier should be available in the laboratory. (Care! hand dryers should not be placed or used near flammable materials.)
- Laboratories should be equipped with an adequate supply of waste boxes, preferably of two distinctive kinds, one for dry and broken waste and one for wet waste such as filter papers and biological materials. These should be cleaned out at the end of each day (Section 2. 6, p. 17).
- An eye wash fountain is desirable. Alternatively a length of rubber tubing on a suitable cold water tap may be used. The force of water should be gentle as the water could damage the eye if the force is too great, a shower spray on the end can reduce the force.

[2] *Irish 1993 First Aid Regulations*

# CHAPTER 2

## Laboratory organisation and management

Every school must have a set of laboratory safety rules. These rules should be sufficiently comprehensive to cover all eventualities yet be simple and concise. The rules must be displayed clearly in a prominent place in the laboratory. Safety training must play a major part in ensuring freedom from accidents and should aim to explain the basis for the rules. Everyone in a laboratory should be made aware that he/she is responsible for both his/her own safety and the safety of those working alongside them. It must be stressed that at all times the most important consideration is human safety.

A list of recommended safety apparatus is given in Appendix A, (p. 63). A safety check list is given in Appendix C, (p. 65).

### 2. 1 Laboratory rules for pupils

**DO NOT** enter the laboratory without permission.

**DO NOT** use any equipment unless permitted to do so by the teacher. Make sure you know exactly what you are supposed to do. If in doubt, ask the teacher.

Long hair **MUST** always be tied back securely.

**ALWAYS** wear eye protection when instructed to do so.

**ALWAYS** check that the label on the bottle is **EXACTLY** the same as the material you require. If in doubt, ask the teacher.

**DO NOT** eat, drink or taste anything in the laboratory or any food brought into the laboratory.

Any substance accidentally taken into the mouth must be spat out **IMMEDIATELY** and the mouth washed out with plenty of water before reporting to the teacher.

Any cut, burn or other accident **MUST** be reported at once to the teacher.

Any chemicals spilled on the skin or clothing **MUST** be washed at once with plenty of water and reported to the teacher.

Always **WASH** your hands after practical work.

This list of rules is repeated in Appendix K (p. 83) and should be copied and displayed prominently in each laboratory. The teacher must decide if the pupil needs first-aid and if it is necessary to go to hospital or to see a doctor.

## 2. 2 Teacher's preparation for practical work

- From the very first practical class in first year pupils must be taught to use equipment without endangering themselves or others and essential practical techniques must be carefully demonstrated. Early practical work should set out to familiarise young people with simple, and absolutely safe equipment, taking it out, setting it up, putting it away. Teachers should proceed slowly to more complicated equipment and from safe materials to materials requiring extra safety precautions over the early years of training.
- All experiments or demonstrations should be tested in advance by the teacher in order to establish possible hazards before being performed with a class. It is often possible to choose alternative experiments or materials in order to avoid hazardous experimental procedures and chemicals.
- All potentially hazardous procedures should be demonstrated behind a safety screen. Pupils must wear safety glasses, goggles or a face shield where there is **ANY** possibility of injury to the eyes and must always wear them when laboratory work involves the use of chemicals. Teachers must set a good example of safe practice in classroom demonstrations and when practical work is in progress by wearing the appropriate safety equipment themselves and following all safety procedures.

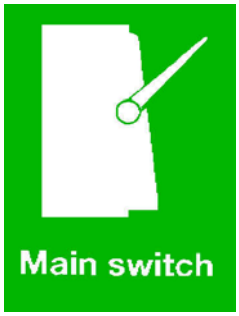
## 2. 3 Conduct and management of classes in laboratories

- Laboratory doors should be locked when laboratory is not in use.
- Only practical activities consistent with the laboratory layout and using appropriate equipment, should be carried out in science laboratories.
- Where theory classes are taught in the science laboratory, all equipment and materials present should be made safe.
- Practical work should not be allowed to commence or continue without the supervision of the science teacher.

- All equipment and materials essential for each practical class should be assembled before the class begins so that it will not be necessary for the teacher to leave the laboratory unattended.
- Experiments other than those authorised by the teacher should **not** be allowed.
- Clothing, laboratory coats and aprons should be such that they do not interfere with practical work or safety.
- Eating, chewing gum, drinking and smoking must **never** be allowed in the laboratory.
- Students should not climb on to the bench or stools in order to perform part of an experiment, e.g. pouring liquid into a burette or to observe demonstrations by the teacher.
- Movement of pupils during practical classes should be kept to a minimum.
- Details of any accident, however trivial, must be entered as soon as possible on the Laboratory Accident Record Book and then on the school/college accident report form and submitted to the school management (Appendix J, p. 82).
- Horseplay must not be tolerated in the science laboratory.

## 2.4 Cleaning up

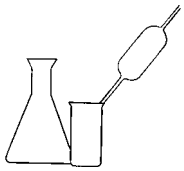
- A practical/demonstration class is never fully completed until all the apparatus and materials are safely stored away in their correct positions. Pupils should be trained to do this.
- Care should be taken with the proper disposal of waste material (2.6, p. 17).
- Damp cloths should be used for cleaning work benches. Disinfectants (based on sodium hypochlorite, gluteraldehyde, phenolic solutions, chlorohexadiene or a solution of alcohol >75%) should be used where necessary.
- Before leaving the laboratory, gas, water and electricity should be turned off. In addition, the main gas supply should be turned off at the end of the day (Appendix C, p. 65).




## 2. 5 Storage and stock control

- Only authorised persons should have access to chemical stores which should be kept locked when not in use.

- If practical work is to be carried out effectively teachers must plan ahead and keep an up-to-date stock book. Regular checks of chemicals and equipment should be made (Appendix C, p. 65). As an encouragement in this regard computerised systems (non-sophisticated) of stock control could be used.
- Damaged materials, especially glassware (chipped or cracked) and out-of-date chemicals must not be used.



## 2. 5. 1. Storage

All chemicals should be properly labelled in accordance with the European Classification Packaging and Labelling of Dangerous Substances Regulations (1994) and under the International Union of Pure and Applied Chemistry(IUPAC) system of classification (Appendix G, p. 71). Chemicals held and used in the school must be logged and recorded according to the Safety, Health and Welfare at Work (Chemical Agents) Regulations 1994 (Control of Chemicals). These Regulations require all employees to hold an up-to-date Material Safety Data Sheet[3] on **each** dangerous substance held in stock. The employer must also have written procedures in place to handle all foreseeable emergencies (worst possible situation), as well as written procedures for handling each chemical held in stock.
There are many accepted systems for the storage of chemicals. These are governed by three requirements:

- non-compatible chemicals are stored apart to prevent them mixing;
- hazardous chemicals are held in conditions which will reduce their known danger;
- chemicals are held in alphabetic order to facilitate retrieval.

### Chemicals should be stored in alphabetical order except for:

- **Winchesters** (2.5 $dm^3$) and large containers which should be kept at or near floor level but not on the floor.
- **Flammable solids and liquids**, which might react violently upon contact if breakage occurs, should be stored separately (Appendix D, p. 67).
- **Bottles containing concentrated acids or other corrosive liquids** should be kept on plastic drip trays at or near floor level.


- Keep **ethanoic acid** with organics.
- **Acids and Bases** should be stored separately (Appendix D. p. 67).
- It is inadvisable to store large quantities, e.g. more than one litre, of volatile flammable liquids in the laboratory. The maximum volume of such liquids stored should not exceed 2.5 $dm^3$. Flammable liquids should be stored in a

[3] *MSDS are now available for Irish Second Level Schools on the internet site http: //www.psi-net.org*

clearly labelled fire resistant steel cupboard with a metal tray of sufficient capacity to contain any spillage at floor level. Flammable material storage should be located as far as practicable away from escape doors. Reagent bottles of flammable liquids in the laboratory should not exceed 250 $cm^3$.

**Flammable liquids** should be stored in a cool, well ventilated area so that they can not come in contact with oxidising agents, particularly nitric acid, hydrogen peroxide and potassium manganate(VII) (potassium permanganate) (Appendix D, p. 67).

**Flammable solids,** e.g. Group I (Li, Na, K) and Group II (Be, Mg, Ca) metals and metallic hydrides ($BH_3$, $AlH_3$, $LiAlH_4$) should be stored separately, with phosphorus being kept apart from flammable metals.

Chemicals that give off **Noxious Vapours** e.g. fuming nitric acid, bromine, etc., should be stored where there is adequate ventilation to remove any vapours that may be accidentally discharged.

**Small cylinders of compressed gas,** e.g. hydrogen, oxygen, carbon dioxide, should be stored at floor level in a well ventilated, cool, dry place, away from heat or corrosive flames. They should be chained or clamped firmly in an upright position or used in the special stands which are available. All flammable gas lines should be fitted with a flash back arrestor. All gas pipes should be clearly labelled, indicating their contents at regular intervals.

**Cylinders of propane/butane must not be permitted in the laboratory**. Propane gas outlets should be piped from an outside cylinder rack or bulk cylinder.

**Chemicals**, particularly those stored in sealed glass containers, must never be stored in direct sunlight.

**Radioactive materials** must be stored in a safe and secure storage area, properly labelled, according to the procedures laid down by the Radiological Protection Institute of Ireland's (p. 77) licensing arrangements with the school.

**Pipettes and burettes** should be washed thoroughly after use and stored vertically to facilitate drainage (burette taps should be left open).

**Volatile solvents** with low flash point should be stored in a spark-proof refrigerator.

### 2. 5. 2 Stock control

When ordering hazardous materials and materials which are difficult to dispose of the quantities ordered should be kept to the minimum necessary (2 year's stock maximum). Non-hazardous stable and easily disposed of materials can be ordered in larger quantities (5 year's stock maximum). Never repeat a previous year's order without making sure that there is less than one year's supply of each material on the list.

- New stock should be date stamped on receipt and entered in a stock control book or computer records.
- Substances should be ordered in such amounts as to ensure a fairly rapid turnover (2 years max).
- Any stock which has lost its label or shows signs of deterioration must be disposed of by the recommended method (2.6. p. 17).
- Reagent bottles in the laboratory should be clearly labelled (2.5.1. p. 15 and Appendix G, p. 71).
- Inspection, for the purposes of disposal of out-of-date chemicals in store rooms, refrigerators, fume cupboards, laboratory's etc., should be undertaken at regular intervals (Appendix C, p. 65).

## 2. 6 Waste disposal

### 2. 6. 1. General

- In schools the quantities of toxic, noxious or otherwise hazardous materials which must be destroyed are usually unlikely to cause environmental damage if properly neutralised before disposal. Nevertheless, waste must be disposed of in accordance with the European Communities (Waste) Regulations, 1979 (S.I. No. 390 of 1979) that is, without danger to health or the environment, or it must be handed to a local authority or an EPA approved permit holder for disposal. Toxic and dangerous waste must be disposed of in accordance with the European Communities (Toxic and Dangerous Waste) Regulations, 1982 (S.I. No. 33 of 1982).
- Under the Local Government (Water Pollution) Act, 1977 and 1990 a licence is required for all discharges (other than domestic sewage and storm water) made to sewers. The local authority for the area should be consulted in relation to application for such licences. Licences are also required where discharges from the laboratory are made to rivers lakes or other waters. The local authority should also be consulted in such situations.

### 2. 6. 2 Chemical waste

- Subject to requirements which may be specified by the local authority in

relation to effluent disposal, dilution with large quantities of water and disposal via the laboratory drainage system may be used in the case of small amounts of acids, alkalis and solutions containing small quantities of metals.

- Mercury, when spilled, must be recovered if possible (p. 34). It should be stored in a labelled plastic screw cap bottle for recovery and recycling.
- Organic waste should be collected in labelled bottles for disposal. It should never be flushed down the laboratory sink. However, very small quantities may be disposed of by burning over waste ground or incinerated in a proper incinerator.
- Halogenated solvents must be recovered and purified by distillation for reuse. Waste residues should be disposed of by a licensed waste disposal company (see “Golden Pages”).
- In cases where teachers cannot safely dispose of waste chemicals it may be possible to:

  (a) refer to the Department of Education and Science Guidelines for the disposal of unwanted chemicals (Safety in the School Laboratory Disposal of Chemicals; published Autumn 1996; revised 2001).

  (b) obtain the co-operation of a large teaching institution or hospital which generates large quantities of similar waste and will have made provision for its regular collection and safe disposal;

  (c) consult the Health and Safety Authority (HSA) (Appendix L, p. 85).

  (d) consult a specialist firm dealing with such waste ("Golden Pages" Telephone Directory);

  (e) consult the Local Authority Environmental Section, e.g. County Council this is advisable in any case for all matters relating to waste disposal and Water Pollution Act requirements.

### 2. 6. 3 Biological waste

- Potentially infectious material, e.g. blood, serum, urine, bacteriological and fungal cultures, must not leave the laboratory unless it has first been treated in the autoclave. The safest method of doing this is to use autoclavable plastic bags. When autoclaving, it is desirable to separate disposable and reclaimable containers, e.g. glass.

- The remains of all non-infectious products and dissected animals should be placed in sealed plastic bags or other specially designed containers and then incinerated.
- The safest method of disposing of biological waste is by incineration.
- Disinfectants may be used to sterilise pipettes etc., which can not be autoclaved. Hospital type disinfectants are recommended and should be used according to the manufacturer's instructions. Some household disinfectants may not kill the germs. Hypochlorite disinfectants should be diluted to make a solution containing 2500 ppm of available chlorine and should be prepared daily. All materials to be disinfected should be completely submerged and air bubbles removed. Otherwise microbes will not be killed.
- Where recyclable laboratory ware is greasy it should be washed with soap and hot water and rinsed with cold water before sterilising.

### 2. 6. 4 Radioactive waste

- Radioactive waste must be disposed by special arrangement with the Radiological Protection Institute of Ireland (Appendix L, p. 84).

### 2. 6. 5 Glass and sharps waste

- Non-infectious or non-contaminated glass and sharps waste should be placed in metal bins and may be disposed of with domestic waste to land fill sites.

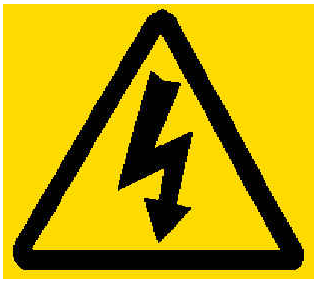
# CHAPTER 3

## Hazards and safety precautions

### 3. 1 General electrical safety precautions

These are safety precautions which are common to all sciences chemistry, physics and biology.

- Electric current passing through the human body can cause danger to life if it is greater than 20 mA a.c. (50 Hz) or 80 mA d.c. Pupils must not use high voltage power packs which can supply more than 5 mA d.c. on short circuit. All electrical equipment should be protected by a residual current device (RCD).
- No electrical apparatus, lead or connection should be touched with damp or wet hands or when standing on a wet surface.
- The connecting leads should be short. Trailing cables are very dangerous.
- Only one plug should be in each socket and the use of multi-adaptors should be avoided.
- If equipment is to be opened for examination it must be disconnected from the mains.
- All equipment not in use should be unplugged.



### 3. 2 Safety precautions in physics

#### 3. 2. 1 Electrical equipment

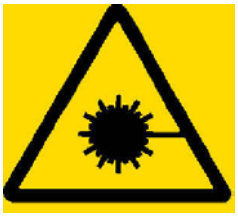
- Experiments involving the use of integrated circuits (IC) can sometimes be hazardous. If the incorrect connections are made to an IC overheating will result, which can cause the IC cladding to fracture ejecting broken pieces. These pieces can cause eye damage. The risk can be reduced by applying a little piece of adhesive tape on the IC before use.
- All large capacitors (>10 mF and 36 V) should be stored with a suitable resistor across the terminals, as they can recover as much as 10% of their original energy when not in use.
- Electrolytic separation should not be used with a.c.

### 3. 2. 2 Non-ionising radiation

**Lasers.** Only continuous wave lasers of power not exceeding 5 milliwatts should be used in schools.

**The following precautions should be taken when the continuous wave laser is in operation.**

- Make sure that the beam or its reflections are not directed towards the students as it could damage their eyes.
- Apparatus is arranged so that any reflections should occur in a vertical plane and not horizontal as this reduces the chance of irradiating students.
- Do not darken the room more than necessary so that the pupil of the eye is not over dilated.



- Keep the laser out of unauthorised student hands.
- Have a matt surface as a target to terminate the direct beam.
- Display a notice warning students, and instruct students before commencing each practical, not to look directly into the beam (Appendix G, p. 71).
- Generally it is good practice to arrange your experiments in such a way that the laser light is at waist level. This minimises the potential danger.

**Ultra violet lamps.** UV lamps may emit very intense radiation and can cause headaches, conjunctivitis and blindness if viewed directly for too long. Some people are more sensitive than others due to hereditary factors. Overexposure may not be recognised until hours, even days, after the incident. It can take weeks to get over the immediate injury and the person's eyes will always be very sensitive to strong lights thereafter.

- UV sources, even when in dark glass envelopes, should not be viewed directly.
- Burning magnesium and many other intense light sources have a high UV content.
- Unshielded mercury lamps should not be used. Care should be taken to prevent UV spillage when mercury lamps are used (i.e. UV radiation escaping out the side of an enclosed shielding).

**Stroboscopes and signal generators.** Light or sound vibrations at about 7 Hz should be avoided as they can cause dangerous and unpleasant effects. Excessive sound levels (in excess of 85 dB) should not be demonstrated. Excessive noise levels can cause headaches and temporary or permanent hearing damage.

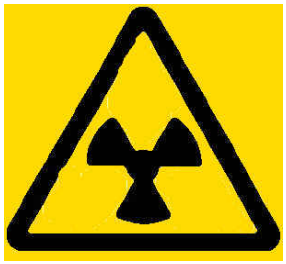
### 3. 2. 3 Ionising radiation

Extra precautions must be taken when handling sources of ionising radiation as there are usually no apparent indications of danger. Damage to tissue could result from exposure to such sources and this effect would not be immediately evident. The advice on radiation protection, set out below and in the Guidance Notes of Appendix H, will assist teachers and students in minimising exposure to the sources of ionising radiation used in school science and will ensure that this important topic can be studied in safety. It must be emphasised that students under 16 years of age must not be involved in experiments or demonstrations involving sources of ionising radiation. It is assumed that eating, drinking, smoking and the application of cosmetics are prohibited in the school laboratory.

The sources of ionising radiation used in school science are radioactive substances and equipment, such as discharge tubes, that are not designed for but are capable of emitting X-rays. Schools shall acquire only radioactive sources and equipment that meet the requirements set out in these Guidance Notes. If you are in doubt as to whether a particular radioactive source or piece of equipment will meet those requirements, further advice can be sought from the Regulatory Service of the Radiological Protection Institute of Ireland (RPII). Experiments and demonstrations using sources of ionising radiation must only be carried out in a laboratory suitable for such work.

Schools that have radioactive substances must take note of the following points:

- All radioactive sources must be of a type designed for the purpose of educational use and must be acquired only from a supplier licensed by the RPII to distribute such sources. Schools should not acquire or accept donations, however well intended, of radioactive sources that are designed for other purposes.
- Radioactive sources currently used in school science are almost exclusively in sealed form. The exception is the thorium or uranium compound used in the experiment to determine the half-life of radon (thoron) gas that is in unsealed form (see below).
- The number of sealed radioactive sources held by a school should be as low as possible.
- Students must be directly involved only with experiments that use sealed sources and then only under the supervision of the science teacher.
- A long forceps must be used when handling sealed radioactive substances.
- Radioactive sources must never be pointed towards the bodies of those handling the sources.



- All radioactive sources and their containers must have the internationally recognised ionising radiation trefoil symbol for ionising radiation hazard clearly displayed.
- The containers of radioactive sources must bear a label stating the radionuclide, the activity of the radionuclide and the type of ionising radiation emitted.
- Radioactive sources must be stored in a safe, secure and segregated location, preferably in the school laboratory preparation area/store. Disused or unwanted sources should be visually checked at regular intervals.
- Use radioactive sources only for as long as is necessary for the teaching purpose. Return the sources to their storage location immediately after the experiment or demonstration is completed. On completion of experiments, sealed sources must be immediately replaced in their lead pot and the pots returned to their containers. Practice runs of experiments without the actual radioactive sources may be helpful in this regard.
- Damaged or misplaced radioactive sources must be reported immediately to the teacher responsible for radiation safety.
- The experiment to determine the half-life of radon (thoron) must only be carried out by the teacher as a demonstration experiment. Ideally, this experiment should be carried out in a fume cupboard. The teacher must wear rubber gloves, dust mask and laboratory coat. The generator or any other unsealed radioactive source must not be handled by a teacher having cuts or abrasions on his/her hands.
- The apparatus used to determine the half-life of radon (thoron) must be of a type designed specifically for this experiment. The squeeze bottle, tubing and connections must be inspected regularly for the development of cracks or other malfunction. On completion of this experiment, the generator must be immediately returned to its storage location. Lead sheeting, of about 2 mm thickness, can be placed around the squeeze bottle to shield the teacher and students from the ionising radiation emitted by the thorium compound.
- Devices such as the Wilson Cloud Chamber apparatus or the thoriated gas mantle are not sealed sources but access to the radioactive substances therein is somewhat restricted. Nevertheless, experiments involving these sources must only be demonstrated by the science teacher. The same restriction applies to experiments involving ores or minerals, such as granite, containing naturally occurring radionuclides.

- There are currently no routes available for the disposal of the sealed and unsealed radioactive sources used in school science. Disused or unwanted sources must be safely stored until notification by the Department of Education and Science.
- Packaging that once contained radioactive sources must have all labels and other markings, indicating the presence of such sources, removed or defaced before disposing of the packaging material as ordinary refuse.
- Schools must keep up-to-date records of all radioactive sources held. These records must include the date of acquisition, the name and address of the supplier, the source type and serial number and the activity of each source.
- A record must also be kept of the usage of the radioactive sources. This record should include each date and time that a source was removed from its storage location and from its shielding, the time over which the source was used and confirmation that the source was immediately returned to its shielding and storage location at the end of the experiment or demonstration. The science teacher involved must sign each entry in the record.
- Schools that have equipment, such as discharge tubes and high voltage rectifier tubes that are capable of emitting X-rays should take note of the following points:
- Equipment, such as discharge tubes, that are not designed for but are capable of emitting X-rays (usually at voltages in excess of 5 kV) must be of a type designed for educational use and must be acquired only from a supplier licensed by the RPII to distribute such equipment. Schools should not acquire or accept donations, however well intended, of equipment designed to generate or capable of emitting X-rays. Wherever possible, hot cathode tubes should be used as discharge tubes.
- Students may only operate equipment capable of emitting X-rays while under the supervision of the science teacher.
- Equipment capable of emitting X-rays should only be operated for short periods.
- The beam of radiation from equipment capable of emitting X-rays must never be pointed towards students or teachers.
- Equipment capable of emitting X-rays must be shielded with lead sheeting. A lead thickness of about 2 mm will provide more than adequate shielding for this type of equipment.
- Equipment capable of emitting X-rays must be electrically isolated when not in use and placed in secure storage.

- Damaged or misplaced equipment capable of emitting X-rays must be reported immediately to the teacher responsible for radiation safety.
- Disused equipment capable of emitting X-rays must be rendered inoperable and may then be disposed of as ordinary waste equipment.
- Records must be kept of each item of equipment capable of emitting ionising radiation that is held by a school. These records must include the date of acquisition, the name and address of the supplier, the equipment type and identification number.
- A record must be kept of the usage of each item of equipment capable of emitting ionising radiation. This record should include the date and time that the equipment was removed from its storage location, the time over which it was used and confirmation that the equipment was immediately returned to storage at the end of its use. The science teacher involved must sign each entry in the record.

## 3. 3 Special Precautions in Biology

All schools and colleges must comply with the Safety, Health and Welfare at Work (Biological Agents) Regulations 1994) Appendix Q p. 104. These require each employer:

- to avoid the use of harmful biological agents;
- to prevent the exposure of employees to harmful biological agents at work; and
- to ensure that the level of exposure of employees is reduced to as low a level as necessary to protect the health and safety of employees and others.

### 3. 3. 1 Potential hazards from materials used in biology

- Care should be taken in the culture of all micro-organisms as pathogens (disease-causing organisms) carried by the culture may infect the student/teacher.
- Known or suspect pathogens should never be used. (Appendix Q, page 104)
- Petri dishes with cultures should be sealed with tape before class examination.
- Cultures must be killed by autoclaving before disposal.
- Some plant material commonly used in biology is poisonous if ingested, e.g. Digitalis (foxglove) and poisonous fungi.
- Some pupils may be hypersensitive towards various plant extracts and/or body fluids of certain animals and allergic reactions may occur.

- Animals kept in the school should be restricted to the species and numbers to which proper care can be given (space, water, ventilation, temperature control and freedom as defined by the ISPCA).
- The risks of infection from animals should be clearly understood. This is particularly serious with wild rats, badgers, birds and fleas etc., dead or alive.
- Animals for dissection should be obtained from accredited suppliers.
- "Specific Risk Material" which encompass the skull, including the brain, eyes, the tonsils and vertebral material from bovines and ovines should not be used in schools in the context of Bovine Spongiform Encephalopathy (BSE) {See S.I. No. 164 of 2001 European Communities (Specific Risk Material) (Amendment) Regulations 2001 for further information}. As an alternative, schools are advised to use pig eyes rather than those of the bovine (ox) and the ovine (sheep).
- Disposable gloves should be used at all times when handling or dissecting biological specimens.
- Gloves should be worn and care should be taken when handling materials preserved in formalin (methanal solution) as the vapour is irritating to the nose, throat, eyes and skin. Formalin should never be allowed to come into contact with hydrogen chloride with which it forms a known carcinogen. Preserved materials should be handled with gloves in a well ventilated area and thoroughly washed with water for at least four hours before use. For thorough washing the material should be completely submerged in a bucket (or suitable large receptacle) of water and the water continuously replaced by a running tap.
- Dissecting instruments should always be washed and sterilised after use.
- Materials for dissection or microbiological work must never be placed in refrigerators used for domestic purposes.
- Food for human consumption must not be stored in laboratory refrigerators.
- The use of Millon's reagent for protein studies is not recommended as it contains a high concentration of mercury. Depending on the nature of the protein, suitable alternative reagents should be used, e.g. Biuret, Sakaguchi, Albustix and Cole's modification of Millon's reagent.
- Ninhydrin reagent should be used only in a fume cupboard.
- Special care should be taken with antimony(III) chloride in the test for Vitamin A as it is very toxic.

### 3. 3. 2 Students as subjects of experiments

Experiments in physics, chemistry or biology which use pupils as the subject and are outside the range of normal everyday experience can give rise to a number of problems. The following guidelines are suggested.

- Pupils should not be forced to take part in such experiments.
- Pupils not permitted by a parent, guardian or doctor to take part in normal school P.E. activities must not take part in investigations on the effects of exercise on respiration, pulse rate, etc.,
- Samples of blood must **NOT** be taken.
- Experiments must not be carried out in which biological, chemical or physical means (e.g. drugs or electrical stimulation) are used to affect the mental state of the subject.
- Before testing the ability to taste phenylthiocarbamide (PTC) (phenylthiourea) teachers should be aware of the poisonous nature of PTC. Only the paper strip method should be used and no student should taste more than two strips each containing no more than 0.1 mg/strip. (PTC is toxic, $LD_{50}$ orally in rats is 40 mg/kg. This means that if you take 100 rats each weighing 1 kg and you administer 40 mg to each rat then 50 of them would die in 24 hours from the effects. Humans are generally more sensitive than the extrapolated $LD_{50}$ based on rats would suggest.)

### 3. 3. 3 Disposable and ordinary syringes

- Disposable syringes must never be obtained second hand from any source, e.g. hospitals, as they cannot be sterilised.
- Syringes used for nutrient solutions may promote the growth of micro-organisms and should be destroyed by incineration after use.
- Care should be taken by the teacher to ensure that no syringes of any type are taken from the laboratory.
- Excessive pressure on a syringe fitted with a needle can cause the needle to blow off and the liquid to spray out and either or both could strike another student.


- Used disposable syringes and needles should be placed in a contaminated sharps box (a special commercially available yellow plastic box into which syringes/needles can be placed where they will not present a danger to teachers or students). This box should be kept locked away when not in use and should be disposed of by incineration when two/thirds full.

### 3. 3. 4 Steam sterilising

Large autoclaves need periodic testing and certification to ensure that their chambers reach a temperature high enough to sterilise their contents. Certification is not considered necessary with domestic-type pressure cookers. However, they should be checked to ensure that they can achieve the necessary temperature to sterilise their contents. All pressure vessels are dangerous unless properly used and serviced.

**The following rules apply to the use of both autoclaves and pressure cookers.**

- Bottles containing media for sterilisation must have their caps loosened before autoclaving.
- Never exceed the pressure for which the piece of equipment was designed.
- Fill with water to the specified level.
- All air should be expelled from the machine before the steam vent is closed.
- Never overload and ensure that openings to the pressure valve and the safety valve are not obstructed.
- After use allow the pressure to fall to atmospheric pressure (or below 80$^{o}$C) before opening. Do not rely on a fitted pressure (temperature) gauge being accurate.
- Open with care, lift the side of the lid away from you first and use it as a shield.
- Wear a visor and heat-resistant gloves when opening and unloading.

### 3. 3. 5 Field trips

**Before taking pupils on a field trip the teacher should:**

- Examine the site for hazards;
- Obtain the local telephone numbers of doctors, hospital, gardaí, rescue services;
- Obtain the location of local public telephones in the area of the field trip or carry at least two fully charged and paid up mobile phones;
- Pupils should be fully instructed about all the potential hazards of the area that they may encounter;
- Pupils should dress properly for the area and the weather;
- A basic first-aid kit should be brought (Appendix B, p. 64);

- The use of glass collection jars and containers should be avoided plastic containers (bags and bottles) are much safer, and
- Detailed information must be left with a responsible person stating the location of the field trip and the expected time of return. This person must be informed of any delay as soon as possible.

## 3. 4 Special hazards with chemicals

While sensible precautions should be taken when carrying out any experimental work in the science laboratory, this is particularly necessary where experiments involving the use of chemicals are concerned. At school level, therefore, it is probably best to assume that all chemicals may cause injury if proper care is not taken. Many chemicals are poisonous, corrosive, irritant, harmful, flammable or explosive. If in doubt, check the label. If necessary, consult;

- the Material Safety Data Sheet (MSDS), provided by the chemical supplier;
- the internet at http: //www.psi-net.org/ (for MSDSs specially prepared for the needs of Irish second level schools);
- "Safety in the School Laboratory Disposal of Chemicals", Department of Education and Science; and/or
- a suitable reference book (Bibliography, p. 111).

It is important to appreciate that different forms of the same substance (e.g. dust, vapour, gas) can present very different levels of risk and a combined or sequential exposure to a variety of substances may have additive effects. When considering the risks associated with a hazardous substance, it is important to appreciate that the school is different from a chemical factory. Typically in a school a range of hazardous substances are used in small quantities and on an irregular basis. Thus continuous exposure to levels in excess of the OEL are most unlikely to occur. However, it is equally important to recognise that most of those working with hazardous substances in the school are young people and may be more at risk from the chemicals (e.g. a girl may not know she is pregnant during the most vulnerable period of her pregnancy). On these grounds it is most important that the teacher always errs on the side of caution and safety and never knowingly takes a chance.

The teacher has a general **DUTY OF CARE** to these young people in their care and part of their scientific education involves **learning to work safely** with substances that can present hazards to their health and safety. It should be remembered that some hazards (e.g. lead) may present a greater risk to young

people than to members of the teaching or technical staff in the school. Occupational exposure limits (OEL) may appear unnecessary as people are not exposed to any substance for 40 hours per week. However, OELs or maximum exposure limits (MEL) (where they may be given) must never be exceeded and towards this end safety precautions, safe work practices and good housekeeping are essential.

### 3. 4. 1 General principles of chemical safety

**The following short list of general principles should be adopted.**

- Always use a spatula when working with solid chemicals.
- Solutions and chemicals spilled on the floor or bench should be cleaned up immediately. A respiration mask (with suitable carbon filter) should be available for wearing when dealing with a spillage of volatile chemicals which might give off harmful vapours.

- Safety spectacles must be used for all experiments, particularly those involving heating, chemicals or where splashing may occur.
- When carrying out investigative experiments, such as the effect of heat on substances, only very small quantities (10-100 mg) should be used.

- Should chemicals come in contact with skin the affected area must be washed thoroughly with water (or soap and water) and reported to the teacher.
- Highly concentrated solutions of reagents must only be used when absolutely necessary. A commonly used concentration is 10% (≅3 M). However, when using reagents known to be vigorous in their reaction 5% (≅1. 5 M) or 2% (≅0. 5 M) is more appropriate (Appendix M, p. 86).
- All gas cylinders should be securely shut off at the cylinder valve when not in use. They must always be shut off at the end of the day.
- Fume cupboards must be used when toxic, harmful, corrosive or irritant vapours are being emitted. Chemical fumes should not be inhaled.

## 3. 4. 2 Explosions

All unplanned explosions even when no one is injured should be reported as serious potential incidents to the Principal and should be recorded in the Laboratory Accident Record Book.

### Some of the more common causes of accidental explosion

**Ignition of hydrogen:** Whenever hydrogen is burned in experiments there is a danger of hydrogen/air mixtures exploding. A safety screen should be used and eye protection worn. Keep the volume of the apparatus through which the hydrogen is passed to a minimum.

**NB** (i) Before igniting hydrogen coming from a gas preparation apparatus, a sample test-tube full of the gas should be collected and tested at a distance not less than 2 metres from the apparatus. This should be repeated until the gas burns quietly without an explosive pop.

(ii) Hydrogen from a gas cylinder fitted with a flashback arrestor provides a convenient alternative and safer source of hydrogen. The faster flow rate (which can be obtained) will flush air out of the apparatus much more easily. Similar precautions should be taken in the reduction of a metal oxide by heating in hydrogen.

**Chlorates:** These should never be mixed with easily oxidised materials such as sulfur or phosphorus. The preparation of oxygen using potassium chlorate(V) /manganese(IV) oxide mixture must be replaced by the release of oxygen from hydrogen peroxide (20 vol.) in the presence of a catalyst such as manganese(IV) oxide. Concentrated strong acids should not be added to chlorates. Lead and zinc chromates are suspected carcinogens.

**Preparation of chlorine:** Explosions have occurred when chlorine was prepared from concentrated hydrochloric acid and potassium manganate(VII) (potassium permanganate) either because of accidental contamination with sulfuric acid or the inadvertent use of concentrated sulfuric acid.

**NB** This experiment should only be demonstrated by the teacher using a fume cupboard and the use of manganese(IV) oxide (manganese dioxide) is recommended.

**Oxidants:** Ammonium nitrate should **not** be heated because of danger of explosion. Manganates (permanganates) and sodium peroxide are powerful oxidants and their use requires care.

### 3. 4. 3 Violent reactions

The following list and Appendix E (p. 69) indicate a number of hazardous materials or mixtures which can react suddenly and violently with little or no warning.

- strong or concentrated acids with strong or concentrated bases;
- oxidizing agents with:
  (a) metal powders or
  (b) reducing agents;
  metal hydrides in contact with water;
- alkali or alkaline earth metals with water, acids or chlorinated solvents (potassium, sodium, and phosphorus must be used only in very small quantities and with due understanding of their properties. Delayed action fires have been started by carelessly discarding sodium, peroxide or phosphorus into waste boxes or plastic sinks);
- hydrocarbons with halogens, chromic acid or peroxides;
- concentrated nitric acid with alcohol mixture usually reacts only after some delay and with violence, if either is contaminated, and reacts violently with many organic compounds;
- **controlled explosions:** explosions of mixtures of hydrogen and oxygen should not be carried out in glass bottles but may be carried out in small plastic bags (250 $cm^3$) or balloons.

### 3. 4. 4 Other chemical hazards

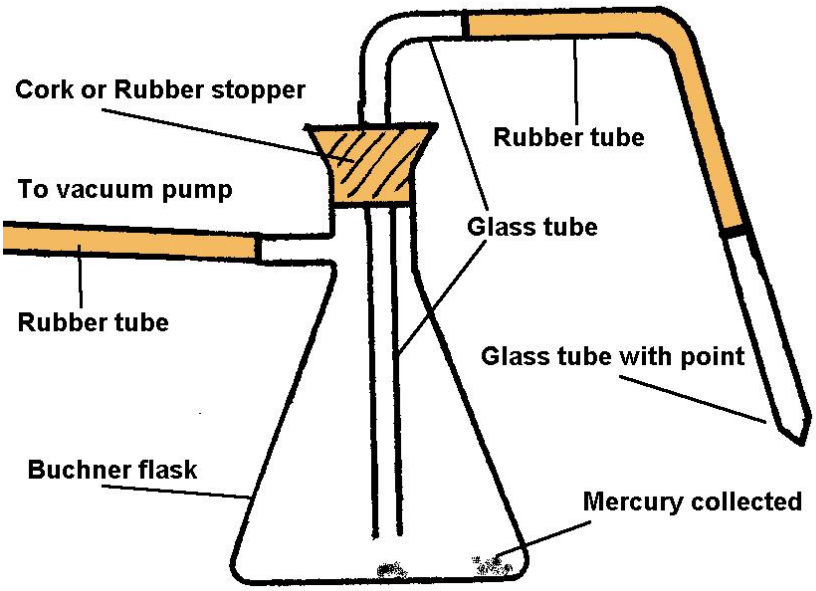
**Alkaline solutions** are especially dangerous, 50% NaOH in the eyes can cause permanent blindness in 15 seconds.

- **Dibenzoyl peroxide (benzoyl peroxide):** When it is allowed to become dry or when heated above 40°C it has been known to cause explosions. Its role as a catalyst in several organic polymerisations can be more safely taken over by dodecan-l-oyl peroxide (lauroyl peroxide).
- **Bromine** and **iodine** vapour are dangerous to nose, lungs and eyes.
- **Liquid bromine bottles** fracture easily. It is safer and more convenient to buy bromine in packs of sealed ampoules each containing 1, 2 or 2.5 $cm^3$.

- **Carbon disulfide** is extremely flammable and explosive. Its vapour is toxic and it can be absorbed through the skin. It should not be used in school laboratories.
- **Chlorine** and **hydrogen sulfide** should only be prepared in an efficient fume cupboard as should ammonia, hydrogen chloride, the oxides of nitrogen and sulfur(IV) oxide.
- **Ethoxyethane (Diethyl ether or ether)** readily forms peroxides which can accumulate to cause a dangerous explosion. The presence of peroxide can be tested by using acidified potassium iodide solution. Accumulated peroxides in ether can be destroyed by washing the ether solution with a solution of a reducing agent, e.g. iron(II) sulfate. Diethyl ether should not be prepared in school laboratories as it is highly flammable. Being dense the vapour has been known to cause explosions by rolling along the floor or bench to a lighted flame or electrical appliance some distance away.
- **Halogenated hydrocarbons**: e.g. tetrachloromethane ($CCl_4$) (not recommended in school laboratories), iodomethane ($CH_3I$), 1,2-dichloroethane ($ClCH_2CH_2Cl$), chloromethyl benzene, (benzylchloride) ($C_6H_5CH_2Cl$) and trichloromethane ($CHCl_3$) are toxic, irritating to eyes, respiratory system and skin and they can be absorbed through the skin. All are dangerous to the ozone layer and it is for environmental reasons rather than their toxicity to humans that they have been banned in school laboratories. 1,1,1-Trichloroethane is now classified as a Class 2 Carcinogen and must not be used in school laboratories. (Bromine water should now be used to test for unsaturation.)
- **Hydrogen peroxide**: "100 volumes" (30% w/w) must not be handled by students. It is safe to store in a well ventilated area in plastic bottles (out of sunlight) provided that it is kept free from impurities which could catalyse its decomposition. Students should not use concentrations of greater than "20 volumes".
- **Hydrolysable substances** present hazards because the products may cause a dangerous build-up of pressure if the stopper becomes jammed. Silicon tetrachloride is particularly dangerous in this respect and has caused several accidents with the bottle exploding. Bottles of phosphorus(III) chloride, sulfur dichloride oxide (thionyl chloride), benzoyl chloride, ethanoyl chloride (acetyl chloride), bromine and aluminium chloride should all be opened with considerable caution.

- Mercury if used without special care can give rise to dangerous concentrations of vapour, especially in warm and poorly ventilated places. The vapour is very toxic if inhaled over a long period and has a cumulative toxic effect on all tissues, particularly the kidneys. The use of mercury should be avoided where possible. If used manipulation should take place over a mercury spillage tray or plastic basin.

**Mercury Spill Collection Pump**




Mercury surfaces should not be exposed to the atmosphere for any length of time (cover with oil or water). Mercury from spillage trays or broken thermometers should be recovered immediately using a capillary tube attached to a Büchner flask and vacuum pump (e.g. mercury spill collection pump).

Mercury which is lodged in cracks or crevices should be sprinkled with a paste made by mixing a 50/50 mixture of calcium hydroxide and sulfur powder in a little water.

This should be left overnight or longer before cleaning up. As an alternative to sulfur pour zinc dust over the affected area to form an amalgam. Again it should be left overnight or longer before cleaning up.

Mercury must never be used for playing games in the laboratory. All mercury waste should be disposed of in accordance with the methods described in 2.6.2 (p. 18).

If spectral lamps which may contain hot mercury vapour are broken, the area should be evacuated for a short time and ventilated.

**Phenol** is a corrosive, toxic, skin and eye irritant and can cause dermatitis.

**Phosphorus**. A school laboratory usually possesses both red and white phosphorus. The red amorphous allotrope should be stored in a well stoppered bottle and few precautions are necessary when using it. The white (yellow or waxy) phosphorus is kept under water in a glass bottle. When using it, the phosphorus should be withdrawn by means of crucible tongs and placed in a flat-bottom vessel (or evaporating basin in a sand tray) containing water. The phosphorus should be cut while under water and placed on a filter paper to dry. This allotropic form must never be touched by the hands especially when dry. The heat of the body is sufficient to ignite the phosphorus.

**Polymers**: Experiments in which polymers are being prepared or heated should be carried out in the fume cupboard, as toxic, harmful, and/or irritating fumes may be produced. Particular care should be taken with the following monomers.

**Phenylethene** (*styrene*) Harmful and Category 3 carcinogen.

**Methanal** (*formaldehyde*) Irritant, Harmful and Category 3 carcinogen.

**Methyl-2-methyl propionate** (*methyl methacrylate*) produced by depolymerisation of Perspex is volatile, highly flammable and toxic by inhalation.

**Tollen's reagent** (*ammoniacal silver nitrate*): This solution can become explosive due to the formation of silver azide. The reagent should not be stored but should be freshly prepared when required and disposed of immediately after use.

### 3. 4. 5 Carcinogens

Carcinogenic chemicals always carry the toxic symbol and the risk phrase R 45 "May cause cancer", R 40 "Possible risk of irreversible effects" or R 49 "May cause cancer by inhalation". Carcinogens are classified as Category 1, Category 2 and Category 3 carcinogens depending on their potential to cause cancer in humans. The use of Category 1, Category 2 and Category 3 carcinogens in the work place is governed by the Safety, Health and Welfare at Work (Carcinogen) Regulations 1993 (Appendix P p. 100), the Guidelines to the Regulations and subsequent amendments.

## These Regulations require each school which carries a Class 1 or 2 carcinogen to:

- Carry out a risk assessment and establish exposure levels to the carcinogens used. This can be particularly difficult as there are no known safe Occupational Exposure Levels (OELs) for some carcinogens so the level must be zero;
- Put in place strict safe work practices and procedures;

- Provide information to the Health and Safety Authority;
- Prepare emergency procedures for unforeseen exposure;
- Have in place special hygiene arrangements as deemed necessary by the Health and Safety Authority;

- Provide information and training to all persons who would be exposed;
- Inform the employees/teachers of the hazards;
- Carry out health surveillance of all employees and students exposed;
- Record the records of the health surveillance, the risk assessment, all inspections as well as the carcinogens used, the level to which the persons were exposed and a list of the persons exposed. These records must be held for up to 40 years from the time of the last exposure.

The Safety, Health and Welfare at Work (Carcinogen) Regulations 1993 and Guidelines to the Regulations classify carcinogens under three headings.

**Category 1 carcinogens.** These chemicals have been identified by competent authorities to have the potential to promote cancerous cells in the human body after an unqualified exposure period. These chemicals are identified by either of the risk phrases **R 45 "may cause cancer" or R 49 “May cause cancer by inhalation”**. (This category closely relates to the US “Human Carcinogen” category.)

**Category 2 carcinogens.** There have been no confirmed reported cases of these chemicals causing cancer in humans. They have however, been identified by competent authorities to have the potential to promote cancerous cells in experimental animals and for safety reasons must be treated in the same way as category 1 carcinogens. They have the risk phrase **R 45 "May cause cancer"**. (This category closely relates to the US “Experimental Carcinogen” category).

**Category 3 carcinogens.** There have been no confirmed reported cases of these chemicals causing cancer in humans or in animals but they are structurally related to known carcinogens in categories 1 and 2. They are labelled with the risk phrase **R40 "Possible risk of irreversible effects"**. They do not fall under these regulations but an employer in whose premises such substances are used should follow the same broad approach of risk assessment and control as is required for categories 1 and 2 under the Carcinogen Regulations. (This category closely relates to the US "Suspect Carcinogen" category.)

A list of substances classified as category 1 and category 2 carcinogens (R 45) and (R 49) in Directive 67/548/EEC are given in Appendix P (p. 100).

**Note:** Almost all of these category 1 and category 2 carcinogens would never have been used in science laboratories at second level.

Today, many chemicals which were used routinely or are recommended in practical text books have been reported as category 1 or 2 carcinogens. Persons exposed may not become aware of the potential hazard or appreciate the devastating effects of lax work methods until many years later. **It is important, therefore that schools should never use category 1 or 2 carcinogens.** The long term potential cost completely outweighs any short term educational advantage such chemicals might give.

**Remember;**

1,1,1-Trichloroethane, chloroform and carbon tetrachloride must not be used in school laboratories.

### 3. 4. 6 Do not use these chemicals

**Asbestos**: Inhalation of asbestos dust is known to cause cancer many years after the exposure. Asbestos and asbestos products **must not** be used in school laboratories. Asbestos can be replaced by suitable alternatives, e.g. Kieselguhr as a filtration aid and sinter glass crucibles for gravimetric analysis. Professional help is required to remove asbestos lagging and in the disposal of all asbestos waste. "Safety in the School Laboratory Disposal of Chemicals" Department of Education and Science 2001

**1,2-Dibromoethane**: When testing for unsaturation in organic compounds bromine water or acidified potassium manganate(VII) should be used rather than a solution of bromine in an organic solvent.

**Bis-(chloromethyl) ether**: This is a carcinogen that can be formed when methanal reacts with hydrochloric acid. Therefore methanal and hydrochloric acid should be stored well apart.

**Benzene** should not be in a school laboratory; methylbenzene (toluene) is a safer substitute for benzene as a solvent .

**The following chemicals are highly suspect and their use is not recommended in school laboratories.**

**Iodomethane** and **chloromethyl benzene (benzylchloride)** have been shown to induce cancer in laboratory animals.

**Phenylamine** (aniline), t**richloromethane** (chloroform), **tetrachloromethane** (carbon tetrachloride), **diazomethane**, **hydrazine** and **nitrobenzene** are highly suspect category 3 carcinogens and should be used in an efficient fume cupboard and the hands should be protected by the appropriate gloves.

**Chromates** of **lead** and **zinc** are category 3 carcinogens.

Many other chemicals are known to be harmful. The label and the safety symbol used will indicate the nature of the hazard (Appendix H, p. 77). If in doubt consult the MSDS, http: //www.psi-net.org your chemical suppliers MSDS, Appendix O p. 95, or Safety in the School Laboratory Disposal of Chemicals, Department of Education and Science 2001.

# CHAPTER 4

## Emergency procedures

### 4. 1 Evacuation scheme

- The school management is responsible for fire prevention arrangements and for co-ordinating all emergency procedures but may delegate such organisation to a named member of staff in accordance with the Safety Statement (Appendix N, p. 87).
- It is of the utmost importance that an evacuation scheme should exist to enable pupils to leave the laboratory rapidly and safely in the event of an emergency such as fire, gas leaks, flooding, risk of explosion, etc.
- Details of the scheme should be displayed prominently and should be maintained in a legible condition.
- The scheme should contain specific arrangements for summoning emergency services such as fire brigade, ambulance, etc. These arrangements should clearly show what to do when a fire is discovered:


  - raise the alarm;
  - evacuate the building;
  - summon emergency services such as fire brigade, ambulance, etc., (and indicate where the fire is); attack the fire if trained and it is safe to do so.
- The scheme should contain the procedures on what to do on hearing the alarm:
  - leave the building by the nearest route;
  - close doors behind you; report to your Assembly Point;


  - stay at your Assembly Point until told to return to the building.

- Regular practices should be carried out to familiarise both pupils and teachers with the recommended procedures.
- Escape routes must be kept free from obstruction and exit doors should easily and immediately open from the inside.
- Regular inspections should be made of the fire fighting equipment and fire warning systems.
- A complete list of the quantity of all pressurised gas cylinders and hazardous chemicals held in the laboratory, and their location in the laboratory, should be

available for inspection by the Fire Brigade personnel on arrival in the event of a fire. This list should be kept in a secure place ideally the principal's or the secretary's office but not in the laboratory or in offices adjacent to the laboratory. This list should be updated at set times (Appendix C, p. 65).

## 4. 2 Fire

Fire is one of the most common hazards encountered in the science laboratory due to the presence of:

- flammable liquids, many with low flash points, (Appendix F, p. 70);
- substances which ignite spontaneously such as phosphorus;
- substances which liberate oxygen readily such as chlorates or nitrates;
- gas cylinders or gas supply lines.

All these hazards are present in an environment where heating is usually carried out using the naked flame of a Bünsen burner. Fortunately, the vast majority of fires which occur in laboratories are easily smothered using a notebook, a damp cloth, a fire-blanket or sand. Some may require the use of a fire extinguisher or professional assistance from the fire brigade. It is extremely important for school management and teachers to understand fire classifications and to know the appropriate response.

### 4. 2. 1 Fire classification

Methods of fighting a fire depend on the class to which the fire belongs. The wrong choice of extinguisher can intensify a fire, endanger the fire fighter by causing the emission of highly toxic gases or by causing the fire to flare up. The four different classes of fire are identified according to the European Standard EN2 as follows:

**Electrical fires:** These are nowadays **NOT** considered to constitute a fire class, since any fire involving, or started by, electrical equipment must in fact belong to one of the four mentioned classes. The normal procedure in such circumstances is to cut off the electricity and use a suitable extinguishing method. Only when this cannot be done with certainty will the use of non-conducting extinguishing agents such as vaporising liquids, dry powders, or carbon dioxide be required.

**Class "A"** All fires involving **solid materials** normally of an organic nature (compounds of carbon; e.g. wood, paper, coal). This class of fire is the most common and is effectively extinguished with water in the form of a jet or spray.

**Class "B"** All fires involving **liquids or liquefiable solids** (petrol, alcohol, ethanoic acid, fat). As a general rule the extinguishing agents are foam, vaporising liquids, carbon dioxide and dry chemical powders.

**Class "C"** All fires involving **gases or liquefied gases** (ethane, propane, hydrogen) in the form of a liquid spillage or a liquid or gas leak. Foam or dry chemical powder can be used to control fires involving shallow liquid spills. **NB** Turn off gas before extinguishing flame where possible.

**Class "D"** These are fires involving **metals** (sodium, potassium, magnesium). Only powdered graphite, powdered talc, soda ash, limestone and dry sand are normally suitable as extinguishing media.

### 4. 2. 2 Fire extinguishers


- All laboratories and preparation rooms should be equipped with a bucket of dry sand, a fire blanket (woven fibre glass, for smothering small Class B fires), and with a suitable fire extinguisher, either the dry powder or carbon dioxide type.
- The colour of the body of water extinguishers should be entirely "signal" red. The colour of the body of other types of extinguishers should be predominantly red with the label colour coded to identify the extinguishing medium. The suitability of a fire extinguisher for dealing with a fire depends upon the class of fire as indicated next.

The fire extinguishers above are not suitable for Class D fires. The label on extinguishers should indicate the class of fire(s) for which the extinguisher is suitable and the size of fire which may be extinguished. Teachers should familiarise themselves with the fire extinguishers in their laboratories and know how to use them before an emergency arises.

| Colour of Label | Extinguishing Medium | Fire Classification | | |
|---|---|---|---|---|
| | | Class A | Class B | Class C |
| | | Solid combustibles | Liquids | Gas |
| Red all over | Water | Yes | No | No |
| French Blue<br>1<br>2 | Powder<br>'BC' Powder<br>'ABC' Powder | <br>No<br>No | <br>Yes<br>Yes | <br>Yes<br>Yes |
| Black | Carbon dioxide | No | Yes | No |

### 4. 2. 3 First response fire fighting

In the event of fire the most important consideration must always be human safety. If there is a fire the first priority is to immediately evacuate the pupils, raise the fire alarm and summon the fire brigade. However, prompt action with portable fire fighting equipment, when it can be taken without personal risk, will extinguish the vast majority of fires. When doing this always keep between the fire and the door. If attempts to extinguish the fire cannot be continued with safety, or if the fire is getting out of control, leave the room and the building, close all doors and windows and leave the lights on. Check that nobody is left behind as you go. Then proceed to the Assembly Point.

## 4. 3 First Aid

Under the Safety, Health and Welfare at Work (General Application) Regulations, 1993 Part IX[4] where working conditions require, all places of work including schools must have adequate first-aid arrangements. At least two staff members should hold First Aid certificates awarded by a recognised body in the previous three years. Their training must include general school accidents as well as accidents in the school laboratory.

The first-aid Regulations are **"Risk Driven"**. All schools/colleges will have some provision for equipment but not all need have occupational first-aiders. The amount of first-aid equipment required should be related to their needs and will depend on the risk assessment carried out when drawing up the safety statement. The needs of the school will also reflect the geographic lay out of the school, the distance from the nearest hospital casualty emergency unit or medical treatment facilities and the availability of emergency transport. The school management should appoint a named individual in charge of first aid equipment. A list of the suggested contents of a first aid kit for science laboratories is given in Appendix B (p. 64).

It is recommended that all teachers become familiar with the elementary principles of first aid. It is advisable that all members of staff who are qualified to

[4] *Irish 1993 First Aid Regulations*

give first aid treatment should be immunised against hepatitis B. The material given in this handbook is basic and general and it is not intended as a first aid course. Its purpose is to highlight good first aid principles of which all science teachers should be aware. It should be remembered that first aid is a strategy vital to prevent loss of life and further deterioration in health following accidental injury or sudden illness.

### First-aid is given to:


- sustain life;
- prevent deterioration in existing condition;
- promote recovery.

### 4. 3. 1 Philosophy of first aid

It is important to remember that first aid treatment aims at preventing a deterioration in the condition of the casualty and making him/her comfortable and at ease while awaiting the appropriate medical assistance. For this reason the treatment must involve the minimum of interference with the casualty who should be continually reassured by voice and touch. Even a seemingly trivial accident may cause the casualty to suffer from shock. Close and continual observation and verbal or contact reassurance is required. Shock arises from a lowering of the vital functions of the body and it can be fatal.
A clear line of communication should be established with the emergency agencies, the local doctor, hospital and garda authorities. When an accident occurs medical help should be sought immediately.

### 4. 3. 2 Priorities of first aid

According to the Department of Health and Children's "Education Unit First Aid index chart" it is important to determine the priorities of treatment in accordance with the following order:

- Breathing.
- Unconsciousness.
- Bleeding.
- Eye injuries.
- Shock.
- Poisoning.
- Burns.
- Other limb injuries.

### 4. 3. 3 Breathing difficulties

- When a person finds it hard to breathe due to exposure to fumes get him/her into fresh air.
- Loosen any tight clothing.
- If the person has stopped breathing apply artificial respiration. It is important to begin this immediately as the first seconds are vital.
- Pull the casualty clear from immediate danger of further injury, except in the case of electric shock (Electrocution 4. 3. 9. 1, p. 51).
- Check to see if the casualty is conscious, by shaking the shoulder and shouting "Are you all right".
- If there is no response send for help.
- Lay the casualty on his/her back and open an airway.
- Firstly, remove dentures, if any.
- To open the airway put one hand under the neck and the heel of the other hand on the forehead.
- Tilt the head back so that the chin is pointing straight up as in Fig. 1. Look out for possible head and neck injuries.

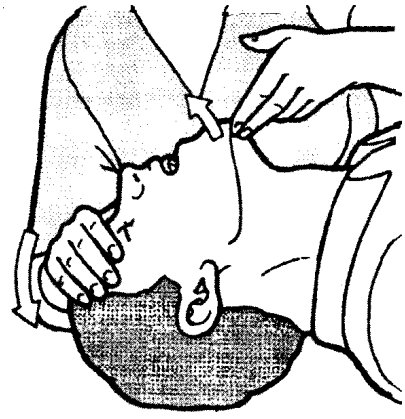


Fig 1

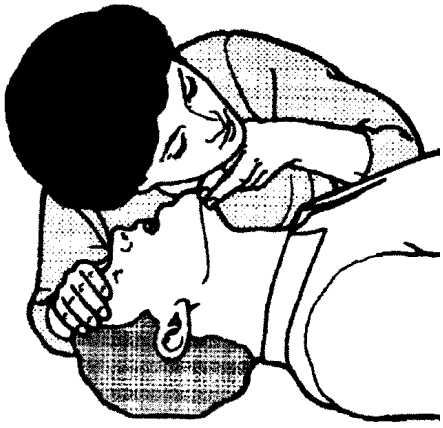


Fig 2

- To help ensure that the head is properly tilted, place the fingers of your lower hand on the chin as in Fig. 2.
- If a neck injury is suspected roll the patient over carefully with the aid of a rolled up towel to keep the body and head straight.
- See if the casualty is now breathing. You can do this by putting your ear close to the casualty's mouth. Listen for breathing sounds, look for chest and stomach movements and feel for breath on your cheek.
- If the victim is still not breathing, open the mouth and pinch the nostrils with the hand that is on the forehead. Seal your lips tightly around the mouth and blow firmly, watching the chest wall (Fig. 3).

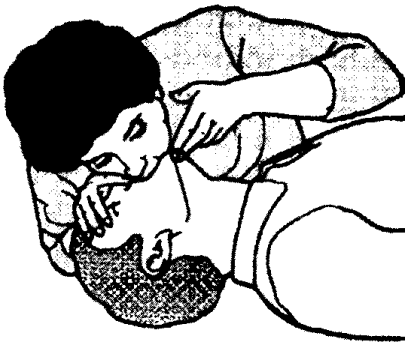


**Fig 3**

- Stop when the chest wall begins to rise.
- Remove your mouth and allow the chest wall to fall so that the process can be repeated.
- The cycle should take 4-5 seconds (12-15 times per minute).
- If the chest cannot be inflated remove any obstruction from the mouth and throat. If necessary this can be done by turning the casualty on his/her side and giving a hard slap between the shoulder blades.
- The process should be continued until the casualty recovers or until medical help arrives.
- If the casualty does recover put him/her into the recovery position (semi-prone position) (Fig. 4). In this position the casualty is lying on his/her side supported by one leg and one arm, with the head away from the hand.

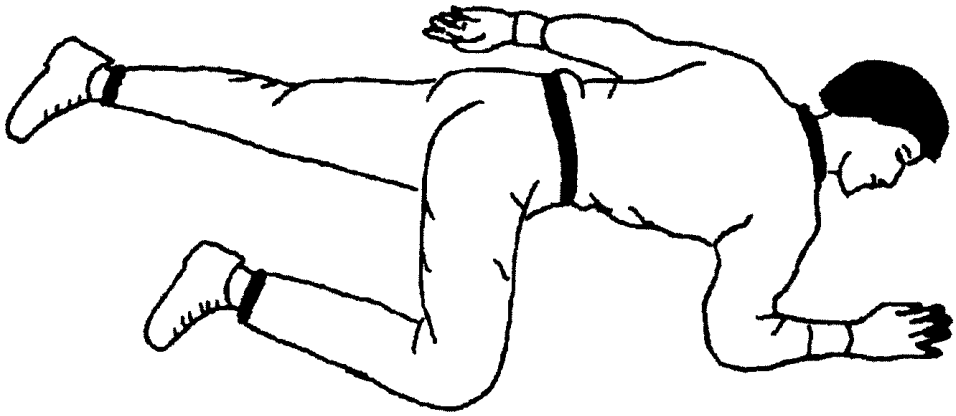


**Fig 4**

### 4. 3. 4 Unconsciousness

- If the casualty is breathing normally, place him/her in the recovery position.
- Remove dentures, if any.
- If he/she has stopped breathing, begin resuscitation immediately.
- The cause of unconsciousness should be investigated. It may be due to a head injury, diabetes, epilepsy, poisoning or fainting.
- Never give anything to drink when the casualty regains consciousness, especially alcohol.

### 4. 3. 5 Bleeding

The majority of wounds will not involve large blood loss. While the treatment is straight forward, the casualty and onlookers may be alarmed by the blood and so they should all be reassured. Never allow your hands to become contaminated with blood. Medical rubber gloves **must** be worn when treating any wound involving the loss of body fluids including blood.

#### 4. 3. 5. 1 Severe and moderate bleeding

- Apply a clean dressing with a firm constant pressure. This should be held in position until the bleeding stops.
- If the wound area is large, the sides of the wound should be pressed firmly but gently together.
- If there is a foreign body in the wound, such as broken glass, place a ring bandage (made by rolling cotton wool or a handkerchief and making it into a circle) to surround the injury. Then bandage over the wound so that no pressure is applied to the injury and it is protected from further contamination. This prevents the material being pushed further in.

- The casualty should be laid down in a comfortable position with the feet higher than the body.

- The injured limb should be raised and supported above the body height to reduce the blood supply to the injured limb so long as a fracture is not suspected.
- Cover the wound with a clean dressing and apply a pressure bandage as soon as possible.
- Send patient to hospital.

### 4. 3. 5. 2 Mild bleeding

- Wash the wound in running water from the centre outwards.
- Dress the wound firmly.
- Send home or back to class.

### 4. 3. 5. 3 Nose bleed

- The casualty should sit in a comfortable position and lean forward with a dish under the nose.

- Press the nostrils together just below the hard part of the nose.
- Encourage mouth breathing.
- Do not allow speaking, moving, nose blowing, wiping or rubbing.
- A cold pad placed on the forehead may help.
- If bleeding is severe send the patient to hospital with the nose packed with cotton wool.
- Recurring nose bleeds should be investigated by a doctor.

## 4. 3. 6 Poisoning

A poison is any substance which causes damage if taken into the body. It can be swallowed, inhaled, injected or absorbed through the skin. If in any doubt, medical attention should be sought immediately.

**DO NOT ATTEMPT TO INDUCE VOMITING.**

### 4. 3. 6. 1 Oral poisoning

- If taken into the mouth spit out immediately and wash the mouth with large quantities of water.

- If poison is swallowed the conscious casualty should be given 250 $cm^3$ of water to drink and this is repeated every 15 minutes even on route to hospital.
- Arrange for transport of the casualty to hospital.
- Provide information to the Hospital Casualty Department on the chemical consumed with, if possible an estimate of the quantity and concentration of the chemical, the time that has elapsed since the accident occurred, and the first aid treatment given.

### 4. 3. 6. 2 Inhaled poisoning

**Propane/butane and natural gas:** These gases are not toxic but they can cause suffocation. Remove the casualty to fresh air and loosen clothing. If breathing has stopped apply artificial respiration and get medical assistance.
**Bromine or chlorine vapour:** Where this is not serious, allow the pupil to smell dilute ammonia solution cautiously. A gargle of sodium hydrogen carbonate solution is beneficial. Indeed, whenever chlorine or bromine is being prepared, it is advisable to have a glass of such a solution at hand.

### 4. 3. 6. 3 Antidotes for poisons

Under the Health Safety and Welfare at Work Act 1989 when hazardous materials are being used then full-back up emergency services must be put in place by the person in charge of the work before any work commences. The purpose of this section is to give essential guidelines in the preparation of the emergency procedures.

- Before work with any toxic material commences, the antidote must be made available in the laboratory.
- The local hospital casualty department must be informed of the toxins use and the necessary antidotes. The local hospital must also be informed when the work is complete so that they do not hold unnecessary antidote in stock.
- When sending a poisoned patient to hospital it is most helpful to state the name and age of the patient, the toxin taken, the quantity taken, how long since the exposure and the first aid treatment given.
- All material evidence, samples, specimens including samples of vomit should also be carefully labelled and preserved.
- A guide to treatment can be obtained from the Poisons Information Service, Beaumont Hospital Tel (01) 379964 or 379966. However, it is normal for

replies to such a request to be given only *via* a medical practitioner. Few specific antidotes are available and, in general, they form no part of first aid.

## 4. 3. 7 Burns and scalds

### 4. 3. 7. 1 Severe heat burns and scalds

- Lay the casualty down and make him/her as comfortable as possible.
- Protect the burn area from ground contact.
- Make every effort to remove heat from the burn with cold water or ice packs. Do not over cool the patient.
- Gently remove any constrictive items rings, watches, belts, and/or tight clothing from the affected area.
- Cover the affected area loosely with a sterile dry non-stick dressing of non-fluffy material. Do not remove anything sticking to the burn.
- If the casualty stops breathing, apply artificial respiration. If unconscious but breathing place in the recovery position.
- Send for medical help immediately.

### 4. 3. 7. 2 Minor heat burns and scalds

- Place the affected part under slowly running cold water or immerse in cold water for ten minutes or until the pain eases, whichever is the longer.
- Gently remove any constrictive items before swelling begins.
- Dress the wound with a clean sterile non-fluffy material.
- Do not apply lotions or adhesive dressings. Do not break blisters.
- If in doubt, seek medical attention.

### 4. 3. 7. 3 Chemical burns

- Treat the area with running water for at least 15 minutes.
- Gently remove contaminated clothing while treating the burned area. Take care not to become contaminated.
- If serious, continue treatment as for severe burns (4.3.7.1).
- Remove patient to hospital if burns are severe.
- Do not reuse contaminated clothing until it has been hot washed.

### 4. 3. 8 Eye injuries

Always consider medical aid for eye injuries. If it is possible to carry out first aid before going to hospital by a qualified person then it should be done first as time is often vital in the case of eye injuries.

#### 4. 3. 8. 1 Chemical injuries to eyes

- The eye should be washed immediately and carefully in a plentiful stream of gently flowing clean water (e.g. from a rubber tube on a high-necked tap or special eyewash bottle).


- Lift the eyelid and wash the eyeball thoroughly.
- This should be continued for at least 15 minutes or until 10 minutes after the burning ends, whichever is the longer.
- The eye may be covered lightly with a sterile pad.
- Remove to hospital immediately and continue emergency treatment on the way if necessary.

#### 4. 3. 8. 2 Foreign bodies in eye

- Make sure that the victim does not rub the affected eye.
- If the foreign body is visible, wash out the eye with plenty of water.
- If this is not successful, the object may be removed using a damp clean piece of cloth.
- Do not attempt to remove an object if it is on the coloured part of the eye or embedded in the eyeball. Cover the eye loosely with an eye-pad. Seek medical aid.

### 4. 3. 9 Shock

Shock is a condition of general weakness caused by loss of circulating body fluids, e.g. loss of blood through internal or external bleeding, or loss of plasma from major burns or through extreme pain or fear. The shocked casualty may feel weak, faint, giddy, anxious or restless. He/she may feel sick and vomit. Skin may become pale, cold and clammy sweating can occur. Breathing may be shallow and rapid. Unconsciousness may develop.

- Shock is present in all accident cases to a varying degree. Some medical conditions, and/or some medicines taken earlier, may make some pupils more likely to go into shock than others. Therefore, particular care may be required. The treatment of shock must aim to halt deterioration of the patient's condition. Having dealt with the underlying injury the first-aid is as follows.
- Arrange for immediate medical aid or hospitalisation.

- While this is being effected try to get the injured person into as comfortable a position as possible. Turn the patient on his/her side keeping the head low and turned to one side, preferably with the feet raised.
- Restrictive clothing is loosened and dentures (if any) removed.
- Keep the patient warm and comfortable continually reassure him/her while awaiting medical assistance.
- If breathing stops commence artificial respiration (4. 3. 3, p. 44).
- If breathing becomes difficult or the person seems likely to get sick place the patient in the recovery position.

### 4. 3. 9. 1 Electrocution

**WHATEVER THE CAUSE OF AN ELECTRICAL ACCIDENT, NEVER TOUCH THE CASUALTY WITH BARE HANDS UNLESS YOU ARE SURE THAT THERE IS NO DANGER TO YOURSELF.**

- Switch off the electrical supply if possible and remove the casualty from contact with the electrical source, using non-conductive articles such as a dry brush handle, dry rope or piece of clothing.

- If breathing and heart beating have stopped, begin resuscitation immediately (4. 3. 3, p. 44).
- If casualty is breathing, but unconscious, place him/her in the recovery position (4. 3. 4, p. 46).
- Take steps to minimise shock (4. 3. 9, p. 50).
- Remove to hospital in all cases.

**Remove to hospital in all cases.**

### 4. 3. 10 Asthma

Asthma sufferers usually carry their own medication in case of unexpected attack. When breathing difficulties arise:

- The victim is reassured, made to sit in a comfortable position leaning slightly forward resting their elbows on a support such as a bench (or his/her knees).
- Ensure a good supply of fresh air.

- Allow the casualty to take own prescribed medication.
- If the symptoms persist, seek medical aid.

### 4. 3. 11 Diabetes mellitus (Diabetic coma)

Diabetic coma may be due to many underlying causes.
**NB** Do not give anything by mouth if a victim is unconscious. When a diabetic feels weak or dizzy treat as for concussion below (4. 3. 13).

- If the casualty is conscious and capable of swallowing, immediately give sugar lumps, a sugary drink, chocolate or other sweet food in order to raise the level of sugar in the blood.
- If the casualty is unconscious but breathing normally, place in the recovery position, (4. 3. 4, p. 46) and carry out general treatment for unconsciousness (4. 3. 4, p. 46).
- Call for help promptly.
- If a doctor is not available, call an ambulance or bring the patient to the nearest hospital.

### 4. 3. 12 Epilepsy

Epileptic attacks or fits may occur with varying degrees of severity.

- The aim of first aid is to prevent injury to the casualty and to keep the airways clear.
- The patient's movements should be guided rather than restricted.
- Padding, e.g. cushions, coats, etc., should be placed near adjacent walls and under the patient's head if possible.
- Restrictive clothing should be loosened and sharp objects, e.g. jewellery, removed.
- Environmental dangers should be removed, e.g. fire, water, chemicals, tables, chairs and sharp objects.
- Do not place any objects in the patient's mouth.
- It is advisable for persons suffering from known disorders to carry an identity card with home address, doctor's or clinic's address so that immediate advice can be sought.
- Students should be encouraged to let the teacher know if they are receiving any special medication.

- The Irish Diabetic Association and the Irish Epilepsy Society give useful advice to members (Appendix L, p. 84).

### 4. 3. 13 Concussion

If there is any possibility of concussion having been suffered, when a blow on the head has been sustained, the victim should be transported to hospital. Do not allow the patient to take the decision as the sense of judgement may have been affected.

## 4.4 Accident report

The priority of those who are at the scene of an accident should be:

- care and protection of the person involved; and
- immediate protection against the risk of any further injury.

It is essential that a report be drawn up as soon as possible after an accident. Delay could cause vital information to be missed and persons with strong personalities to influence others. Failure to investigate an accident and implement its findings could allow a recurrence of a similar accident with the possibility of more serious consequences. The accident report should give the following:

- Time and location of accident.
- Nature of injuries sustained and individuals affected.
- Others present as witnesses.
- Damage sustained.
- A comprehensive description of the events leading up to the accident and the emergency action undertaken. A sketch or photographs of the accident scene as necessary.
- Name of reporter and name(s) of staff assistants.
- Recommendations to prevent recurrence with a view to prevent similar accidents in future.

A copy of the report must be given to the school principal for keeping in school records and to the safety officer and a copy kept in the laboratory accident report file. A specimen report sheet is given in Appendix J (p. 82).

### 4. 4. 1 Accident reporting and the law

Under the Safety, Health and Welfare at Work (General Application) Regulations 1993 (Part X)[5] all accidents at work which cause an employee to be away from their normal work duties for more than three calendar days must be reported to the Health and Safety Authority on Form No. I.R. 1. This includes accidents to staff when they are away from the school on school business, i.e. field trips, and school tours. [An outline copy of the Form No I.R. 1 "FORM OF NOTICE OF ACCIDENTS" and the instructions are given in Appendix R. p. 110. The form can be obtained from the HSA web site at http: //www.hsa.ie and filled in directly on this web site.] The normal accident reports to the school principal and to the school's insurance company should also be completed. A suggested internal school simple accident report form is given in Appendix J, p. 82. Each school should have their own forms for recording and investigating all accidents, the prime purpose of which should be to establish the facts and prevent re-occurrence. The Safety Statement should indicate the chain of command for reporting accidents in the school and for reporting accidents to the Health and Safety Authority.

Where "Others" including students suffer an accident on the school grounds or on a school trip the guidelines for reporting the accident to the Health and Safety Authority are as follows: as a result of their injuries the injured student is seen by a medical practitioner or attends a hospital casualty outpatients unit the accident must be reported to the HSA. The chain of communication by which the teacher in charge of the class must report the accident to the school Manager/Principal should be indicated in the School Safety Statement.

[5] *Irish 1993 Notification of Accidents and Dangerous Occurrences Regulations*

# CHAPTER 5

## Useful practical techniques

This chapter emphasises basic safe procedures for doing practical work. Training should focus on proper procedures and the student becoming absolutely familiar with the tools of the trade and attention to detail with safety. The true value of practical work is good workmanship in safety.

### 5. 1 Bünsen burners

#### Lighting a Bünsen burner

- Place the Bünsen burner well in from the edge of the bench and, ideally, not in direct sunlight.
- The air inlet should be fully open.
- Hold the gas lighter over the top of the Bünsen barrel (pieces of paper should not be used).
- Do not have your face over the Bünsen.
- Turn on the gas.
- Strike the gas lighter until ignition occurs.
- When not in use, a lighted Bünsen burner should show a non-smoking, visible yellow flame (air inlet almost closed). Only when it is in use should the air inlet be fully open so that it gives a blue or semi-visible flame.
- If burning takes place at the jet, turn off the gas and allow the barrel to cool before re-ignition.

**Never permit lighting a Bünsen burner at or near gas taps.**

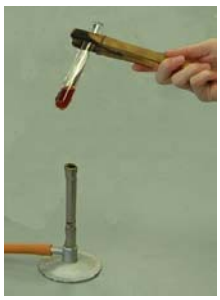
### 5. 2 Handling hot equipment and materials

- Bünsen burners, tripod stands or other equipment should be allowed to cool after use before handling and putting away.
- When cool, they should be lifted by the base or as low down as possible as this area is always cooler.

## 5. 3 Heating

### 5. 3. 1 Heating test-tubes

- These must always be held in a suitable holder at an angle of 45° to 60°.
- The open end should point away from the student but not in the direction of another person.
- Never heat test-tubes which are more than one-third full.
- Care should be taken to heat the test-tube slowly.
- The test-tube should be shaken in the flame to spread the heat over the whole material and to stop liquids from bumping.
- Particular care is needed when heating organic liquids or volatile mixtures in a test tube, (e.g. Lassaigne Test) as they can react violently, explode or catch fire.



### 5. 3. 2 Collection of gases over water

Should strong heating be required, the heat must always be applied very gently at first, by moving the flame backwards and forwards. Hold the Bünsen at an angle (of 45-60°) so that your hand is not under the flask in case it breaks. Then gradually slow down the movement and allow the heat to build up, by holding the flame constant. When finished heating, the stopper must be taken out immediately to prevent water being sucked back into the flask or tube.

### 5. 3. 3 Graduated apparatus

Never heat graduated apparatus or a thermometer in a direct flame as they are made of soft soda glass which cracks easily.

## 5. 4 Using pipettes

- Under no circumstances should mouth pipetting be allowed.
- A safety filler should always be used when filling a pipette.
- Pipettes should always be cleaned immediately after use and stored in a proper rack.
- Placing a pipette on the laboratory bench can result in contamination or breakage.

## 5. 5 Dilution

- Solute should always be added to solvent (acid to water) in small amounts with constant swirling.
- When the reaction is highly exothermic, e.g. dilution of a strong acid, it may help to add the acid to frozen deionised water (ice) in a beaker.
- Drips down the side of the reagent bottles must be wiped clean using a damp cloth while wearing gloves.
- Small amounts of concentrated solutions should be diluted before being poured down the sink.

## 5. 6 Using thermometers

- Thermometers must not be heated above their maximum temperatures.
- Never cool thermometers rapidly or use ordinary thermometers for stirring.
- Thermometers should be placed on the bench in such a way as to prevent them rolling off.
- Mercury thermometers should not be used where alcohol thermometers could be used. If they break it is always very difficult to ensure complete recovery of the mercury.
- If a mercury thermometer breaks then any mercury spilled should be recovered as thoroughly as possible (3. 4. 4, p. 34).

## 5. 7 Testing for smell

- Fumes and vapours from volatile chemicals or from chemical reactions should be tested only by a "wafting" motion of the hand and cautious sniffing.

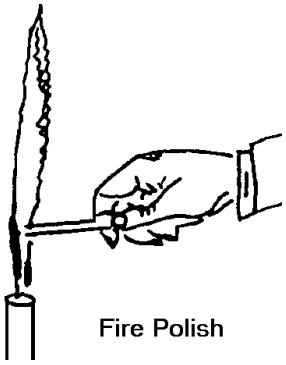
## 5. 8 Using radioactive materials

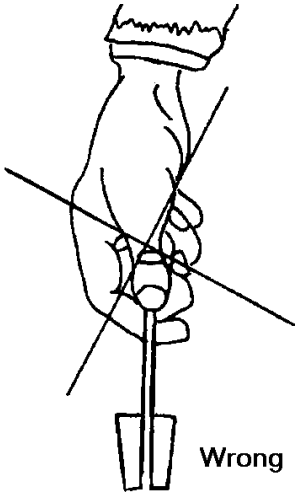
- Radioactive materials should only be used where the highest level of supervision can be provided.
- Students must follow the procedures outlined.
- The sources should be returned to their containers when not in use.
- Checks on stock must always be carried out after use to ensure that nobody removes radioactive materials from the laboratory.

## 5. 9 Glassware

### 5. 9. 1 Inserting glass tubing in bungs

- Excess force should not be used when passing glass tubing through rubber bungs.
- The glass tubing must be of suitable bore and fire polished.
- Both bung and tubing should be lubricated with water, petroleum jelly, glycerol or washing up liquid.
- Always protect your hands with a cloth when putting a glass tube into a rubber bung.

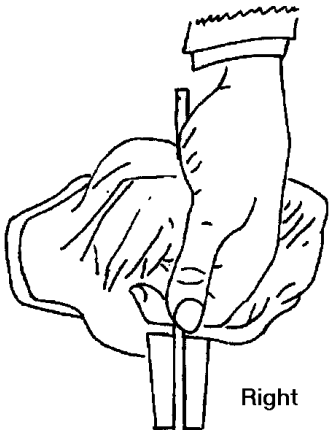

Fire Polish


Wrong

- Insert by holding the glass with the towel near the bung.
- Then, with a twisting motion, press the glass gently into the bung.

**To remove glass tubing from bungs:**

- Hand should be wrapped in a heavy cloth or heavy duty glove and excess force should not be used.
- If the glass is valuable (thermometer) and will not come easily then it may be worked out with a cork borer.

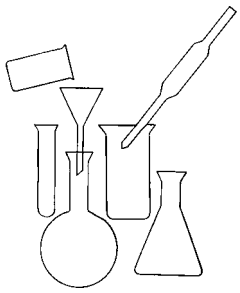

Right

- Otherwise it is safer to discard it altogether.
- If glassware is stored, mounted in tubing for long periods, the rubber perishes and forms an incredibly tight seal with the glass. Such rubber should be removed by cutting the rubber tube just below where the glass reaches into the rubber. The rubber is then cut longitudinally and then peeled back from the glass. If the process is difficult and the glass is not valuable discard the glass.

### 5. 9. 2 Cutting glass tubing

- Rotate cloth covered tube on bench against a glass knife or lightly held file.
- Wet scratch and protect hands with a cloth.
- Press thumbs behind mark.
- Pull cloth covered tube with hands by lightly bending back.
- Fire polish or file sharp ends immediately.

### 5. 9. 3 Glass containers

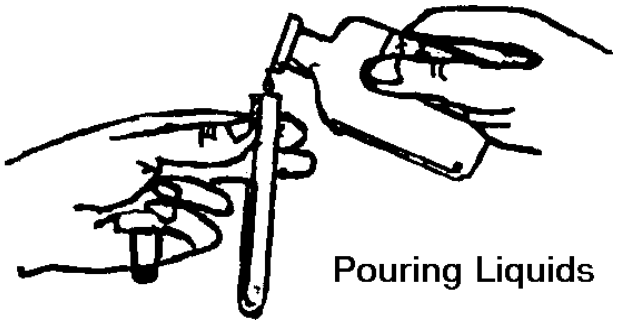


- Beakers, and other glassware containing liquids, should always be placed well away from the edge of a bench.
- Glass is not a completely inert material and glassware should always be cleaned as soon as possible after use especially if it has contained sodium hydroxide solution.
- Bottles should be opened with care especially if they contain volatile or corrosive chemicals.
- It may often be desirable to cover the bottle with a cloth and to hold the bottle behind a screen, or in a fume cupboard while the stopper is being removed.

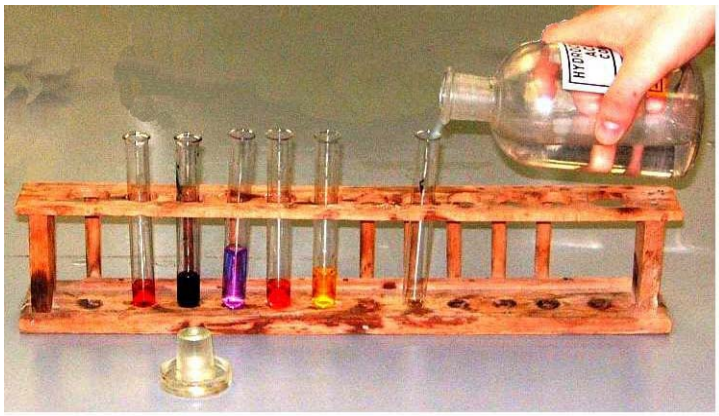
#### Seized stoppers and stopcocks

- These should be released carefully.
- Do not use force.
- Tap gently.
- Heat gently with rotation in a yellow sooty flame or under a hot tap followed by gentle tapping against a wooden surface. This procedure must not be used if the bottle contains a volatile, flammable, an unknown or water reactive chemical, e.g. Na/K. It should only be performed by a competent person.

## 5. 9. 4 Pouring liquids from reagent bottles


Pouring Liquids

- Hold test-tube between the first two fingers (index and middle) and thumb in the left hand.
- Pick up reagent bottle in the right hand with the label towards the palm of the hand.
- Remove the top from the bottle by grasping it between the lower finger and heel of the left hand.
- Make sure you hold the cone of the top (which may be contaminated) well away from all parts of the hand.
- Where a child's hand is too small, unsteady or weak to hold the top in this way the test-tube should be placed in a test-tube rack.
- Holding the bottle top only in the left hand (if right handed) and the bottle in the right hand pour into the test tube.



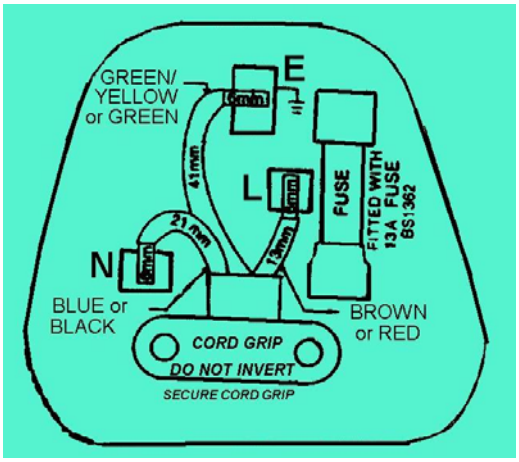
- Pour the reagent away from the label side of the bottle into the test tube.
- Replace top on bottle and place bottle back on shelf with the label facing out.

## 5. 10 Low voltage electric circuits

- All contacts and the circuit should be checked before switching on the current or connecting to the low voltage supply.
- Care should be taken to use meters of the appropriate range.
- Always use 4 mm plugs or spade terminals rather than bared wires.
- Only leads with sufficient current carrying capacity (for the use in question), should be employed.

## 5. 11 Wiring a plug

Only plugs which meet Electrical Technical Council of Ireland or BS standards should be used. Plugs today come sealed or with wiring diagrams. Where it is necessary to wire the plug, the wiring diagram must be followed exactly. As an added precaution the bare wire might be soldered to ensure that there are no bare strands of wire which could cause short circuiting. Always ensure that all the screws are tight and that the cable retention clip is secure to the outer insulation.

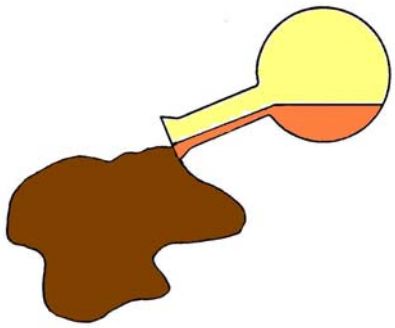



**N B** It is recommended that only square pin 13 amp switch sockets be used in schools, as each individual plug can have a fuse, rated to the needs of the apparatus. The use of adapters and other plug designs is not recommended.

## 5. 12 Using a centrifuge

- A centrifuge must be operated according to the manufacturer's instructions.
- It should be placed on a stable bench or the floor.
- Care should be taken to balance the samples before centrifuging.
- If it is very noisy, switch it off at the mains, and allow to stop before opening and balancing the load.
- The lid must never be opened until the rotor has stopped. All centrifuges should be fitted with an interlock to prevent this.
- Never use a centrifuge if the bearing is suspect.
- Improper use of centrifuges can be lethal.
- A regular servicing record must be kept.

## 5. 13 Cleaning up chemical spills



This procedure is general and elementary- important characteristics of any emergency procedure.

- A list of apparatus suitable for cleaning up chemical spills is provided in Appendix A (p. 63).

- All laboratory staff members should be trained in the proper procedure for cleaning up chemical spills.

a. Ensure the safety of everyone in the laboratory.

- Be certain that no chemical burn or poisoning will result. Remove any clothing that came in contact with chemicals and immediately flush the skin with water.
- Put on necessary protective safety gear.
- If flammable solvents were spilled, turn off Bünsen burners and electrical equipment that might spark.
- Alert other personnel and block off the spill area with warning signs. If the quantity is large consider evacuation.

b. Carefully cover the affected area with clean dry sand beginning at the outside and working towards the centre.

c. Keep adding the sand until adsorption is complete.

d. Put the mixture into a plastic bucket for disposal.

- Do not use papers or rags to clean up chemical spills as they could cause spontaneous combustion.
- For mercury spillage see p. 34.

# Appendix A

## Safety apparatus

| | |
|---|---|
| **1. Protective clothing.** | (a) Laboratory white coats (cotton or cotton polystyrene) to NISO standard. |
| | (b) Aprons (P.V.C./waterproof) |
| **2. Eye Protection.** | (a) Safety Spectacles with side shields to CE standards. |
| | (b) Face Shield (for teacher only). |
| | (c) Safety screen. |
| **3. Gloves.** | (a) Polythene (Disposable). |
| | (b) PVC or leather. |
| | (c) Heat resistant gloves non-asbestos. |
| **4. Eye wash/shower.** | (a) Eye wash stand or eye wash bottle or a fixed rubber tube on a convenient tap. |
| **5. Fire.** | (a) Fire extinguishers $CO_2$/dry powder. |
| | (b) Fire blankets. |
| | (c) Fire buckets. |
| **6. Chemical Spill Clean-up kit.** | Two heavy duty plastic buckets, (one with sand), a plastic dust pan and hand brush, two heavy duty plastic bags, two warning notices. |
| **7. First Aid Kit.** | Appendix B (p. 64). |

**8. Self adhesive labels with hazard warnings.**

**9. Safety pipettes and pipette fillers.**

**10. Bottle carriers and drip trays.**

**11. Trolleys, supports and stands for gas cylinders.**

**12. Small steps/platform.**

**13. Lockable poisons cupboard.**

**14. Dust mask and carbon filter mask.**

# Appendix B

## Contents of a first aid kit

1. Scissors (blunt-nosed).
2. Forceps.
3. Selection of roll bandages
4. Box of waterproof plasters.
5. Sterile cotton wool.
6. Box of tissues.
7. Safety Pins.
8. Antiseptic cream, liquid and lotion.
9. Eye wash bottle.
10. Spray for burns.
11. Disposable or surgical rubber gloves.
12. Eye pad.

**A photocopy of this page should be held with the First Aid kit.**

# Appendix C

## Safety check list

### DAILY END OF DAY CHECK LIST

1. Safety equipment, chemicals, reagents, and laboratory equipment stored properly.
2. Benches and floors clean, ‘no spills’, waste paper, chemicals and broken glass in bins provided.
3. Windows closed and locked.
4. Animals made comfortable and cages clean.
5. Dissecting instruments sterile.
6. Glassware clean.
7. Water, gas, electricity, ovens, balances, centrifuges, incubators, fume cupboards, gas cylinders, etc., turned off.
8. Accident book up to date.
9. Doors closed and locked.

### WEEKLY CHECK LIST

1. As Daily List plus below.
2. Fire extinguishers, Eye wash bottle/shower, First Aid Kit, Safety Spectacles, Safety Screens, Safety Gloves, Face Visors, and Chemicals spills clean up kit are all in their place and in good working order.

## ONCE A TERM CHECK LIST

1. As Weekly and Daily plus below.
2. Fire Drill procedures carried out.
3. All electrical leads in good condition, plugs properly wired, sockets secure and not damaged.
4. Bünsen burners and tubing in good condition.
5. Fume cupboard ventilation adequate.
6. Chemical storage shelves tidy and in proper order (no incompatible chemicals close to each other), no loose or damaged stoppers, out-of-date chemicals disposed of.
7. Animal cages in a safe condition.
8. Housekeeping good.
9. Gas cylinders storage area safe and clean.
10. Accident book checked and `Term Accident Report' prepared for management.
11. Update the emergency hazardous chemicals list held in the Principal's administration office.

# Appendix D

## Summary of preferred arrangements for chemical storage

| Type of chemical | 1st choice | 2nd choice |
|---|---|---|
| **FLAMMABLE STOCK LIQUIDS** | Internal flammable only store. | In a fire resistant cabinet, in an internal secure chemical store meeting fire requirements. |
| **"Working bottles 500 $cm^3$"** | Chemical/flammable store. | In fire resistant cupboard in Prep. Room. |
| **CORROSIVE LIQUIDS STOCK e.g. acids and alkali.** | Internal store at low level (flammables elsewhere). | Internal chemical store at low level. |
| **"Working bottles 250 $cm^3$"** | Assuming internal store close to Prep. Room. | Cupboard in Prep. Room. |
| **OXIDISING AGENTS** | Isolated cupboard in internal chemical store >1 meter from combustibles. | Cupboard in Prep. Room >1 meter from combustibles. |
| **WATER REACTIVE** | Internal chemical store. Stored in a special Prep. Room cupboard | Special container in Prep. Room. |
| **VERY TOXIC and TOXIC** | Locked cupboard in Prep. Room. | Internal chemical store with general chemicals in alphabetical order. |
| **CORROSIVE VOLATILES** | Internal chemical store. Stored in a desiccator*. | Exclusive cupboard in Prep. Room with good ventilation to outside. |
| **SPECIALS: Methanal**<br>**Phosphorus** | Not in same Prep. Room as HCl#.<br>Away from H2O damp or reactive in chemical store. | With toxic chemicals in locked cupboard in Prep. Room. |
| **GENERAL ORGANIC & INORGANIC CHEMICALS**<br>**(Alphabetic arrangement)** | Internal chemical store. Label shelves when chemicals are stored elsewhere. | Cupboards in Prep. Room. |

* In desiccator or in polythene bags with dehydrated silica gel.

# or substances which react with moist air to yield hydrogen chloride.

## Appendix D continued:

Summary of preferred arrangements for chemical storage

| Other Choice | Avoid contact with | Type of Chemical |
|---|---|---|
| External chemical store, fire resistant cupboard in Prep. Room. | Oxidising agents. | **FLAMMABLE STOCK LIQUIDS** |
| On shelves in Prep. Room. | Oxidising agents. | **"Working bottles 500 $cm^3$** |
| External chemical store, on plinth in Prep. Room. Bottles in single rank. | | **CORROSIVE LIQUIDS STOCK e.g. acids and alkali.** |
| On shelves in Prep. Room. | | **"Working bottles 250 $cm^3$** |
| External chemical store or on shelves in Prep. Room >1 meter from combustibles. | Flammables organics and powerful reducing agents. | **OXIDISING AGENTS** |
| Ext. chem. store in special compartment or shelves in Prep. Room clearly labelled. | Phosphorus and made up solutions. | **WATER REACTIVE** |
| External chemical store or on shelves in Prep. Room but clearly labelled. | Flammable liquids. | **VERY TOXIC and TOXIC** |
| Ext. chemical store in a desiccator or in Prep. Room in desiccator. | | **CORROSIVE VOLATILES** |
| | Hydrochloric acid.<br>Water reactives. | **SPECIALS**<br>**Methanal**<br>**Phosphorus** |
| External chemical store or on shelves in Prep. Room. | Oxidising agents. | **GENERAL ORGANIC & INORGANIC CHEMICALS**<br>**(Alphabetic arrangement)** |

# Appendix E

## Dangerous mixtures

The following is a list of the more common dangerous mixtures. It his by no means exhaustive. Check the material safety data sheets if in doubt.

| SUBSTANCE | HAZARDOUS WHEN MIXED WITH |
|---|---|
| **Water** | Alkali metals and their oxides; sulfur(VI) oxide (Sulfur trioxide); phosphorus(V) chloride and oxide; oleum; sulfuric acid; calcium dicarbide (acetylide); calcium hydride or lithium aluminium hydride. |
| **Aluminium** | Chlorates; nitrates; copper(II) oxide or powdered lead oxides. |
| **Chlorates** | Sulfuric acid; sulfur or sulfides; ammonium salts; phosphorus; easily oxidised materials such as sugar, sawdust, etc., or metal powders. |
| **Ethanoyl (acetyl) chloride** | Lower aliphatic alcohols; water; ammonia solutions or amine solutions. |
| **Lithium aluminium hydride** | Ethyl ethanoate (recommended in the past for destroying lithium aluminium hydride, now known to be responsible for some explosions) or water. |
| **Magnesium** | Ammonium, sodium or potassium chromate(VI), silver nitrate powder (explodes violently on contact with water) or sulfur. |
| **Nitric acid** | Ethanoic acid, alcohols or organics. |
| **Peroxides** | Aluminium, magnesium or zinc. |
| **Potassium Manganate(VII)** | Not stored or used with conc. sulfuric or hydrochloric acids. |
| **Zinc powder** | Sulfur. |

# Appendix F

## Flash points and auto-ignition temperatures of some flammable liquids

| Substance | Flash Point (°C)[6] | Auto-ignition Temperature (°C)[7] |
|---|---|---|
| Butan-1-ol | 29 | 365 |
| Butan-2-ol | 24 | 406 |
| Carbon disulfide | -30 | 100 |
| Cyclohexane | -20 | 260 |
| Cyclohexene | -60 | 310 |
| Ethanal (acetaldehyde) | -38 | 185 |
| Ethanoyl chloride (acetyl chloride) | 4 | 390 |
| Ethanoic acid (acetic acid) | 40 | 426 |
| Ethoxyethane (diethyl ether) | -45 | 180 |
| Ethanol | 12 | 392 |
| n-Heptane | -4 | 223 |
| n-Hexane | -30 | 225 |
| Methanol | +10 | 446 |
| Methylbenzene (toluene) | 4 | 482 |
| Methyl ethanoate (acetate) | -10 | 502 |
| Methyl-2-methylpropionate (methyl methacrylate) | +10 | 421 |
| 2-Methyl-2-propanol (t-butyl alcohol) | 9 | 458 |
| n-Octane | 13 | 220 |
| Pentane | -49 | 309 |
| Petroleum ethers | -57 | 288 |
| Propan-1-ol | 15 | 371 |
| Propan-2-ol | 12 | 399 |
| Propanone (Acetone) | -18 | 538 |
| Styrene | 31 | 490 |
| Xylene | 14 | 464 |

[6] ***Flash*** *point is the lowest temp. where sufficient vapour is given off to flash momentarily when a flame is applied but will not support combustion.*

[7] ***Auto-ignition temperature*** *is the lowest temperature at which the substance will ignite spontaneously without the introduction of flame or other ignition source*

# Appendix G

## Labelling of chemicals

The need for adequate labelling extends far beyond the immediate requirements of the individual user, both for safety and experimental procedure reasons.
All chemical reagents and materials should be correctly labelled as there is a danger of samples becoming accidentally exchanged. Proper labelling can also help educate students. Correct and systematic labelling adds to the general efficiency of the laboratory.
Labelling of all laboratory samples must now follow the rigorous system adopted by the European Union for dangerous chemicals and modified as necessary for non hazardous chemicals, biological materials and radioactive substances.
All dangerous substances which are available to the general public (students) in European Union countries must comply with European labelling regulations. These are known as "The Classification, Packaging and Labelling of Dangerous Substances Regulations 1994".
All dangerous materials received from suppliers will comply with these regulations and it should not be necessary to relabel any container. When a sample is removed from the container and placed in a new container for the purpose of issuing to students, the name, the hazard symbol and the nature of the risk should also be transferred to the new label.

### In general labels should include the following data:

- Name of sample.
- Concentration when appropriate.
- A word or symbol to indicate the hazard if necessary (see later).
- In the case of dangerous chemicals the risk and safety phrases.
- Name of the teacher in charge of the class and the date.

**Sodium hydroxide**

**NaOH 1.0 M**

**R 35** Causes severe burns.
**S 26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
**S 36/37/39** Wear suitable protective clothing, gloves and eye/face protection. Wear suitable protective clothing, gloves and eye/face protection.
Ms Safebody

## Labelling of Radioactive substances

All stores and laboratories containing radioactive substances shall have clearly displayed at the entrance in black on yellow background.

(1) The trefoil radioactivity warning symbol.
(2) Radiation **KEEP OUT.**

The shielding container in which the sealed low level radiation source is stored should be clearly labelled on the outside with black on a yellow background:
(1) Trefoil radioactivity warning symbol.
(2) Caution radioactive substances.
Each sealed radiation source is labelled by the manufacturer and should not be tampered with. Each source should clearly show stamped on its case:
(1) Radioactive isotope present.
(2) The strength of the source at manufacture in becquerel Bq (or Curie Ci-old system).
(3) The type of radiation emitted-α, β, γ.

## E.U. Hazard Labelling Symbols

### A Chemical symbols

There are seven commonly used symbols and fourteen classifications. These indicate the general nature of the risk in each classification.

| Characteristic properties of the substance. | Classification and indication of general nature of risk. | Symbols |
|---|---|---|
| A substance which may explode under the effect of a flame or which is more sensitive to shocks or friction than dinitrobenzene. | **Explosive** |  |
| A substance which gives rise to highly exothermic reaction when in contact with other substances, particularly flammable substances. | **Oxidizing.** |  |

| Characteristic properties of the substance. | Classification and indication of general nature of risk. | Symbols |
|---|---|---|
| A liquid having a flash point of less than zero degrees Celsius and a boiling point of less than or equal to 35 degrees Celsius. | EXTREMELY FLAMMABLE |  |
| A substance which:<br>(a) may be hot and finally catch fire in contact with air at ambient temperature without any application of energy; | HIGHLY FLAMMABLE |  |
| (b) is a solid and may readily catch fire after brief contact with a source of ignition and which continues to burn or to be consumed after removal of source of ignition; | HIGHLY FLAMMABLE | As for (a) |
| (c) is a gas and flammable in air at normal pressure; | HIGHLY FLAMMABLE | As for (a) |
| (d) in contact with water or damp air, evolves highly flammable gases in dangerous quantities; or | HIGHLY FLAMMABLE | As for (a) |
| (e) is a liquid having a flash point below 21 degrees Celsius | HIGHLY FLAMMABLE | As for (a) |

| | | |
|---|---|---|
| A substance which is a liquid having a flash point equal to or greater than 21 degrees Celsius and less than or equal to 55 degrees Celsius. | FLAMMABLE | No symbol |
| A substance which if inhaled or ingested or penetrates the skin may involve extremely serious acute or chronic health risks and even death. | VERY TOXIC | |



| | |
|---|---|
| A substance which if it is inhaled or ingested or penetrates the skin may involve serious, acute or chronic health risks and even death. | **TOXIC** |

| Characteristic properties of the substance. | Classification and indication of general nature of risk. | Symbols |
|---|---|---|
| **Harmful** A substance which if it is inhaled, ingested or penetrates the skin may involve limited health risks. | HARMFUL |  |
| **Corrosive** A substance which may on contact with living tissues destroy them. | CORROSIVE |  |
| **Irritant** A non-corrosive substance which through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation. | IRRITANT |  |
| **Carcinogenic** "May cause cancer" or "Possible risk of irreversible effects" Category 1 and Category 2 | TOXIC HARMFUL |  |
| **Mutagenic** Danger of mutation to the cell's hereditary system. Many chemicals are suspected, none are known at this time. | TOXIC HARMFUL |  |
| **Harmful for reproduction** (Teratogen) Causes damage to the unborn child in the womb. | TOXIC HARMFUL |  |
| **Dangerous for the environment** Substances or preparations which if disposed of in an improper manner can cause damage to the environmental plants animals and/or aquatic life. | DANGEROUS FOR THE ENVIRONMENT |  |

## B Other symbols that conform to EU Regulations


Red - Fire & Prohibition
Fire - hose reel
Fire alarm
No matches
No Entry
No mouth pipetting
No smoking
Emergency stop
Blue Manditory & Protection
Glasses
Lab coat
Face shield
Dust mask
Gas mask
Hair net
Ear protection
Hard hat

# Appendix H

## Guidance Notes on the Safe Use of Ionising Radiation in Post Primary Schools

### Introduction

In most school circumstances, the study of the properties of radioactive substances and the ionising radiation these substances emit has been mainly confined to experiments involving small sealed radioactive sources and the experiment to determine the half-life of thoron. There has been an increasing tendency to limit these laboratory studies to demonstration experiments. Schools may also carry out experiments with electrical equipment that, although not intended to, can generate X-rays.

Common sense and attention to both the local rules outlined in Section 3.2.3 of this Safety Booklet and the guidance notes on radiation protection that follow will ensure that this important subject may be studied in safety. Queries on these matters should be addressed to the Radiological Protection Institute of Ireland (RPII). Further information may also be found on the Institute's web site.

### Organisation of Radiation Protection in Secondary Education

Responsibility for the organisation of radiation protection in a school holding sources of ionising radiation lies with the School Authorities. The School Authorities must appoint a competent person with responsibility for the practical implementation of radiation safety procedures. The person appointed as Radiation Protection Officer (RPO) must have the necessary training and experience in the use of sources of ionising radiation. The Principal must ensure that the RPO is given the appropriate support in carrying out his/her duties in this regard and, if necessary, training in radiation protection. The RPO shall ensure satisfactory compliance with the regulations of S I No 125 of 2000 that are relevant to the use of sources of ionising radiation in secondary education (Ref 1)

The RPO must have control of all sources of ionising radiation in the school and must draw up the required radiation safety procedures. These procedures must be prominently displayed in the school laboratory and a copy made available to each science teacher for whom they have relevance. Students involved in demonstrations and experiments involving the use of sources of ionising radiation must be made fully aware of the safety procedures relevant to their laboratory studies.

It should be noted that only science teachers, who are competent to do so, should conduct demonstrations or experiments with sources of ionising radiation.

### Types of Ionising Radiation

#### (i) Alpha Radiation

Alpha radiation is a radioactive process in which a particle comprising two neutrons and two protons (a helium nucleus) is ejected from the nucleus of an unstable isotope of a heavy element such as uranium, thorium or plutonium.

Due to their relatively large mass and a charge of +2, alpha particles produce intense ionisation over short distances if inhaled or ingested. It is therefore very important that unsealed radioactive sources, such as the thorium compound in the thoron generator, are handled with extreme care in order to prevent contamination of persons.

Alpha particles, which can only travel a few centimetres in air and can be stopped by a sheet of paper, do not present an external radiation hazard as they cannot penetrate human skin.

### (ii) Beta Radiation

Beta radiation is a radioactive process in which an electron is ejected from the nucleus of an unstable isotope of an element such as strontium, caesium or thallium. Beta particles are more penetrating than alpha particles and can travel distances of a few metres in air. Beta particles can, therefore, present a particular external radiation hazard to the skin and the eyes. It is possible, however, to stop these particles using low density shielding materials such as Perspex or aluminium.

### (iii) Gamma Radiation

After the emission of an alpha or a beta particle by an atom, the resulting nucleus is often in an excited state. This excess energy is then lost by the emission of a photon of electromagnetic radiation called a gamma ray. Gamma rays are identical to visible light or microwaves except that they are of much higher energy and can therefore ionise atoms of the medium through which they travel.

Gamma rays lose their energy more slowly than alpha and beta particles and penetrate much further greater that the latter. Like beta particles, gamma rays can present an external hazard to those handling radioactive substances that emit this type of ionising radiation. Important gamma emitters are cobalt-60 and caesium-137 (these radionuclides also emit beta particles). Other examples of gamma emitter are uranium and thorium (these heavy radionuclides also emit alpha and beta particles).

Gamma rays require dense shielding even for partial absorption. Materials such as lead or concrete best shield gamma rays.

### (iv) X-radiation

X-ray production occurs whenever electrons of high energy strike a heavy metal target like tungsten or copper. Some of the equipment used for the teaching of physics, such as discharge tubes, may result in the unintended generation of X-rays. The properties of X-rays are almost identical to those of gamma rays and can be shielded in like manner.

## General Aspects of Radiation Protection

Protection against sources of ionising radiation is best achieved under the general heading of ‘TIME, DISTANCE AND SHIELDING’. These precautions may be summarised as follows:

TIME – The teacher must ensure that as short a minimum amount of time is spent experimenting with or demonstrating with sources of ionising radiation.

DISTANCE – The teacher must ensure that a reasonable distance as is maintained between sources of ionising radiation and the students.

SHIELDING – The sealed radioactive sources designed for school science are usually supplied in a lead pot. The teacher should ensure that additional shielding is available when radioactive sources are removed from their pots for experimentation or demonstration and when operating equipment capable of generating X-rays.

The sealed radioactive sources used in school science are quite low in activity and should not exceed 185 kBq (1 Becquerel is equivalent to one nuclear transformation event per second). The radioactive sources used in devices such as the Wilson Cloud Chamber have considerably lower activities. The radon (thoron) generators supplied to schools are unsealed sources with masses in the region of 20 g of the thorium or uranium compound and corresponding activities in the region of a few hundred kBq.

The combination of using only radioactive sources of low activity, adopting the radiation protection measures of time, distance and shielding and those other precautionary measures set out in Section 3.2.3 of this booklet will ensure that any radiation doses, arising from the use of appropriate sources of ionising radiation in school science, are kept As Low As Reasonably Achievable in keeping with the ALARA principle of radiation protection (Ref 2 and 3). The teaching of this important topic can therefore be justified and can be done with negligible risk to students and teachers.

## References

1. Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000 (Statutory Instrument No 125 of 2000).

## Further Reading

An Introduction to Radiation Protection (1996). A. Martin and S.A. Harbison. Edward Arnold, London.

Protection Against Ionising Radiation in the Teaching of Science. Annals of the ICRP Volume 10, No 1, 1983, ICRP Publication 36. (Pergamon Press, Oxford).

# Appendix I

## The Teacher and the Law

1. If negligence is shown in a laboratory accident, the teacher may be held responsible. Negligence can only be ascertained in a court of law but may be defined as the failure to take care when care is called for. The measure of care expected of a science teacher is that of a careful parent for his/her children having regard to all the circumstances.
2. Teachers cannot claim from their employer for an accident if this is not due to some negligence on their employer's part. The employer is not absolutely liable to his/her employees for the safety of the premises in which they have to work. The employer is only liable for those defects of which he/she knows or ought to have known, had he/she been reasonably diligent in examining the state of the premises from time to time.
3. For this reason, science teachers should be careful to notify necessary repairs to fume cupboards, gas, electrical plugs, faulty apparatus, etc., to those responsible. Teachers should also determine if their professional organisation provides suitable insurance.
4. The type of insurance coverage provided may vary from one type of school to another.

### (i) Community/Comprehensive Schools

The State provides a general indemnity to Community/Comprehensive schools which extends to all members of staff when they are engaged on activities authorised by the school authority whether in respect of pupils or otherwise.

# Appendix I continued:

## The Teacher and the Law continued:

### (ii) Vocational Schools

Vocational Education Committees generally take out the following policies.

(a) Public liability policy which insures committees and their employees against claims for injuries by pupils.

(b) Employers liability which insures Committees against claims for injuries to employees. In the case of injury to a teacher incurred in carrying out his/her normal duties in a school the teacher must submit a claim for damages.

### (iii) Secondary Schools

The secretariat of secondary schools advise their members to have:

(a) Public liability policy.

(b) Employer's liability policy.

(c) Property insurance policy including consequential loss insurance (to cover property losses in case of fire etc., and cost of rebuilding, teachers loss in salary due to school closure during rebuilding etc.).

# Appendix J[8]

## Our School Accident Report Form

| | | | | | |
|---|---|---|---|---|---|
| **Date** | // | **Class** | | **Teacher** | |
| **Time** | | **Subject** | | **Room** | |
| Pupil's Name: | | | | Home Phone number | |
| Others Involved/Witnesses: | | | | | |
| Description of First Aid (if any) | | | | | |
| Name of Nurse/Doctor (if relevant) | | | | | |
| Principal Informed Time/Date | | | | | |
| Brief description to include: | | | | | |
| (a) Events leading up to accident. | | | | | |
| (b) How the accident occurred. | | | | | |
| (c) Nature of injuries sustained. | | | | | |
| (d) Type of supervision the pupil had at time of accident. | | | | | |
| (e) Was safety equipment in use at the time of the accident? | | | | | |
| (f) What safety instructions had been given to prevent this type of accident? | | | | | |
| (g) Suggestions to prevent recurrence. | | | | | |

Signed: _____

| | |
|---|---|
| School Doctor: [9] | Local Hospital Casualty[9] |
| Phone No.[9] | Phone No.[9] |

Please continue overleaf if necessary.

[8] *Replace "Appendix J" with the name of your school/college*

[9] *Have these names and telephone numbers printed on the accident report form*

# Appendix K

## Laboratory Rules for Pupils

1. **DO NOT** enter the laboratory without permission.
2. **DO NOT** use any equipment unless permitted to do so by the teacher. Make sure you know exactly what you are supposed to do. If in doubt, ask the teacher.
3. Long hair **MUST** always be tied back securely.
4. **ALWAYS** wear eye protection when instructed to do so.
5. **ALWAYS** check that the label on the bottle is **EXACTLY** the same as the material you require. If in doubt, ask the teacher.
6. **NOTHING** must be tasted, eaten or drunk in the laboratory.
7. Any substance accidentally taken into the mouth must be spat out **IMMEDIATELY** and the mouth washed out with plenty of water. The incident must be reported to the teacher.
8. Any cut, burn or other accident **MUST** be reported at once to the teacher.
9. Any chemicals spilled on the skin or clothing **MUST** be washed at once with plenty of water and report to teacher.
10. Always **WASH** your hands after practical work.

# Appendix L

## Information sources and addresses

Chemicals: A wealth of information is available free in the form of **"Material Safety Data Sheets"** from your chemical supplier. Each Data sheet contains very extensive and accurate information on the chemical but do remember that they are written for bulk handling and may contain some industrial bias. MSDS's prepared for second level schools are available from the Teachers Centre Web site http: //www.psi-net.org

### HSA

**National Authority for Occupational Health and Safety.**

Temple Court,
Hogan Place,
Dublin 2.
Tel. 01-6620400 Fax 01-6620417
http: //www.hsa.ie

The H.S.A. has offices in Athlone, Cork, Waterford, Limerick, Galway, Sligo and Drogheda. Check your local telephone directory for details.

### Department of Education and Science

Marlborough House,
Marlborough Street,
Dublin 1. Tel. 01-8734700
http: //www.irlgov.ie

### NISO

National Irish Safety Organisation,
A11 Calmount Park,
Calmount Av.,
Ballymount,
Dublin 12.
Tel. 01-4659760. Fax 01-4659765

### Radiological Protection Institute of Ireland,

3 Clonskeagh Square,
119 Clonskeagh Road,
Dublin 14.
Tel. 01-2697766. Fax 01-2697437
http: //www.rpii.ie

### National Safety Council,

4 Northbrook Road,
Ranelagh,
Dublin 6.
Tel. 01-4963422. Fax 01-4963306

### Irish Diabetic Association,

82 Lower Gardner St.,
Dublin 1. Tel 01-8363022

### Irish Epilepsy Association,

249 Crumlin Road,
Dublin 12.
Tel (01) 4557500. Fax 4554133

### Enterprise Ireland

The Irish Science and Technology Agency,
Ballymun Road,
Glasnevin,
Dublin 9.
Tel. 01-8570000/8082000. Fax 8082020

## Information sources and addresses continued:

### First Aid training courses see your local branch of:

The Irish Red Cross Society,
The Order of Malta or
St John Ambulance Brigade of Ireland.

### Department of the Environment and Local Government,

Custom House,
Dublin 1.
Tel. 01-8882000, Fax 01-8882888

### ENFO

The Environment Information Service,
17 Andrew Street,
Dublin 2.
Tel 01-8882001 Fax 01-8883946
http: //www.environ.ie

### Safety Aids,

Personal Protective Clothing and Safety Aids.
See Golden Pages under
"Protective clothing and equipment".

### Government Publications Office,

Sun Alliance House,
Molesworth Street,
Dublin 2.
Tel.01-6613111.

### Poisons Information Services

**Beaumont Hospital,**
Dublin 9. Tel. 01-8092566

**Royal Victoria Hospital,**
Grosvenor Road,
Belfast BT12-6BA,
Tel. 048-90-240503
(Information only given to GPs or nurses in Hospital).

### Royal Society of Chemistry,

Burlington House,
London WIV,
England.

### CLEAPSE Development Group,

Brunel University,
Uxbridge UB8 3PM,
England.

### Association for Science Education,

College Lane,
Hatfield,
Herts AL10 9AA,
England.

# Appendix M

## Concentrations of chemicals bought as liquids

| Chemical | Standard Description | Remarks | Concentration mol per litre | Volume to make 1 litre of 1M solution |
|---|---|---|---|---|
| Ammonia | 0.88 or 35% | | 17.5 | 57 $cm^3$ |
| Ammonia | 5% w/w | Easier to handle | 12.8 | 78 $cm^3$ |
| Ethanoic Acid | Glacial Acetic Acid | 99.5% W/V | 17.5 | 57 $cm^3$ |
| Hydrochloric Acid | 32% W/W | | 10.3 | 97 $cm^3$ |
| Hydrochloric Acid | 36% W/W | | 11.8 | 84 $cm^3$ |
| Hydrogen peroxide | 100 vols | | 8.8 | 114 $cm^3$ |
| Methanoic Acid | Formic Acid | 80% W/W | 20.6 | 49 $cm^3$ |
| Methanoic Acid | Formic Acid | 90% W/W | 23.5 | 43 $cm^3$ |
| Methanoic Acid | Formic Acid | 100% W/W | 26.2 | 38 $cm^3$ |
| Nitric Acid | 70% W/W | | 16.1 | 62 $cm^3$ |
| Phosphoric Acid | Orthophosphoric Acid | 90% W/W | 15.9 | 63 $cm^3$ |
| Sodium chlorate(1) | Sodium hypochlorite | 10-14% W/V (approx.) | 1.7 | 600 $cm^3$ |
| Sulfuric Acid | 98% W/W | | 18.4 | 54 $cm^3$ |

**For example in the case of Sulfuric acid.**

To make 1 $dm^3$ of a 1 M solution you need .....54 $cm^3$ of 98% acid.
So, for 1 $dm^3$ of a 2 M solution you need .....54 X 2 = 108 $cm^3$ and for 2.5 litre of a 2 M solution you need ...108 X 2.5 = 270 $cm^3$

**DON'T FORGET ALWAYS ADD ACID TO WATER !**

# Appendix N

## Preparation of a school science safety statement

### INTRODUCTION:

### Preparation of a School/College Science Safety Statement

INTRODUCTION: Under the 1989 Safety, Health and Welfare at Work Act it is obligatory on all employers to prepare a Safety Statement and bring it to the notice of all employees. The Safety Statement must set out the general **'duties of care'** for both employers and employees. Employers must ensure that, **in so far as is reasonably practicable,** the Safety, Health and Welfare of all employees and others under their direct control (e.g. contractors) is protected. The Safety Statement is the School/College Board of Management's statement of intent which outlines how the Safety, Health and Welfare of employees, is protected and how its safety management programme is implemented in the college/school. A full coverage of this topic is beyond the scope of these Guidelines as it would be impossible to cover all eventualities. A good outline guide to the preparation of a general safety statement is given in the "Report of the Advisory Committee on Occupational Safety and Health at First and Second Levels in the Education Sector to the Health and Safety Authority 1995". This Appendix is intended as a supplement to that general school guide and it should assist the College/School Management in the preparation of that part of the Safety Statement which are exclusive to the science areas of biology, chemistry and physics. It is not an exhaustive list of all hazards which can occur in every college/school science laboratory. It is intended only to highlight some of the areas that must be addressed and to indicate the depth to which they must be covered. A full **"Risk Assessment"** should be carried out for each laboratory, classroom, workroom, store etc., in the school.

All hazards must be classified as **"HIGH, MEDIUM** or **LOW"**. **High** indicates that the worst possible scenario exists, a person may be killed, or suffer an irreversible injury, lose a hand, finger, foot, etc. **Medium** indicated that the worst possible injury is that a person would sustain a 3-day HSA reportable accident. In the case of accidents to students if they have to attend a hospital or are seen by a General Practitioner as a result of their injuries then it must be reported to the HSA. **Low** implies that the worst that can happen is that an injured person may require in-house first aid and then return to class.

Having a Safety Statement will not prevent accidents. However, by making a commitment to promote safety and health in the school and specifying the arrangements and resources which are made available, the statement can play a vital part in reducing accidents and implementing the policies it contains.

Under the Safety, Health and Welfare at Work Act 1989 the employer is required to identify all the hazards in their work place and must state how the health, safety and welfare of all employees and others is protected from these hazards. The General Application Regulations 1993 require this to be a written risk assessment. In the educational system this means that the School/College Board of Management is ultimately responsible for the safety of all its workers, teachers, office staff, cleaners, caretakers, contractors. The Board of Management may assign certain duties to be carried out by certain people but they are ultimately responsibility for the safety of everyone in the school/college and they can not delegate this responsibility. The Board is responsible for the recruitment of competent staff, and each staff member who has an area of responsibility under their control also has responsibility for safety in that area. They must be aware of all Safety, Health and Welfare at Work Laws, Codes of Practice and Regulations, which apply to all the disciplines taught or used in their area of responsibility.

**In accordance with the 1989 Act the general school/college safety statement must address the following areas.**

1. General Policy Statement on the College Safety Health and Welfare procedures (which should includes how the safety of staff and others in the science area will be protected).

Signed by Chairperson of Board of Management.

2. The management safety structure and how the Safety Statement is brought to the attention of the Safety Representative, the employees and others who work in the science area.
3. Under the 1989 Safety Health and Welfare at Work Act, and the 1993 General Application Regulations employers are required to conduct a written" Risk Assessment ". This involves:

- Identifying all the hazards to employees and others in the school;
- Assess the "Risk" of injury;
- List the control methods taken to eliminate or minimise the identified hazards to the lowest level reasonably practicable.

Name the person who is responsible to ensure that these procedures are followed.

The outline of the Safety Statement below assumes that areas such as:

- The Line of command,
- Accident Reporting procedures,
- Training,
- Fire procedures,
- Evacuation drills,
- Fire equipment inspection procedures,
- Emergency procedures,
- First aid,
- Display Screen Equipment procedures,
- Electricity,
- Manual Handling,
- Personal Protective Equipment,
- Machine guarding, etc.

All these areas are addressed in the school/college general safety statement and it indicates how these are addressed in the science area where special hazards may exist.

This Appendix is only intended as a guide to the essentials which should be added on to the school/college safety statement and to highlight special risks in the science area.

# Scoil Sabhailteacht Safety Statement

## Science Laboratory Hazard Identification

Prepared by Prepared 10 Nov. 2001 Page 1 of 5

## Chemical/Biological/Physical Health Hazards

| Name Hazard | What is the risk to employees | Steps taken to avoid injury | Date Action taken | Responsible person |
|---|---|---|---|---|

## Laboratory General

### Safe place of work

| | | | | |
|---|---|---|---|---|
| Housekeeping | Medium | See[10] Chapter 1.1,2.2,2.3, Appendix G, I & K, (pages, 71). | 5 Nov. 2001 | Mr/s Principal |

### General Services

| | | | | |
|---|---|---|---|---|
| Gas (propane Natural) | Medium | See Chapter 1.2 (page 9) | 5 Nov. 2001 | Mr/s Laboratory |
| Water | Low | See Chapter 1.2 | 5 Nov. 2001 | Mr/s Laboratory |

### Waste disposal

| | | | | |
|---|---|---|---|---|
| General | High | See Chapter 2.6.1 (page 17) | 5 Nov. 2001 | Mr/s Laboratory |
| Chemical | Medium | See Chapter 2.6.2 (page 18) | 5 Nov. 2001 | Mr/s Chemistry |
| Biological | Medium | See Chapter 2.6.3 & 3.3.3. | 5 Nov. 2001 | Mr/s Biology |
| Electricity | High | See Chapter 1.3, (page 10), 3.2.1 (page 20), 5.10 (page 60) & 5.11 (page 61) | 5 Nov. 2001 | Mr/s Physics |
| Hygiene | Medium | See Chapter 1.4 (page 11) | 5 Nov. 2001 | Mr/s Laboratory |

[10] *This refers to the appropriate section(s) in the SAFETY IN SCHOOL SCIENCE Guidelines, you should read this (these) section(s) and copy or amend them to best suit the needs of your school consistent with good safety practice. You should then write them out fully into your School or College safety statement.*

# Scoil Sabhailteacht Safety Statement

## Science Laboratory Hazard Identification

Prepared by Prepared 3 Sep 2001 Page 2 of 5

## Chemical/Biological/Physical Health Hazards

| Name Hazard | What is the risk to employees | Steps taken to avoid injury | Date Action taken | Responsible person |
|---|---|---|---|---|

## Hazards

### Non-ionising radiation

| | | | | |
|---|---|---|---|---|
| Lasers | High | See Chapter 3.2.2 | 5 Nov. 2001 | Mr/s Physics |
| Ultra violet radiation | High | See Chapter 3.2.2 | 5 Nov. 2001 | Mr/s Physics |
| Strobscopes & Signal Generators | Medium | See Chapter 3.2.2 | 5 Nov. 2001 | Mr/s Physics |

### Ionising radiation

| | | | | |
|---|---|---|---|---|
| X-Rays | High | See Chapter 3.2.3 | 5 Nov. 2001 | Mr/s Physics |
| Radioactive sources | High | See Chapter 3.2.25.8, Appendix H) | 5 Nov. 2001 | Mr/s Physics |
| Ultra violet radiation | High | See Chapter 3.2.2 | 5 Nov. 2001 | Mr/s Physics |
| Biology | High | See Chapter 3.3, Appendix Q (page 104) | 5 Nov. 2001 | Mr/s Biology |
| Steam sterilisation | Medium | See Chapter 3.3.4 | 5 Nov. 2001 | Mr/s Biology |
| Field trips | High | See Chapter 3.3.5 | 5 Nov. 2001 | Mr/s Biology |

# Sabhailteacht College Safety Statement

## Science Laboratory Hazard Identification

Prepared by Prepared 3 Sep 2001 Page 3 of 5

## Chemical/Biological/Physical Health Hazards

| Name Hazard | What is the risk to employees | Steps taken to avoid injury | Date Action taken | Responsible person |
|---|---|---|---|---|
| **Chemistry** | | | | |
| Hazards & general principles | High | See Chapter 3.4, 3.4.1, Appendix G, M | 5 Nov. 2001 | Mr/s Chemistry |
| Explosions | High | See Chapter 3.4.2, 3.4.3, 3.4.4 Appendix D, F | 5 Nov. 2001 | Mr/s Chemistry |
| Hydrogen | High | See Chapter 3.4.2 | 5 Nov. 2001 | Mr/s Chemistry |
| Chlorates | High | See Chapter 3.4.2 | 5 Nov. 2001 | Mr/s Chemistry |
| Oxidants | High | See Chapter 3.4.2 | 5 Nov. 2001 | Mr/s Chemistry |
| Other chemicals | High | See Chapter 3.4.3,3.4.4, Appendix O | 5 Nov. 2001 | Mr/s Chemistry |
| Carcinogens | High | See Chapter 3.4.5,3.4.6, Appendix p | 5 Nov. 2001 | Mr/s Chemistry |
| Chemical spills | High | See Chapter 5.13, Appendix A | 5 Nov. 2001 | Mr/s Chemistry |
| Cleaning up spills | Medium | See Chapter 2.4 | 5 Nov. 2001 | Mr/s Teacher |
| Storage | High | See Chapter 2.5.1, Appendix D, A, F | 5 Nov. 2001 | Mr/s Chemistry |
| Stock control | High | See Chapter 2.5.2, Appendix D, F | 5 Nov. 2001 | Mr/s Chemistry |

# Scoil Sabhailteacht Safety Statement

## Science Laboratory Hazard Identification

Prepared by Prepared 3 Sep 2001 Page 4 of 5

## Chemical/Biological/Physical Health Hazards

| Name Hazard | What is the risk to employees | Steps taken to avoid injury | Date Action taken | Responsible person |
|---|---|---|---|---|

## General Equipment

| | | | | |
|---|---|---|---|---|
| Bünsen burner | Medium | See Chapter 5.1 | 5 Nov. 2001 | Mr/s Teacher |
| Heating equipment | Medium | See Chapter 5.2,5.3 | 5 Nov. 2001 | Mr/s Teacher |
| Pipettes | High | See Chapter 5.4 | 5 Nov. 2001 | Mr/s Teacher |
| Dilution | Medium | See Chapter 5.5 | 5 Nov. 2001 | Mr/s Teacher |
| Thermometers | Medium | See Chapter 5.6 | 5 Nov. 2001 | Mr/s Teacher |
| Using test-tubes | Medium | See Chapter 5.3.1 | 5 Nov. 2001 | Mr/s Teacher |
| Testing for smell | Medium | See Chapter 5.7 | 5 Nov. 2001 | Mr/s Teacher |
| Glassware | High | See Chapter 5.9 | 5 Nov. 2001 | Mr/s Teacher |
| Cutting glass tubing | Medium | See Chapter 5.9.3 | 5 Nov. 2001 | Mr/s Teacher |
| Glass containers | High | See Chapter 5.9.3 | 5 Nov. 2001 | Mr/s Teacher |
| Pouring liquids | High | See Chapter 5.9.4 | 5 Nov. 2001 | Mr/s Teacher |

# Scoil Sabhailteacht Safety Statement

## Science Laboratory Hazard Identification

Prepared by Prepared 3 Sep. 2001 

## Chemical/Biological/Physical Health Hazards

| Name Hazard | What is the risk to employees | Steps taken to avoid injury | Date Action taken | Responsible person |
|---|---|---|---|---|

## General Equipment

| | | | | |
|---|---|---|---|---|
| Bromine[11] | Very Toxic Corrosive | See[12] "Safety in the School Laboratory" *An Roinn Oideachais 1996* | 5 Nov. 2001 | Mr/s Chemistry |
| t-Butyl alcohol | Harmful Highly Flammable | | 5 Nov. 2001 | Mr/s Chemistry |
| Calcium chloride | Oxidising | | 5 Nov. 2001 | Mr/s Chemistry |
| Calcium chloride | Irritant | | 5 Nov. 2001 | Mr/s Chemistry |
| Copper nitrate | Harmful Oxidising | Chapters 2.5, 2.6, 3.4, 4.2, | 5 Nov. 2001 | Mr/s Chemistry |
| Cyclohexane | Irritant Flammable | 4.3.6 & 5.13 | 5 Nov. 2001 | Mr/s Chemistry |
| Di(dodecanoyl) peroxide | Oxidising | Appendices A, D, E, F, G, O, P, & Q | 5 Nov. 2001 | Mr/s Chemistry |

[11] *Just a sample of chemicals a full audit must be carried out for all chemicals held.*

[12] *This refers to SAFETY IN THE SCHOOL LABORATORY by An Roinn Oideachais 2001. The appropriate Material Safety Data Sheets available at http: //www.psi-net.org/ should be studied along with the appropriate sections in the SAFETY IN SCHOOL SCIENCE Guidelines. You should copy or amend them to best suit the needs of your school consistent with good safe' practice. You should write your adopted procedure out in full into your school safety statement.*

# Appendix O

## Material Safety Data Sheets (MSDS)[13]

Material safety data sheets have been and are known by many names. Hazardous Chemical Data Sheets was the first name, as initially they were only produced for a limited number of particularly hazardous chemicals. This name is seldom used today because material safety data sheets are produced for many non-hazardous chemicals. Material Safety Data Sheets or MSDS is the popular name in Ireland. Safety Data Sheets is the term often used in Health and Safety Regulations. The term safety data sheets can cause confusion when communicating with engineers as this term is used in their profession in reference to safe work practices on machines. Data Sheets is sometimes used as a simple abbreviation but again often causes confusion with other professions where it can have other meanings. Chemical Safety Data Sheets is the term favoured by the Royal Society of Chemistry and in the UK but is little used in Ireland. All these terms may be found in literature as alternative, to MSDS. However, MSDS is the most popular term in Irish Industry at this time so this is the term which has been adopted in these guidelines.

The Material Safety Data Sheets (MSDS) gives employers and workers detailed information about the hazards of specific chemicals and how to control them. Chemical Manufacturers and suppliers are obliged under the 1989 Act, the European Chemical Agents Regulations 1994 to provide dangerous substances users with an up-to-date Material Safety Data Sheet on each dangerous substance which they use or hold in stock. The layout of these MSDSs is specified in the Chemical Agents Regulations and is outlined below. Each user is obliged to hold an up-to-date (not more than three years old) Material Safety Data Sheet on each dangerous substance which they hold in stock. Material Safety Data Sheets are very often written with the needs of the large industrial user being paramount. Some of the suggestions may not be very practical in the school laboratory. One good example is when handling conc. acid or alkali they will always recommend wearing face shield, goggles, neoprene gloves, rubber apron, rubber boots, etc. This may be necessary when handling Winchesters, but when handling 250 $cm^3$ bottles in the laboratory dexterity and manual manipulation is of utmost importance. Here safety glasses and laboratory coat are more satisfactory in a laboratory where there is plenty of water available to clean up spills. The language used is technical and the terminology is not consistent from company to company. In short they are not user friendly to school science laboratories. Each employer is required to provide this information in a format which his/her

[13] *MSDS's on Chemicals used in Second Level Irish Schools are available on the internet on http: //www.psi-net.org Abbreviated chemical safety information is available in the "Green Book" published by the Department of Education and Science 1996 revised 2001. This book is now available on the internet from the above site.*

workers can understand. The Material Safety Data Sheets must be available to workers in each area where the dangerous substance is stored and used.

## Obligatory Headings for Material Safety Data Sheets

(They are only required for dangerous substances although they form a very good basis of information for all chemicals)

### Identification of the substance/preparation and of the manufacturing company or supplier;

- The common name and the chemical name of the material, unless this information is a trade secret;
- The name, address, and phone number of the manufacturer, and emergency telephone numbers you can use to get immediate information on specific chemical hazards;
- The date the MSDS was written or last revised;

### Composition/information on ingredients:

- Any hazardous ingredients in the chemical.
- Physical information that will help you identify the chemical and how it behaves.

### Hazards identification.

- Corrosive, Toxic, Flammable etc.

### Physical appearance,

- Colour, odour, labelling, CAS Number, EC number, UN number, ADR number.

### First-aid measures:

- Emergency and first-aid treatments.

### Fire-fighting measures:

- The material's flash point, auto-ignition temperature, and upper and lower flammability limits;
- Materials to use to put out fires involving this chemical;
- Special fire-fighting techniques and equipment;
- Any unusual fire or explosion hazards.

**Accidental release measures:**

- How to deal with spills and leaks:
- Clean-up techniques;
- Personal protective equipment to be used during clean-up; and
- How to dispose of waste materials.

**Handling and storage:**

- Measures to control the chemical's hazards:
- Engineering controls;
- Safe storage of the chemical;
- Safe handling practices;
- Incompatibility with other chemicals; and
- Types of containers in which it is safe to store it.

**Exposure controls/personal protection:**

- Personal protective equipment.

**Physical and chemical properties:**

- Melting point, boiling point, water miscibility, density, concentration, vapour pressure,

**Stability and reactivity:**

- Dangers from chemical reactions with this material:
- Whether the chemical itself is stable or unstable;
- Conditions and other materials that can cause reaction with this chemical; and
- Any dangerous substances that can be produced when it reacts.

**Toxicological information:**

Information about the chemicals health hazards.

- Safe exposure limits, such as the Occupational Exposure Limits (OEL) (the concentration of a potentially harmful substance in the air below which it will not cause harm to the majority of people). Permissible Exposure Limit (PEL) and the Threshold Limit Value (TLV) are similar and are found in literature. {The OEL is the time-weighted average concentration of a chemical agent, for a normal 8 hour working day and a 40 hour work week, to which nearly all workers can be exposed, day after day without adverse effect. This concentration is measured in parts per million (ppm) or

milligrams per cubic metre ($mg/m^3$)}. Many substances have Maximum Exposure Limits (MEL), also known as Short Term Exposure Limits (STEL). The MEL is the time-weighted concentration of a chemical agent which should not be exceeded over any 15 minute period in the working day. Chemicals which have adverse health effects following brief single or multiple exposures are given a MEL in addition to their OEL. A full listing of OELs and MELs is revised and published annually by the Health and Safety Authority. These values are based on exposure to single substances for normal adults. Values have not been established for young persons and for exposure to multiple substances. A full account of these can be found in the Code of Practice for Safety Health and Welfare at Work (Chemical Agents) Regulations 1994 (Limit Values).

- LD50, LC50, (Lethal dose 50% kill and lethal concentration 50% kill of a group of laboratory test animals. It gives the relative toxicity of a material to living creatures other than humans);
- Acute (short term symptoms of an injury or exposure to a hazardous substance) and chronic (long term symptoms of an injury or exposure to a hazardous substance);
- The chemical's main routes of entry into the body (the ways in which a potentially hazardous substance can enter the body, inhalation, injection, ingestion or through the skin);
- Medical conditions that can be made worse by exposure;
- Whether the chemical can cause cancer (certain chemicals are known to cause cancer and these are listed in Appendix P, p. 100);
- Whether it is a mutagen (certain chemicals are suspected of causing mutations in the cell structure and this can be passed on by hereditary); and
- Whether it is toxic for reproduction (formally known as teratogens, these cause malformation of the child in the womb - a large number of chemicals are known to be harmful for reproduction but a full list does not exist, alcohol is an example).

**Ecological information:**

- Negative effects the material is known to have on the environment, e.g. fish, animals, birds and plants.

### Disposal considerations:

- Safe methods for disposal which have minimal destructive effect on the environment e.g. burn, neutralise, dump in land fill, evaporate and dump with household waste.

### Transport information:

- Special transport arrangements for the chemical.

### Regulatory information:

- EU, and Irish regulations controlling the transport of the material.

### Other information.

- The information on the MSDS can help you make your workplace safe.
- Know where the MSDS manual is kept in your work area.
- Be familiar with the most important points for each hazardous material you use.
- Check the MSDS whenever you need more information.
- Be ready to find emergency-response information on the school MSDS forms quickly.
- Follow the safety practices the MSDS gives you.

# Appendix P

## Classified Carcinogens

### A List of substances classified as Carcinogens (R45 or R49) in Directive 6715481EEC

### CATEGORY 1 CARCINOGENS

| Substance | Annex 1 (EU) Number |
|---|---|
| 4-Aminobiphenyl | 612-072-00-6 |
| 4-Aminobiphenyl salts | 612-073-00-1 |
| Arsenic pentoxide | 033-004-00-6 |
| Arsenic acid and salts | 033-005-00-1 |
| Asbestos fibres all types | 650-013-00-0 |
| Benzene | 601-020-00-8 |
| Benzidine (4,4'-diaminobiphenyl) | 612-070-00-5 |
| Bis (chloromethyl) ether | 603-046-00-5 |
| Chlorodimethyl ether | 603-075-00-3 |
| Chromium trioxide** | 024-001-00-0 |
| Erionite | 650-012-00-0 |
| Lead hydrogen arsenate | 082-011-00-0 |
| 2-Naphthylamine | 612-022-00-3 |
| 2-Naphthylamine salts | 612-071-00-0 |
| Dinickel trioxide** | 028-005-00-3 |
| Nickel monoxide** | 028-003-00-2 |
| Nickel dioxide** | 028-003-00-2 |
| Nickel sulfide ** | 028-006-00-9 |
| Trinickel disulfide (nickel subsulfide)** | 028-007-00-4 |
| Vinyl chloride | 602-023-00-7 |
| Zinc chromates including zinc potassium chromate | 024-007-00-3 |

**denotes an R49 substance

# Appendix P continued:

## CATEGORY 2 CARCINOGENS

| Substance | Annex 1 (EU) Number |
|---|---|
| Acrylamide | 616-003-00-0 |
| Acrylonitrile | 608-003-00-4 |
| 4-Aminoazobenzene | 611-008-00-4 |
| 2-2-Aminoaotoluene | 611-006-00-3 |
| 4-Amino-3-fluorophenol | 604-028-00-X |
| o-Anisidine | 612-035-00-4 |
| Benz (α) anthracene | 601-033-00-9 |
| Benzo (α) pyrene | 601-032-00-3 |
| Benzo (γ) fluoranthene | 601-035-00-X |
| Benzo (γ) fluoranthene | 601-036-00-5 |
| Benzotrichloride | 602-038-00-9 |
| Beryllium** | 004-001-00-7 |
| Beryllium compounds** | 004-002-00-2 |
| 1,3-Butadiene | 601-013-00-X |
| Cadium chloride | 048-008-00-3 |
| Cadium oxide** | 048-002-00-0 |
| Calcium chromate | 024-008-00-9 |
| Captafol | 613-046-00-7 |
| Carbadox | 613-050-00-9 |
| Chromium(III) chromate | 024-010-00-X |
| 4,4'-Diaminodiphenylmethane(4,4'-methylenedianiline) | 612-051-00-1 |
| Diazomethane | 006-068-00-8 |
| Dibenz (α,β) anthracene | 601-041-00-2 |
| 1,2-Dibromo-3-chloropropane | 602-021-00-6 |
| 1,4-Dichlorobut-2-ene | 602-073-00-X |
| 1,3-Dichloro-2-propanol | 602-064-00-0 |
| 3,3'-Dichlorobenzidine | 612-068-00-4 |
| 3,3'-Dichlorobenzidine salts | 612-069-00-X |

**denotes an R49 substance

# Appendix P continued:

## CATEGORY 2 CARCINOGENS

| Substance | Annex 1 (EU) Number |
|---|---|
| 2,2'-Dichloro-4,4 '-methylendianiline (4,4'-Methylene bis (2-chloroaniline) | 612-078-00-9 |
| 2,2'-Dichloro-4,4 '-methylendianiline (4,4'-Methylene bis (2-chloroaniline) salts | 612-079-00-4 |
| Diethylsulfate | 016-027-00-6 |
| 3,3'-Dimethoxybenzidine (o-dianisidine) | 612-036-00-X |
| 3,3'-Dimethoxybenzidine (o-dianisidine) salts | 612-037-00-5 |
| 3,3'-Dimethylbenzidine (o-tolidine) | 612-041-00-7 |
| 3,3'-Dimethylbenzidine (o-tolidine)salts | 612-081-00-5 |
| Dimethylcarbamoyl chloride | 006-041-00-0 |
| N,N-Dimethylhydrazine | 007-012-00-5 |
| 1,2-Dimethylhydrazine | 007-013-00-0 |
| Dimethylinitrosamine | 612-077-00-3 |
| Dimethylsulfate | 016-023-00-4 |
| Dimethylsulfamoyl chloride | 016-033-00-9 |
| CI Direct Brown | 95 611-005-00-8 |
| Epichlorhydrin | 603-026-00-6 |
| Ethylene dibromide (1,2-dibromoethane) | 602-010-00-6 |
| Ethylene dichloride (1,2-dichloroethane) | 602-012-00-7 |
| Ethyleneimine (aziridine) | 613-001-00-1 |
| Ethylene oxide | 603-023-00-X |
| Extracts (petroleum), heavy naphthenic distillate solvent | 649-004-00-X |
| Extracts (petroleum), heavy paraffinic distillate solvent | 649-002-00-9 |
| Extracts (petroleum), light naphthenic distillate solvent | 649-001-00-3 |
| Extracts (petroleum), light paraffinic distillate solvent | 649-003-00-4 |
| Extracts (petroleum), light vacuum gas oil solvent | 649-005-00-5 |
| Hexachlorobenzene | 602-065-00-6 |
| Hexamethylphosphoric triamide | 015-106-00-2 |
| Hydrazine | 007-008-00-3 |

**denotes an R49 substance

# Appendix P continued:

## CATEGORY 2 CARCINOGENS

| Substance | Annex 1 (EU) Number |
|---|---|
| Hydrazine salts | 007-014-00-6 |
| Hydrazine bis(3-carboxy-4-hydroxylbenzenesulfonate) | 007-022-00-X |
| Hydrazobenzene | 007-021-00-4 |
| Hydrocarbons, C20-55, aromatic rich | 649-006-00-0 |
| Methyl acrylamidoglycolate (containing >0.1% acrylamide) | 607-210-00-7 |
| Methyl azoxy methyl acetate | 611-004-00-2 |
| 4,4'-Methylenedi-o-toluidine (methylene bis (2-methylaniline)) | 612-085-00-7 |
| 1-Methyl-3-nitro-1-nitrosoguanidine (MNNG) | 612-083-00-6 |
| 4-Methyl-m-phenylenediamine | 612-099-00-3 |
| 5-Nitroacenaphthene | 609-037-00-2 |
| 2-Nitroanisole | 609-047-00-7 |
| 4-Nitrobiphenyl | 609-039-00-3 |
| Nitrofen | 609-040-00-9 |
| 2-Nitroaphthalene | 609-038-00-8 |
| 2-Nitropropane | 609-002-00-1 |
| Nitrosodipropylamine | 612-098-00-8 |
| 2,2-(nitrosoimino)bis ethanol | 612-090-00-4 |
| Potassium bromate | 035-003-00-6 |
| 1,3-Propanesuitone | 016-032-00-3 |
| 1,3-Propiolactone | 606-031-00-1 |
| Propyleneimine (2-methylazindine) | 613-033-00-6 |
| Propylene oxide | 603-055-00-4 |
| Strontium chromate | 024-009-00-4 |
| Styrene oxide | 603-084-00-2 |
| Sulfallate | 006-038-00-4 |
| Thioacetamide | 616-026-00-6 |
| o-Toluidine | 612-091-00-X |
| 1,1,1-Trichloroethane | |
| Urethane (ethyl carbamate) | 607-149-00-6 |

**denotes an R49 substance

# Appendix Q

## Biological Reagents and Classification

### (Biological Agents Regulations 1994)

Biological agents appearing on this list as classification 2 or classification 3 should not be used in school laboratories

### BACTERIA and similar organisms

| Biological Agent | Classification |
|---|---|
| Actinoacillus actinomycetemcomitans | 2 |
| Actinomadura madurae | 2 |
| Actinomadura pelletieri | 2 |
| Actinomycas gerencseriae | 2 |
| Actinomyces israelii | 2 |
| Actinomyces pyogenes | 2 |
| Actinomyces spp. | 2 |
| Arcanobacterium haemolyticum (corynebacterium haemolyticum) | 2 |
| Bacillus anthracis | 3 |
| Bacteroides fragilis | 2 |
| Bartonella bacilliformis | 2 |
| Bordetella bronchiseptica | 2 |
| Bordetella pertussis | 2 |
| Borrelia burgdorferi | 2 |
| Borrelia duttonii | 2 |
| Borrelia recurrentis | 2 |
| Borrelia spp. | 2 |
| Brucella abortus | 3 |
| Brucella canis | 3 |
| Brucella melitensis | 3 |
| Brucella suis | 3 |
| Camoylobacter fetus | 2 |
| Camoylobacter jejuni | 2 |
| Camolyobacter spp. | 2 |
| Cardiobacterium hominis | 2 |
| Chlamydia trachomatis | 2 |
| Chlamydia psittaci (avian strains) | 3 |
| Chylamydia psittaci (other strains) | 2 |
| Clostridium botulinum | 2 |
| Clostridium perfringens | 2 |
| Clostridium tetani | 2 |
| Clostridium spp. | 2 |
| Corynebacterium diphtheriae | 2 |
| Corynebacterium minutissiumum | 2 |
| Corynebacterium pseudotuberculosis | 2 |
| Corynebacterium spp. | 2 |
| Coxiella burnetii | 3 |
| Edwardsiella tarda | 2 |
| Ehrlichia sennetsu (Rickettsia sennetsu) | 2 |
| Ehrlichia spp. | 2 |
| Eikenella corrodens | 2 |
| Enterobacter aerogenes/cloacae | 2 |
| Enterobacter spp. | 2 |
| Enterococcus spp. | 2 |
| Erysipelothrix rhusiopaethiae | 2 |
| Escherichia coli (with the exception of non-Pathogenic strains) | 2 |
| Flavobacterium meningosepticum | 2 |

# Appendix Q continued:

| Biological Agent | Classification |
|---|---|
| Fluoribacter bozemanae (Legionella) | 2 |
| Francisella tularensis (Type A) | 3 |
| Francisella tularensis (Type B) | 2 |
| Fusobacterium necrophorum | 2 |
| Gardnerella vaginalis | 2 |
| Haemophilus ducreyi | 2 |
| Haemophilus influenzae | 2 |
| Haemophilus spp. | 2 |
| Helicobacter pylon | 2 |
| Klebsiella oxytoca | 2 |
| Klebsiella pneumoniae | 2 |
| Klebsiella spp. | 2 |
| Legionella pneumophila | 2 |
| Legionella spp. | 2 |
| Leptospira interrogans (all serovars) | 2 |
| Listeria monocytogenes | 2 |
| Listeria ivanovii | 2 |
| Morganeila morganii | 2 |
| Mycobacterium africanum | 3 |
| Mycobacterium aviumvintracellulare | 2 |
| Mycobacterium bovis (except BCG strain) | 3 |
| Mycobacterium chelonae | 2 |
| Mycobacterium fortuitum | 2 |
| Mycobacterium kansasii | 2 |
| Mycobacterium leprae | 3 |
| Mycobacterium malmoense | 2 |
| Mycobacterium marinum | 2 |
| Mycobacterium microti | 3(*) |
| Mycobacterium paratuberculosis | 2 |
| Mycobacterium scrofulaceum | 2 |
| Mycobacterium simiae | 2 |
| Mycobacterium szulgai | 2 |

| Biological Agent | Classification |
|---|---|
| Mycobacterium tuberculosis | 3 |
| Mycobacterium ulcerans | 3(*) |
| Mycobacterium xenopi | 2 |
| Mycobacterium pneumoniae | 2 |
| Neisseria gonorrhoeae | 2 |
| Neisseria meningitidis | 2 |
| Nocardia asteroides | 2 |
| Nocardia brasiliensis | 2 |
| Nocardia farcinica | 2 |
| Nocardia nova | 2 |
| Nocardia otitdiscaviarum | 2 |
| Pasteurella multocida | 2 |
| Pasteurella spp. | 2 |
| Peptostreptococcus anaerobus | 2 |
| Plesiomonas shigelloides | 2 |
| Porphyromonoas spp. | 2 |
| Prevotella spp. | 2 |
| Proteus mirabilis | 2 |
| Proteus penneri | 2 |
| Proteus vulgaris | 2 |
| Providencia aicalifaciens | 2 |
| Providencia rettgeri | 2 |
| Providencia spp. | 2 |
| Pseudomonas aeruginosa | 2 |
| Pseudomonas mallei | 3 |
| Pseudomonas pseudomallei | 3 |
| Rhodococcus equi | 2 |
| Rickettsia akan | 3(') |
| Rickettsia canada | 3(') |
| Rickettsia conorii | 3 |
| Rickettsia montana | 3(') |
| Rickettsia typhi (Rickettsia moosen) | 3 |

# Appendix Q continued:

| Biological Agent | Classification |
|---|---|
| Rickettsia prowazekii | 3 |
| Rickettsia Rickettsii | 3 |
| Rickettsia tsutsugamushi | 3 |
| Rickettsia spp. | 2 |
| Rochalimaea quintana | 2 |
| Salmonella Arizonae | 2 |
| Salmonella Enteritidis | 2 |
| Salmonella Typhimurium | 2 |
| Salmonella Paratyphi A, B, C | 2 |
| Salmonella Typhi | 3(') |
| Salmonella (other serovars) | 2 |
| Serpulina spp. | 2 |
| Shigella boydii | 2 |
| Shigella dysentenae (Type 1) | 2 |
| Shigella flexneri | 2 |
| Shigella sonnei | 2 |
| Staphylococcus aureus | 2 |
| Streptobacillus moniliformis | 2 |
| Streptococcus pneumoniae | 2 |
| Streptoccoccus pyogenes | 2 |
| Streptoccus spp. | 2 |
| Treponema carateum | 2 |
| Treponema pallidum | 2 |
| Treponema pertenue | 2 |
| Treponema spp. | 2 |
| Vibrio cholerae (including El Tor) | 2 |
| Vibrio parahaemolyticus | 2 |
| Vibrio spp. | 2 |
| Yersinia enterocolitica | 2 |
| Yersinia pestis | 3 |
| Yersinia pseudotuberculosis | 2 |
| Yersinia spp. | 2 |

| Biological Agent | Classification |
|---|---|
| **VIRUS** | |
| Adenovindae | 2 |
| Arenavindae Junin virus | 4 |
| Lymphocytic choriomeningitis virus (neurotropic strains) | 3 |
| Lymphocytic choriomeningitis virus (other strains) | 2 |
| Machupo virus | 4 |
| Mopeia virus and other Tacaribe viruses | 2 |
| Astroviridae | 2 |
| Astroviridae | 2 |
| Bunyaviridae Bunyarriwera virus | 2 |
| Oropouche virus | 3 |
| California encephalitis virus | 2 |
| Hantaviruses: | 2 |
| Hantaan (Korean haemorrhagic fever) | 3 |
| Seoul virus | 3 |
| Puumala virus | 2 |
| Prospect Hill virus | 2 |
| Other hantaviruses | 2 |
| Nairoviruses: | |
| Crimean-Congo haemorrhagic fever | 4 |
| Hazara virus | 2 |
| Phleboviruses: | |
| Rift Valley fever | 3 |
| Sandyfly fever | 2 |
| Toscana virus | 2 |
| Other bunyaviridae known to be pathogenic | 2 |
| Calciviridae: | |
| Norwalk virus | 2 |
| Other Caliciviridae | 2 |
| Coronaviridae | 2 |

# Appendix Q continued:

| Biological Agent | Classification |
|---|---|
| Filoviridae: | |
| Ebola virus | 4 |
| Marburg virus | 4 |
| Flaviviridae: | |
| Australia encephalitis (Murray Valley encephalitis) | 3 |
| Central Europeantick borne encephalitis virus | 3(') |
| Absettarov | 3 |
| Hanzalova | 3 |
| Hypr | 3 |
| Kumlinge | 3 |
| Dengue virus type 1-4 | 3 |
| Hepatitis C virus | 3(') |
| Japanese B encephalitis | 3 |
| Kyasanur Forest | 3 |
| Louping ill | 3 |
| Omsk | 3 |
| Powassan | 3 |
| Rocio | 3 |
| Russian spring-summer encephalitis (TBE) | 3 |
| Reoviruses | 2 |
| St. Louis encephalitis | 3 |
| Wesselbron virus | 3(') |
| West Nile fever virus | 3 |
| Yellow fever | 3 |
| Other fiaviviruses known to be pathogenic | 2 |
| Hepadnaviridae: Hepatitis B virus | 3(') |
| Hepatitis D virus (Delta) | 3 |
| Herpesviridae Cytomegalovirus | 2 |

| Biological Agent | Classification |
|---|---|
| Epsteir-Barr virus | 2 |
| Herpesvirus simiae (B virus) | 3 |
| Herpes simplex viruses types 1 and 2 | 2 |
| Herpesvirus varicella-zoster | 2 |
| Human B-Iymphotropic virus (HBLV-HHV6) | 2 |
| Orthomyxovindae Influenza viruses types A, B and C | 2 |
| Tick-borne orthomyxoviridae: Dhori and Thogoto viruses | 2 |
| Dhori and Thogoto viruses Papovaviridae 8K and JC viruses | 2 |
| Human papillomaviruses | 2 |
| Paramyxoviridae Measles virus | 2 |
| Mumps virus | 2 |
| Newcastle disease virus | 2 |
| Parainfluenza viruses types 1 to 4 | 2 |
| Respiratory syncytial virus | 2 |
| Parvoviridae Human parvovirus (819) | 2 |
| Picornaviridae | 2 |
| Acute haemorhagic conjunctivitis virus (AHC) | 2 |
| Coxsacki viruses | 2 |
| Echo viruses | 2 |
| Hepatitis A virus human enterovirus (type 72) | 2 |
| Polioviruses | 2 |
| Rhinoviruses | 2 |
| Poxyviridae Buffalopox virus | 2 |
| Cowpox virus | 2 |
| Elephantopox virus | 2 |
| Milkers' node virus | 2 |
| Molluscum contagiosum virus | 2 |
| Monkeypox virus | 3 |

# Appendix Q continued:

| Biological Agent | Classification |
|---|---|
| Orf virus | 2 |
| Rabbitpox virus | |
| Vaccinia virus | 2 |
| Variola (major & minor) virus | 4 |
| White pox virus ("Vanola virus") | 4 |
| Yatapox virus (Tana & Yaba) | 2 |
| Reoviridae Coltiviruses | 2 |
| Human rotaviruses | 2 |
| Orbiviruses | 2 |
| Retroviridae Human immunodeficiency virus | 3 |
| Human T-celllymphotropic viruses (HLTV) types 1 and 2 | 3 |
| Rhabdoviridae: Rabies virus | 3(') |
| Vesicular stomatitis virus | 2 |
| Togaviridae Alfaviruses: Eastern equine encephalomyelitis | 3 |
| Bebaru virus | 2 |
| Chikungunva virus | 3(') |
| Everglades virus | 3(') |
| Mavaro virus | 3 |
| Mucambo virus | 3 |
| Ndumu virus | 3 |
| O'nyong-nyong virus | 2 |
| Ross River virus | 2 |
| Semliki Forest virus | 2 |
| Sindbis virus | 2 |
| Tonate virus | 3(') |
| Venezuelan equine encephalomyelitis | 3 |
| Western equine encephalomyelitis | 3 |
| Other known alfaviruses: | 2 |
| Rubivirus (rubella) | 2 |
| Toroviridae | 2 |

| Biological Agent | Classification |
|---|---|
| Unclassified viruses Blood-borne hepatitis viruses not yet identified | 3(') |
| Hepatitis E virus | 3(') |
| Unconventional agents associated with Creuzfeld-Jakob disease | 3 |
| Gerstmann-Straussler-Scheinker syndrome | 3 |
| Kuru | 3 |
| Parasites Acanthamoeba castellani | 2 |
| Ancylostoma duodenale | 2 |
| Angiostrongylus cantonensis | 2 |
| Angiostrongylus Costaricensis | 2 |
| Ascaris suum | 2 |
| Babesia divergens | |
| Babesia microti | 2 |
| Balantidium coli | 2 |
| Brugia malayi | 2 |
| Brugia panangi | |
| Capillaria philippinensis | 2 |
| Capillaria spp | 2 |
| Clonorchis sinensis | 2 |
| Clonorchis viverrini | 2 |
| Cryptospondium parvum | 2 |
| Cryptospondium spp. | 2 |
| Dipetalonema streptocerca | 2 |
| Diphyllobothrium latum | 2 |
| Dracunculus medinensis | 2 |
| Echinococcus granulosus | 3 |
| Echinococcus Multilocaris | 3 |
| Echinococcus vogeli | 3 |
| Entramoeba histolytica | 2 |
| Fasciola gigantica | 2 |
| Fasciola hepatica | 2 |

# Appendix Q continued:

| Biological Agent | Classification |
|---|---|
| Fasciolopsis buski | 2 |
| Giardia lambia (Giardia intestinalis) | 2 |
| Hymenolepsis diminuta | 2 |
| Hymenolepis nana | 2 |
| Leishmania brasiliensis | 3 |
| Leishmania donovani | 3 |
| Leishmania ethiopica | 2 |
| Leishmania mexicana | 2 |
| Leishmania peruviana | 2 |
| Leishmania tropica | 2 |
| Leishmania major | 2 |
| Leishmania spp. | 2 |
| Loa Loa | 2 |
| Mansonello ozzardi | 2 |
| Mansonella perstans | 2 |
| Naegiena flowieri | 3 |
| Necator americanus | 2 |
| Onchocerca volvulus | 2 |
| Opisthorchis felineus | 2 |
| Opisthorchis spp. | 2 |
| Paragonimus westernani | 2 |
| Plasmodium falciparum | 3 |
| Plasmodiums spp (human & simian) | 2 |
| Sarcocystis suihominis | 2 |
| Schistosoma haematobium | 2 |
| Schistosoma intercalatum | 2 |
| Schistosoma japonicum | 2 |
| Schistosoma mansoni | 2 |
| Strongytoides stercoralis | 2 |
| Strongytoides spp. | 2 |
| Taenia saginata | 2 |
| Taenia solium | 3 |
| Toxocara canis | 2 |
| Toxoplasma gondii | 2 |
| Trichinerta spiralis | 2 |
| Trichuris trichiuria | 2 |
| Trypanosoma brucei brucei | 2 |
| Trypanosoma brucel gambiense | 2 |
| Trypanosoma brucei rhodesiense | 3 |
| Trypansoma cruzi | 3 |
| Wuchereria bancrofti | 2 |

## Fungi

| | |
|---|---|
| Aspergiilus fumigatus | 2 |
| Blastonmyces dermatitidis (Ajellomyces dermatidis) | 3 |
| Candida albicans | 2 |
| Coccidioides immitis | 3 |
| Cryptococcus neoformans var. neoformans (Filobasidiella neoformans var. neoformans) | 2 |
| Cryptococcus neoformans var. gattii (Filobasidiella bacillispora) | 2 |
| Emmonsia parva var. parva | 2 |
| Emmonsia parva var. crescens | 2 |
| Epidermophyton floccosum | 2 |
| Fonsecaea compacta | 2 |
| Fonsecaea pedrosol | 2 |
| Histoplasma Capsulatum var. Capsulatum (Ajellomyces Capsulatus) | 3 |
| Histoplasma capsulatum duboisii | 3 |
| Madurella grisea | 2 |
| Madurella mycetomatis | 2 |
| Microsporum spp. | 2 |
| Neotestudina rosatii | 2 |
| Paracocidioides brasiliensis | 3 |
| Penicillium marneffei | 2 |
| Sporothrix schenckii | 2 |
| Trichophyton rubrum | 2 |
| Trichophyton spp. | 2 |

# Appendix R

## IR 1 Form of Notice of Accident[14]

*Approved under the Safety, Health and Welfare at Work (General Application) Regulations, 1993*

### 1. Details of Injured Person

Name: Date of Birth:
Sex: Nationality
Address: RSI Number:
Occupation: Length of Service:
Time of starting work: Normal time of finishing work
Date of Accident: Time of accident:
Is the injured person:

### 2. Employer/Self-Employed Information

Name of business or company name: Phone Number:
Address of Head Office: Nature of Business:
Address of establishment where injured person was based, if different from address of Head Office:
If accident did not occur at the establishment address, state where:
Approximate number employed at establishment where injured person was based:
Approximate total number employed by business:

### 4. Circumstances of the Accident

Describe what the injured person was doing at the time of the accident, identifying the agent involved:
Describe the departure from normal, including the agent involved:
Describe the action leading to the injury, including the agent which actually caused the injury:

### 5. Details of the Injury

Indicate type of injury:
If other, please give a description:
Indicate part of the body most seriously injured

### 7. Details of Notifier

Notifier:
Employer/Self-Employed Person providing training
Person in control of workplace Other
If other, please give a description:
Your name, please: Your position, please:
Address for acknowledgement/Clarification, if different from that given in Section 2 above:
Telephone number for acknowledgement/clarification, if different from that given in Section 2 above:
Your email address, if you wish to receive a copy of the form:
Date:

[14] *This form is available on the HSA web page at http: //www.hsa.*

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