Safety Code of Practice

Faculty of Life Sciences

PREFACE

This Safety Code of Practice has been produced to help the Departments and Institutes comply with the *Health and Safety at Work etc. Act 1974* (HSW Act) and with the regulations enabled by the Act, *e.g*. the *Management of Health and Safety at Work Regulations* and the *Control of Substances Hazardous to Health (COSHH) Regulations*. The Safety Code of Practice is mandatory for staff, students and visitors working in offices, laboratories and other accommodation in the University, whether occupied solely by the Department of Health and Human Sciences (DHHS), the Institute of Brain Chemistry and Human Nutrition (IBCHN) or the Institute of Health and Research and Policy (IHRP) or shared between the Department and the Institutes. The Code is intended to be read and understood within the context of the Health, Safety and Fire Safety Policy Statements of the Department and Institutes.

The HSW Act gives legal force to the codes of practice laid down by the employer or person responsible for the place of work. All staff, students and visitors have a personal responsibility to ensure the safety of themselves and of those who may be affected by their activities.

Although not all of what is contained within this Safety Code of Practice will be relevant to all workers in the Department/Institutes at a particular time, staff, students and visitors must ensure that they make themselves aware of the appropriate sections as and when necessary. Part I is applicable to all staff and students. Part II is more applicable to those working in the Science Centre laboratories. From time to time other, more detailed, documents are produced and will be distributed as appropriate.

Workers undertaking research projects in other establishments and students on work placement must comply with the appropriate Health and Safety policies and Local Rules when working in those establishments. This must be understood by the worker/student, the placement supervisor and the placement tutor.

Any safety literature and websites referred to in the text are correct at the time of writing, but may change.

P J Baillie, Assistant Health and Safety Adviser, July 2008

CONTENTS

PART I

1 Working Hours

The University's opening times are displayed at the main entrance to each building. On Saturdays, everyone entering the University **must** sign in at the main reception desk and sign out on leaving.

Full-time undergraduate students may carry out laboratory work on projects until 1800, Mondays to Fridays only. Working hours for part-time undergraduate project students and MSc project students are by arrangement with the appropriate supervisor. In all cases, work is only permitted if at least two persons are present and if supervisors have ensured that adequate supervision has been provided and safety precautions are taken.

UNDERGRADUATE STUDENTS ARE NOT ALLOWED TO WORK ALONE IN A LABORATORY OR WORKSHOP AT ANY TIME.

Staff and postgraduate students/researchers may be permitted to work alone, provided that the nature of the work has been assessed as of low risk and at least one other person is within earshot and is kept informed of the nature of the work. Postgraduate students/researchers must, in addition, obtain prior approval from their academic supervisors before working alone, and the supervisor must be given details, in advance, of such periods.

If essential work has to be done when the building is otherwise unoccupied (*e.g*. over the Christmas closure), special arrangements must be made in advance with the Security Staff.

The risk assessment for projects must include the times and any specific conditions for working.

2 Smoking, Eating and Drinking

Smoking is illegal in all buildings of the University. Taking food or drink (including the chewing of gum) into laboratories, instrument rooms or stores is prohibited unless it is specifically required as part of a laboratory exercise (*e.g*. in nutrition).

3 Emergency Procedures

3.1 Emergency Services

In the event of serious injury, fire, or other emergency, the Emergency Services should be called immediately by dialling:

666 on any North Campus internal telephone for the University's emergency services;
9-999 on any internal telephone, or 999 on any mobile phone, for the external emergency services (police, ambulance, fire brigade).

Reception must be informed if the emergency services are called so that Reception staff can direct them to the location of the incident.

3.2 Fire and Other Emergency Alerts

Everyone working in any of the University's buildings **must** be aware of the procedure to follow in the event of a fire, the locations of fire exits and of the assembly areas. **Generally, if the alarm sounds, all persons must leave the building as quickly as possible and in an orderly fashion by means of the stairways. Lifts should not be used and doors should be left closed. No time should be wasted in collecting personal belongings.** Laboratory experiments should be left in a safe condition (electrical equipment and gas taps turned off and compressed gas cylinders closed) insofar as this can be achieved quickly and without incurring personal danger.

IN THE EVENT OF AN EMERGENCY, LABORATORY COATS, GLOVES AND SAFETY SPECTACLES SHOULD BE LEFT IN THE LABORATORIES. THEY MUST NOT BE TAKEN OUT OF THE BUILDING.

Fire wardens appointed by the Department/Institutes should check the rooms on their way to the nearest fire exit to see that all personnel on that floor have left **(without putting their own or other's safety at risk)** and then leave the building. Fire Wardens will then report to the Evacuation Controller informing her/him of which areas have been cleared and which have not. The names of designated, trained fire wardens are listed in the Department's/Institute's Health, Safety and Fire Safety Policy Statement.

3.3 On Discovering a Fire

In the case of major fires, the fire alarm must be sounded and the emergency services alerted as indicated above. Emergency fire alarms are located in all corridors. In addition, each laboratory is equipped with smoke detectors which will set off the fire alarm automatically. Do not attempt to use a fire extinguisher unless you have received appropriate instructions and training. Discretion is essential in deciding whether to tackle a fire personally. Portable fire-fighting equipment is not designed to cope with extensive fires and it is important that fire fighting should cease and the area evacuated as soon as the effects of the fire threaten the means of escape, the building structure, or otherwise indicate that the fire is out of control. Contained fires in small open vessels (oil baths *etc*.) are often most effectively extinguished by covering the vessel with a fire-proof mat or similar device or with a damp cloth.

3.3.1 Types of Fire Extinguisher

The following means of extinguishing fires are available in laboratories and workshops.

WATER MUST NOT BE USED ON ELECTRICAL FIRES OR ON FIRES INVOLVING SODIUM OR OTHER BURNING METALS ETC.

1. Water-filled extinguishers (usually red) are only suitable for wood, paper and textile fires. They must not be used on live electrical equipment.
2. Carbon dioxide extinguishers (usually red with a black panel), are suitable for burning liquid and electrical fires. Carbon dioxide extinguishers should be used with care. They can reduce the oxygen content of the atmosphere in a confined space to a dangerously low level.
3. Dry powder (usually red with a blue panel) extinguishers are suitable for wood, paper and textile fires, burning liquid fires and electrical fires.
4. Sand is available in buckets in the Science Centre store and is suitable for smothering fires involving burning metals (sodium or other alkali metals, magnesium, zirconium, titanium, *etc.*), metal hydrides and organometallic compounds.
5. Fire blankets are also available in the laboratories and are suitable for extinguishing burning clothing.

3.4 Accidents

All accidents and near misses (including personal injury, fire or other incident), however minor, must be reported using the University's Accident/Incident Report Form. These forms are obtainable from Department Offices, Reception desks and technical staff or can be downloaded from the Health and Safety Office website (www.londonmet.ac.uk/safety).

Everyone must familiarise themselves with the names and normal locations of designated first aiders in their area and seek assistance when necessary. Names of designated first aiders are listed in the Department's/Institute's Health, Safety and Fire Safety Policy Statement.

In case of serious injury, the emergency services must be called immediately as indicated in Section 3.1 above.

Suitable procedures for treatment of spillages of hazardous substances, together with fire-fighting and first aid measures, are an essential part of the risk assessment. Any serious spillage or accidental release of hazardous substances, whether or not involving contact with the body, must be reported as above.

4 Risk Assessments

Under the *Management of Health and Safety at Work Regulations* 1999, written risk assessments must be made for all activities where risks can be foreseen. For most

activities, the information contained in this booklet constitutes the principal risk control measure and reference should be made to it on the risk assessment.

The steps in the process of risk assessment can be summarised as follows;

a) Identify significant hazards and risks.
b) Identify **who** is at risk, including any special risk groups.
c) Evaluate risk, considering consequences of uncontrolled hazard.
d) Eliminate or reduce risk by deciding on control measures.
e) Review the assessment when necessary.

4.1 Hazard, Risk & Control

HAZARD is anything with the potential to cause harm including injury or disease to any person or damage or loss to property. Examples of hazards are: fire, substances (*e.g.* chemicals, bacteria), situations (*e.g.* sitting in front of a computer screen, working at height), hazardous agents (*e.g.* electricity, radiation), tools, machines, articles (*e.g.* filing cabinets). Without any controls, these hazards are almost certain to cause harm!

RISK is the likelihood (high, medium or low or a point on a numerical scale) of the harm from any particular hazard (the risk factor) occurring under the circumstances of use. Examples of risk factors are; acute or chronic poisoning, electric shock, burns (hot objects or chemical), trips, slips and falls, traps and entanglements, ejection, impact, cuts, back disorders, eyestrain, hearing problems.

RISK CONTROL is any means of minimising the risk, reducing it to an acceptable level. Examples of controls are; training, instructions for a particular activity or task, written Code of Practice, checking, inspecting or testing equipment before using it. The following are engineering and physical controls; fume cupboards, microbiological safety cabinets, aids for moving equipment or chemicals (*e.g*. trolleys, bottle carriers, safepaks, gas cylinder trolleys), personal protective equipment *(e.g.* safety glasses, laboratory coats, gloves, masks).

5 Office Safety

Offices are the scene of a substantial number of serious accidents every year. Most of these are avoidable if the following simple rules are followed.

1. Office equipment should be used only in accordance with the manufacturers' instructions.
2. All electrical appliances should carry a current Portable Appliance Test label.
3. Electric leads should not be allowed to trail and become a trip hazard.
4. When carrying files or boxes, the number should not be so great that vision is obscured.
5. Filing cabinets are now constructed such that only one drawer can be opened at a time, but in the case of old filing cabinets, there is a risk of the cabinet toppling over if two or more drawers are open.

6. The drawers of all furniture should be kept closed when they are not being used so as to reduce the risk of tripping over.
7. Storage at height should be avoided if possible, but if high storage has to be used, mobile step stools or suitable stepladders should be obtained. They should be labelled and formally inspected at least annually and replaced if faulty or damaged. Stools and chairs **must not** be used as ladders.
8. The floor space should be kept free of boxes and other clutter.
9. Worn or damaged carpets or flooring should be replaced so as not to present a trip hazard.

There is further guidance about office health and safety on the Health and Safety Executive's website at www.hse.gov.uk/office/index.htm.

6 New and Expectant Mothers

The Health and Safety Executive (HSE) has produced a booklet, *A Guide for New and Expectant Mothers Who Work* which is available on the HSE website at www.hse.gov.uk/pubns/indg373.pdf.

Some work activities, such as excessive physical exertion, work with radiation and exposure to hazardous substances (biological or chemical, especially carcinogens, teratogens and mutagens) can present an increased risk to women who are pregnant, have given birth in the last six months or who are breastfeeding.

Although it is not **legally** required, it is in the best interests of nursing mothers and those who are, or suspect that they may be pregnant, to notify their supervisor as early as possible. Until such notification has been received, the University has no obligation to take any action other than those resulting from the risk assessments applicable to all members of staff or students. Such assessments should consider any specific risks to special risk groups including women of childbearing age. Arrangements can then be made to minimise the increased risks from work activities. Such arrangements may include suspension from laboratory work.

7 Electrical Equipment

The principal causes of electrical accidents are faults in the plug and/or cable. All portable electrical appliances in the University are subject to some form of regular testing in accordance with the *Electricity at Work Regulations* 1989. The form of this test depends on the type of appliance, where and how it is used and its age. A copy of Technical Guidance Note 3 'Maintenance of Electrical Equipment' (detailing how the technical staff implement these regulations) may be obtained from the University Health and Safety Office website.

7.1 User Check

The Institution of Electrical Engineers, as the consultant body to the Health and Safety Executive, recommends that, in the first instance, **users** of electrical appliances make a **quick visual check** before connecting to the mains supply. This

visual check should be performed by the **user** each time the appliance is used. It need take only a few seconds and is carried out as follows.

Check the **PLUG** to ensure that;
- there are no cracks in the casing or broken pins,
- there are no obvious signs of overheating,
- the cable is held securely and
- the inner coloured cores of the mains cable or bare copper wire cannot be seen.

Check the **CABLE** to ensure that;
- the cable is intact throughout its length (not frayed, burned or cut),
- there are no obvious signs of overheating and
- the cable is secured where it enters the equipment.

Any faults, or suspected faults, that are discovered must be reported immediately to a member of the technical staff or your supervisor and, if faulty, the equipment will be taken out of service until it can be made safe and serviceable.

8 Display Screen Equipment (DSE)

The use of personal computers (PCs) or any other work equipment with a visual display unit (VDU) at work is covered by the *Health and Safety (Display Screen Equipment) Regulations* 1992 and users are reminded that health hazards are associated with **prolonged** use of PCs and similar equipment. Staff in each Department should have a DSE risk assessment (required by the regulations) and a checklist is available from the University Health and Safety Office website in order to help to comply with the regulations. It is a fairly simple matter to conduct this check, and all members of staff should be able to do it. However, the checklist only covers the workstation and work environment. Risks from other aspects of the work have to be avoided, for example by giving suitable training and by taking regular breaks in the use of the workstation. Further information and an explanation of the DSE risk assessment procedure is available on the Health and Safety Office website under University Codes of Practice and Guidance Notes.

9 Fieldwork

The recommendations of the *Guidance on Safety in Fieldwork*, Universities and Colleges Employers Association (UCEA), 2005 should be followed. There is a link to this document on the Health and Safety Office website under University Codes of Practice and Guidance Notes.

10 Work Placements *etc*.

Staff and students undertaking any work, *e.g.* research projects, in other establishments and students on work placement must comply with the Health and Safety Policies and Local Rules of the host organisation when working in those establishments. This must be understood by the worker/student, the placement supervisor and the placement tutor. Placement tutors will ensure that students are provided with appropriate instruction and information on the health and safety requirements and will check that they are complying with such requirements. A fuller explanation of these requirements may be found in *Health and Safety Guidance for the Placement of HE Students,* UCEA, 1999. There is a link to this document on the Health and Safety Office website under University Codes of Practice and Guidance Notes.

11 Working Overseas

Concern has been expressed over the risks associated with teaching, research and similar activities carried out overseas which, by its nature, is carried out in places remote from the University and is consequently outside its direct control. The document, *Health and Safety Guidance for Working Overseas,* UCEA/USHA, 1999, should be read by all those undertaking work of this nature. Again, there is a link to this publication on the Health and Safety Office website under University Codes of Practice and Guidance Notes.

12 Safety Signs – Colour and Shape

There are various safety signs all around the University ranging from the familiar ‘no smoking’ and ‘fire exit’ to more specialised signs conveying; hazard warnings (yellow triangle with a black border and a pictogram), prohibitory (white with a red border and diagonal line and a black pictogram), compulsory (must do, blue circle with a white pictogram), safe condition (green rectangle with a white pictogram) and fire equipment (red rectangle with white pictogram. Each sign may have an appropriately coloured rectangle under it bearing an explanatory legend.

Advising of hazards

Prohibitory

Mandatory

Advising of safe condition

Fire equipment

PART II

13 Overnight Experiments

Overnight experiments (and other unattended experiments outside normal working hours) are only permitted if authorised by either the experimenter's supervisor or other member of staff (in the case of project and research students) or the experimenter (in the case of members of staff). In either case a member of staff will take responsibility for ensuring that risks are minimised.

For each such experiment, the appropriate form must be completed, giving full details of the apparatus, location, times and dates involved and emergency instructions. The top copy should be fixed in a safe position near to the apparatus and the second copy left at Science Centre Reception.

14 Glassware

MANY LABORATORY ACCIDENTS ARE CAUSED BY GLASS BREAKING DURING THE REMOVAL OF FLEXIBLE TUBING.

PIPETTE FILLERS MUST BE REMOVED BY CAREFULLY EASING THEM FROM THE PIPETTE, NEVER BY DIRECT PULLING. THE HANDS SHOULD BE KEPT VERY CLOSE TOGETHER.

DO NOT ATTEMPT TO REMOVE RUBBER TUBING FROM GLASSWARE, ESPECIALLY CONDENSERS AND DRECHSEL BOTTLES (TRAPS) UNLESS TRAINED AND AUTHORISED TO DO SO.

Broken glassware can cause serious injury and bleeding. It is important to handle all glassware with due care. The use of excessive force should be avoided in attempting to remove tight stoppers or to separate glass joints that have become tightly jammed. The advice or assistance of an experienced operator should be sought. The fitting of rubber or polythene tubing over glass connections can be particularly dangerous; a lubricant, *e.g*. water or grease may help, and the tubing should be held in leather gloves to prevent injury in the event of breakage. Broken glass **must not** be discarded in the ordinary waste bins, but should be placed in the 'broken glass' containers which are available in each laboratory.

15 Pressure Vessels and Other Sealed Containers

Pressurised systems, *e.g*. compressors, must be used strictly in accordance with the manufacturer's instructions and under the supervision of an experienced operator. Such equipment must be inspected and pressure tested at regular intervals according to the *Pressure Systems Safety Regulations* 2000. The

University's insurers require that an up-to-date safety certificate for the equipment (kept in the Technicians' Office) must be in force when the apparatus is in use.

Experiments in sealed vessels, and other experiments at elevated pressures must be carried out only in specially designated areas, away from other workers and with adequate protection. Sealed glass tubes must be adequately protected by placing them in metal tubes or wire mesh containers and the experiment must be carried out behind a protective screen.

16 Apparatus Under Reduced Pressure (Vacuum)

A potential danger exists in the event of the failure of glassware under reduced pressure. Glassware should be checked for the absence of cracks or other faults before use in vacuum distillations *etc*. Generally, only round-bottomed flasks (**not** conical) should be used. Larger equipment, including large vacuum desiccators, should be used only behind a safety screen or with other adequate protection against the risk of implosion.

17 Cryogenic Materials (Solid Carbon Dioxide and Liquid Gases)

Solid carbon dioxide (-80 ºC), liquid nitrogen (-195.8 ºC) and liquid helium (-268.9 ºC) may cause severe burning on contact with the skin and should only be handled with thick protective gloves and with suitable eye protection.

LIQUID NITROGEN MUST NEVER BE STORED IN A SEALED SYSTEM. TRAPS MUST NOT BE LEFT IMMERSED IN LIQUID NITROGEN WHEN OPEN TO THE AIR AS LIQUID OXYGEN WILL CONDENSE AND MAY REACT EXPLOSIVELY WITH ANY ORGANIC MATTER PRESENT.

Liquid gases and solid carbon dioxide **must not be carried in the lifts together with passengers.** The transport of larger quantities of liquefied gases and solid carbon dioxide in the lifts presents a small but foreseeable risk in the event of lift failure if people accompany these asphyxiant gases. In order to eliminate this risk, a written procedure (available to staff) has been developed and must be adhered to. **This procedure may only be performed by individuals who have received the necessary training and are authorised to do so.** It involves temporary removal of the goods lift from service and transporting the substances in an otherwise empty lift.

18 Radioactive Materials

The University does not use radioactive materials and is not licensed to do so by the Environment Agency. **No radioactive sources may be brought into the University.**

19 Radiation Hazards (*X*-rays, Lasers, Ultraviolet Lamps, Microwaves)

Any intense source of radiation may be dangerous, especially to the eyes.

The *X*-ray diffractometer in the Science Centre is designed so that it is completely enclosed and is automatically rendered safe if the surrounding enclosure is opened. Nevertheless, access to the diffractometer area is restricted. The University's Radiation Protection Adviser (RPA) provides advice to ensure compliance with the *Ionising Radiation Regulations* 1999 and conducts an annual inspection of the instrument and its environment.

Lasers and ultraviolet lamps are the commonest examples of radiation hazards. **Never** look directly at these sources. Special safety glasses must be worn when using **unenclosed** ultraviolet lamps as even the scattered radiation can cause severe headaches. The University's Laser Safety Officer keeps a register of all lasers in the Departments except for those in equipment such as DVD players – these are deemed to be safe. Suitable eye protection may be required.

Microwave ovens are subject to annual testing by the technical staff to ensure that no leakage of radiation occurs.

20 Good Housekeeping and Safe Practice

Good housekeeping is a prerequisite for a safe working environment. All those working in laboratories are required to maintain their own working areas in a clean and tidy condition at all times.

The following rules apply to all types of work in the Science Centre laboratories. Extra rules (Section 26.1.2) apply to work with biological material.

1. Always obey instructions and pay attention to what you are doing.
2. Do not run in laboratories.
3. Do not perform unauthorised experiments.
4. Handle **only** those materials and equipment which you are **required** to use.
5. Students may not remove equipment from the Science Centre without the express written permission of a member of staff.
6. Students may not remove chemicals or biological materials from the Science Centre laboratories without the express written permission of the Head of Department.
7. No equipment from the laboratories and no chemicals or biological materials may be taken into the kitchens or clinics. This includes laboratory coats and other personal protective equipment.
8. All cuts and abrasions, however minor, must be covered with waterproof dressings while carrying out practical work.
9. Hands must be washed before entering and leaving the laboratory and after any accident in which they may have become contaminated. Biocidal soap and paper towels are provided at handwash points in the entrances to each laboratory.

10. Outdoor clothing, bags and other personal belongings inessential to laboratory work should be left in the lockers outside the laboratory.
11. Laboratory coats of the Howie design (provided in numbered pigeon-holes in the teaching laboratory) must be worn when in the laboratories. They must be fastened up to the neck. When leaving the teaching laboratory, laboratory coats must be returned to the correct pigeon-hole. When leaving research laboratories, laboratory coats should be left on the coat racks.
12. Laboratory coats must not be worn outside the laboratories with one exception, moving material between the research laboratory and the preparation room. Staff who need to work in both the research laboratory and the teaching laboratory should maintain two laboratory coats, one in each area, or use the hoists between the preparation room and the teaching laboratory.
13. Laboratory gloves must never be worn outside the laboratories.
14. Safety spectacles are provided and must be worn as indicated on the laboratory doors.
15. Eating, chewing gum, drinking, smoking and applying cosmetics are forbidden in the laboratory. It is also forbidden to bring food or drink into the laboratories except where specifically required for practical classes or research projects.
16. The sucking of pens, pencils, *etc.* must be avoided and care must be taken not to lick the fingers when turning pages!
17. Mouth pipetting is strictly prohibited. Automatic pipettes should be used whenever possible. Other types of pipettes should be filled using appropriate pipette fillers or teats.
18. Laboratory doors must not be propped open.
19. Before using any machine or other equipment, ensure that you know how to use it, that all the safety guards are in place and that you can switch it off in case of emergency.
20. Clothing should be appropriate to the place of work and the type of work being done and should generally not be loose or flowing. Ties and sleeves should be secured to prevent entanglement in machines or contamination by hazardous substances.
21. Footwear in the laboratories should be of a type that is not liable to cause slipping or tripping. The wearing of sandals or shoes with open toes is a potential hazard in the event of chemical spillage and should be avoided.
22. Long hair must be tied back or covered with a cap or similar headgear to prevent it being caught in moving parts of machinery, catching fire when using naked flames or being contaminated by hazardous substances.
23. At the end of each working period, equipment no longer in use should be cleaned and returned to its proper place.
24. Reagent bottles, tools and other equipment should be returned to the appropriate shelves or cupboards and experimental samples must be clearly labelled and stored safely.
25. General working areas, including fume cupboards, sinks (and draining boards) and common equipment such as balances and ovens, must be left in a clean condition after use, for the convenience and safety of other workers.

26. The floors, walkways and access areas must be kept clear and all spillages cleaned up immediately (see Appendix 1).

21 Personal Protective Equipment (PPE)

21.1 Safety Spectacles

Eyes are irreplaceable and any injury may lead to permanent loss of sight. Safety spectacles (or normal spectacles with protective overshields) are designed to protect the eyes from injury either from flying objects or from splashes of hazardous substances. Safety spectacles must be worn when indicated on the laboratory doors whether or not the individuals concerned are engaged in experimental work. Visitors to the laboratories must be supplied with safety spectacles (obtainable from technical staff) before entering laboratories. In some circumstances, *e.g*. when required to look into a microscope, safety spectacles may be removed, but only with the explicit permission of the supervisor and after ensuring that there is no hazardous work in the vicinity.

21.2 Laboratory Coats

Laboratory coats act as a barrier between your clothing or skin and hazardous substances. They also ensure that the hazardous substances stay in the laboratory. Fastened laboratory coats must be worn at all times by persons working in the laboratories and stores where work with hazardous materials is carried out. Contaminated clothing must not be taken out of the laboratories and never into areas where food or drink is consumed or prepared. Laboratory coats will be laundered as necessary.

Staff and research students may wear their laboratory coats when moving between the research lab and the preparation room on the second floor of the Science Centre.

21.3 Gloves

Gloves protect the hands from physical injury by hot or sharp objects and from contamination by chemicals or pathogens. Risk assessment will indicate whether or not gloves must be worn to protect the hands in the activity being assessed. For gloves to be effective, consideration must be given to two major factors: correct selection and correct use.

Correct Selection – A variety of materials is used for glove manufacture and it is essential to choose the right one to provide sufficient protection from either accidental splashes of, or deliberate immersion in, the hazardous substances being handled; each glove material has its own strengths and weaknesses. Some laboratory supplies catalogues give a selection chart to assist in deciding which is the most appropriate material for a particular substance. However, for most work in the laboratories, nitrile rubber (usually blue or purple) is used for protection from a wide range of organic chemicals and pathogens. Latex gloves are not normally provided – they provide little or no protection from most organic chemicals and some people may suffer from an allergic reaction to free latex proteins. The thin

disposable nitrile gloves provided in the laboratories will only protect against accidental splashes and should not be used for deliberate immersion. Leather gloves are also available for handling hot substances.

Correct Use – Incorrect use of gloves will render them ineffective and can even **increase** the risk of skin contamination to both the user and others. Correct use can be summed up in a series of instructions:

1. Routinely inspect each glove visually before and during use for obvious tears. Test for pinholes before use by holding the cuff tightly and squeezing below the cuff so as to inflate the palm and fingers.
2. Take great care not to transfer hazardous substances to objects, such as door handles, switches, taps, *etc.*, which may be handled by another person who is not wearing gloves.
3. Similarly, take care not to touch any unprotected areas of the body, such as the face, while wearing gloves.
4. Learn how to remove gloves without touching the outside surface with an unprotected hand.
5. **NEVER WEAR GLOVES OUTSIDE THE LABORATORY.**

21.4 Other Personal Protective Equipment

Additional equipment, *e.g*. safety footwear, face shields or dust masks, must be worn as specified on risk assessments, to guard against specific hazards. It should never be necessary to wear a face mask to provide protection from hazardous substances in the laboratory under normal operating conditions: the substances should be controlled by *e.g*. a fume cupboard. Furthermore, the selection of the correct type of mask is complex and a rigorous face-fitting process must be undertaken for the mask to be at all effective.

22 Refrigerators and Freezers

Refrigerators and freezers fall into two categories; those intended for the storage of food and drink and those intended for the storage of hazardous materials. Each should be labelled appropriately according to this distinction. Only spark resistant fridges/freezers should be used in laboratories, because of the risk from fire if flammable substances are stored. If used for the storage of biohazardous materials, the appropriate ‘biohazard’ label should be affixed.

The following protocol has been drawn up to maximise safe use of fridges and freezers in the laboratories and to minimise the possibility of fire and corrosion and subsequent failure of the cooling system.

1. Ensure that the fridge or freezer you are going to use is suitable (*e.g.* does it state "not sparkproof, no flammables”?). Only spark-suppressed fridges should be used in the laboratories.

2. Bear in mind that space in fridges and freezers is limited. Use the smallest containers suitable for the amount of sample and remove all samples when they are no longer needed or when your project is finished.
3. Periodic inspections will be made and samples which do not conform to this protocol may be removed for disposal. You are advised to make regular checks on your samples so that such removal is unnecessary.
4. All samples must be clearly labelled with your name, sample identification and date. Care should be taken that the label remains legible while the sample is in the fridge or freezer. Waterproof marker pen is sufficient for short periods, but for longer term storage, pencil is preferable. Sufficient precautions should be taken to prevent the sample leaking or falling through the wire shelves.
5. All flasks, sample tubes and suppliers' bottles which have been opened must be properly sealed with parafilm® sealing film.
6. An entry must be made in the book of fridge/freezer contents when storing samples or chemicals for more than a few hours. The consequences of warming the sample/chemical to room temperature should be indicated.
7. Chemicals in suppliers' bottles must be labelled with the user's name and date of acquisition. **A date must be set for disposal of the contents**.
8. Samples in the freezer must be stored in **sealed** freezer boxes labelled with your name (and, in the case of project students, the name of your supervisor).
9. Special provision may be available for large items. Consult the technical staff.

23 Fume Cupboards

Experiments involving toxic or volatile materials should be carried out in a suitable fume cupboard. Before commencing work, the correct operation of the fume cupboard (including its safety indicators and alarms) should be checked. The sash opening should be kept to a minimum to ensure good ventilation. Chemicals must not be stored in fume cupboards. The COSHH Regulations require that a record be maintained detailing the substances that have been used in the fume cupboards so that maintenance work can be performed in safety. A log book is provided in each laboratory to record the use of the fume cupboards and it is essential that this record be completed. Maintenance engineers will expect to see the log book before carrying out any servicing.

Users of fume cupboards need to follow an effective system of work and, whilst it is not practicable to lay down a universal code of practice which would be applicable to all operations, the following points are relevant to the satisfactory operation of fume cupboards:

1. Write out the experimental protocol, paying particular attention to the safety requirements, and if you have any doubts at all, get it checked by your supervisor.
2. Before commencing work, ensure that the fume cupboard is operating satisfactorily (including its safety indicators and/or alarms). **Report any suspected fault immediately to a member of the technical staff.**

3. Ensure that all unnecessary clutter is removed and that all necessary items are in the fume cupboard before commencing the experiment or process. This will avoid the need to leave the operation, with the attendant disturbance of air flow, and the risks associated with unattended experiments. **No potentially hazardous experiment or process should be left unattended.**
4. Do not set up equipment close to the front edge of the fume cupboard as this increases eddies, with the consequent loss of containment and increased risk of fumes escaping into the laboratory.
5. Use the minimum practicable sash openings – use safety screens if appropriate.
6. If you can avoid it, try not to sit at a fume cupboard because being seated could restrict your mobility in an emergency.
7. Particular care should be taken in the choice of electrical equipment to be used in work involving flammable materials in order to eliminate the danger of sparks.
8. Avoid all rapid movements of the arms within the fume cupboard.
9. Do not use fume cupboards as storage areas; vented storage cupboards are installed.
10. Always tidy up the fume cupboard at the end of an experiment or process; leave it ready in all respects for others – clean and free of contamination, rubbish and equipment.

24 Substances Hazardous to Health

Many of the materials used in the laboratories and workshops are hazardous. They can be dangerous, even deadly, and if not handled properly, could endanger life or health and could cause serious damage to buildings, equipment and the environment. The *Control of Substances Hazardous to Health (COSHH) Regulations* 2002 comprise the most important piece of legislation affecting laboratory work in the study of biology and chemistry. The following is intended to assist staff and students to complete risk assessments required under the COSHH Regulations. Copies of the Approved Code of Practice (ACOP) and Guidance are available for reference from Department Safety Officers.

An assessment must be completed for activities involving the use, transport, storage and disposal of hazardous substances – chemicals and biological agents – before the activity is undertaken. The principal purpose of the assessment is to make the user aware of the hazards inherent in the substances and of the risk control measures to be employed in their use. For the majority of work activities, the assessment must be recorded so that evidence of the assessment process can be produced when required. If performed correctly and thoughtfully, COSHH assessments need not slow down work unnecessarily, but will ensure safe practices and will reduce any risks to the health, safety and wellbeing of all staff, students and visitors.

COSHH assessments should be made on a standard University form. These forms, although they are available as hard copies in most laboratories, may be downloaded

from the Health and Safety Office website. In the case of activities undertaken by a research worker or project student, a COSHH form should be completed and fixed in the laboratory notebook opposite the starting page of a new experiment. COSHH assessments will be examined during the laboratory Safety Inspections.

For taught courses, where the use of hazardous substances is required, the member of staff in charge of each module will carry out the assessment and a copy will be included in the Module Instruction Book.

Arrangements must be made for assessments to be deposited with supervisors when students leave a course or with line managers when staff terminate their employment or change the nature of their employment within the University.

24.1 How to complete the University COSHH form

In the appropriate spaces enter the following information.

1. Your name and an appropriate assessment number.
2. The location of the work.
3. A title for the experiment or activity.
4. A description of the processes involved (what is being done to the hazardous substances; are they being mixed? Are they being heated? *etc.*).
5. The names of substances to be used or stored and their Hazard ID codes (from the list on the form). Include their physical state, *e.g.* gas, liquid, crystalline, powder, solution, because for example, some fine powders may present a greater risk than large lumps. Biological agents and their Hazard Group should also be listed (see Section 26.1). Include also the quantity to be **handled**, *i.e.* the size of the container being opened or stored, not the amount you will be measuring out.
6. The information sources *e.g.* Safety Data Sheet, Advisory Committee on Dangerous Pathogens publications, manufacturers' catalogues or websites.
7. The risk control measures you will use to minimise any effects on the health and safety of you and of anyone else who may be affected by your experiment.
8. First aid measures, spillage treatment, disposal routes and suitable fire extinguishing medium should be entered in the appropriate spaces.
9. Any further recommendations to improve safety should be included. The work should not be started until these recommendations are in place.
10. Details of environmental monitoring (if necessary), health surveillance (if necessary) and training required.
11. Finally, the form should be signed by the assessor (usually the worker and the supervisor, until the worker is sufficiently skilful). The supervisor will sign and date the assessment, to signify agreement.

25 Hazardous Chemicals

The storage, handling, use and disposal of chemicals (and biological materials, see Section 26) is legally subject to the *Control of Substances Hazardous to Health (COSHH) Regulations* 2002. All persons handling hazardous materials must be

aware of the potential dangers and must complete a risk assessment before commencing work. Hazard warning symbols and their meanings are given in Appendix 4. More detailed information on this subject may be found in Technical Guidance Note 1, available from the Health and Safety Office website.

25.1 Carrying Chemicals and Glassware

The carrying of chemicals and of glassware from room to room is potentially dangerous. The risks are particularly high on the stairways and in lifts: the breakage of a bottle of *e.g*. ammonia solution will quickly render the stairway impassable as an emergency escape route. Large bottles should only be transported in the special carriers provided. Other chemicals and glassware should only be carried in suitable, safe containers.

25.2 General Reagents and Research Chemicals

Commercially supplied chemicals should be stored in the manufacturers' containers or other appropriate containers and must be clearly labelled in each case with the chemical name of the contents and the appropriate hazard warnings. Chemicals must be stored only on the reagent shelves or in suitable lockers or vented cupboards. They must not be left on work benches when not in use. The quantity of chemicals stored in any one laboratory should be kept to the minimum required for current work.

25.3 Disposal of Chemicals

Under the requirements of the *Water Industry Act* 1991, Thames Water has placed restrictions on the discharge of waste via the drains and in particular on the concentrations of solutions containing heavy metals (copper, chromium, lead, nickel, *etc*.). These must in general be collected for later disposal and not washed down the sinks unless in extremely low concentrations (5 ppm or less). **Solutions of cadmium and mercury are not permitted in the drains at any level and must always be collected for future disposal.** Non-toxic water-soluble materials may be washed down the sink with a large excess of water. Acceptable methods of disposal of other classes of chemical is described in the respective section below.

25.4 Flammable Solvents

The maximum volume of any one flammable solvent that may be stored in a bottle for regular use is 1 litre. Such bottles must be kept in ventilated cupboards when not in use. Winchester quart (2½ litre) bottles of flammable solvents must be kept in suitable metal cupboards and the total quantity of each must be kept to a minimum. The vapours of flammable solvents must not be allowed to escape in the neighbourhood of a naked flame or electrical equipment that is not flame proof. A fume cupboard should be used whenever possible.

Under no circumstances may flammable liquids that are immiscible with water be allowed to enter the sinks. Waste solvents must be placed in the appropriately labelled containers which are available in all laboratories/ workshops where required. Halogenated and non-halogenated organic waste must not be mixed in these containers.

25.4.1 Absolute ethanol

It is sometimes necessary to use absolute ethanol rather than industrial methylated spirits, *e.g*. when preparing ethoxide solutions, or when the presence of methanol would be otherwise unacceptable. The use of duty-free absolute ethanol is regulated by H.M. Revenue and Customs and it is not openly available on the laboratory shelves. The University is authorised to purchase absolute ethanol for use in teaching and research without paying duty. The Departmental Safety Officer is responsible for issuing absolute ethanol and for maintaining records of its use for inspection by H.M. Revenue and Customs.

To obtain this solvent, an ABSOLUTE ETHANOL form (available from the technical staff must be completed and must include a description of the proposed use, indicating why industrial methylated spirit cannot be used. The authorising person should be prepared to answer questions from H.M. Revenue and Customs inspectors if they visit: they will want to know why industrial methylated spirits could not have been used.

The form must be authorised (signed) by the user's supervisor, or, if it is to be used in a taught practical class, by the practical course supervisor. A suitably labelled bottle (generally 500 cm^3 or less) must be provided and, on presentation of the completed form and the empty bottle, the Safety Officer will decant the required amount and will require a signature on collection.

25.5 Corrosive Chemicals

Strong acids (*e.g.* hydrochloric, hydrobromic, sulfuric, nitric) strong bases (*e.g.* sodium hydroxide, potassium hydroxide, calcium hydroxide) oxidising agents, acid anhydrides, acid chlorides and most phenols are strongly corrosive and will quickly attack and burn body tissue with which they come into contact. Precautions against skin or eye contact must be taken when handling these materials or other corrosive chemicals.

To mitigate the effect of chemical burns from corrosive substances, diphoterine® first aid treatment for skin or eyes is available in the laboratories.

Hydrofluoric acid is particularly dangerous and should only be handled in a fume cupboard specially modified for the purpose and in accordance with written instructions for its use. The only reliable first aid measure for hydrofluoric acid burns is hexafluorine® and a supply must be at hand. Requests for use of hydrofluoric acid must be approved by the Safety Officer and the Head of Department or Director of the Institute.

25.6 Toxic and Very Toxic Chemicals

These categories of hazardous substances include carcinogens, mutagens and reproductive toxins as well as the more obvious poisons such as cyanides, carbon monoxide, chlorine, phosgene, phenol, strychnine, brucine and oxalic acid. Poisoning by these substances can occur by inhalation, ingestion or by skin contact. It is preferable to perform all operations with these compounds in a fume-cupboard.

Standardised risk phrases as well as hazard symbols are assigned to these, and indeed all dangerous chemicals, according to the *Chemicals (Hazard Information and Packaging for Supply) Regulations* 2002 (CHIP3). For toxic or very toxic substances phrases such as R23 'toxic by inhalation' and R28 'very toxic in contact with skin' are assigned. Some are also assigned combined risk phrases such as R39/25 'toxic: danger of very serious irreversible effects through inhalation'. These standardised risk phrases and safety phrases or 'indications of safety precautions' *e.g.* S24 'avoid contact with the skin' are listed in every chemical supplier's catalogue. Relevant risk and safety phrases are included on the labels of hazardous substances. (see Appendix 3)

Many of these substances are kept locked up and will only be issued by the technical staff on receipt of a 'poisons form' authorised by the supervisor, who will ensure that a suitable risk assessment has been completed.

25.7 Carcinogens, Mutagens and Reproductive Toxicants

The COSHH Regulations refer to three categories of carcinogen. Category 1 carcinogens are those substances which are known to cause cancer on the basis of human experience. Category 2 carcinogens are those substances which it is assumed can cause cancer on the basis of reliable animal evidence. Category 3 carcinogens are substances where there is only evidence in animals of doubtful relevance to human health (*i.e*. the evidence is not good enough for Category 1 or 2). Category 1 and 2 carcinogens (bearing the risk phrase R45 'may cause cancer' or R49 'may cause cancer by inhalation' and labelled as 'toxic') are normally kept locked up and will require authorisation before they are issued. Category 3 carcinogens (bearing the risk phrase R40 'limited evidence of a carcinogenic effect' and labelled 'harmful') are not included in the COSHH definition of 'carcinogen'. A complete list of known carcinogenic compounds is given in the HSE document EH40, *Workplace Exposure Limits*.

THE USE OF 2-AMINONAPHTHALENE (2-NAPHTHYLAMINE), BENZIDINE, 4-AMINODIPHENYL AND 4-NITRODIPHENYL, THEIR SALTS AND ANY SUBSTANCE CONTAINING ANY OF THESE COMPOUNDS IN A TOTAL CONCENTRATION EQUAL TO OR GREATER THAN 0.1% BY MASS, IS PROHIBITED UNDER REGULATION 4(1) OF THE COSHH REGULATIONS.

A mutagen is an agent that changes the hereditary genetic material which is part of every living cell. They can be chemical substances or physical agents such as ionising radiation. Mutagenic substances are, like carcinogens, divided into three categories and are labelled as 'toxic' (categories 1 and 2) or 'harmful' (category 3). Examples of chemical mutagens include arsenic and dimethyl sulfate. Their effects can include cancers or changes in chromosomes, and people exposed to mutagens may develop genetic damage which affects future offspring.

Reproductive toxicants are substances that may damage a developing foetus (known as teratogens) or may have an adverse effect on a man's or woman's reproductive capability. As for carcinogens and mutagens, these substances are

also labelled as either ‘toxic’ (category 1 and 2) or ‘harmful’ (category 3). Examples of reproductive toxicants include lead, ethylene oxide, formaldehyde, ethylene dibromide and carbon disulfide. Mutagens and substances that are toxic for reproduction are identifiable by risk phrases such as R46 ‘may cause heritable genetic damage’ or R61 ‘may cause harm to the unborn child’. (See Appendix 3)

25.8 Highly Reactive Chemicals

Highly reactive chemicals present special problems in handling. The following are examples of some commonly met hazards.

1. Finely divided metals (*e.g.* Raney nickel) and organometallic compounds (*e.g.* butyllithium) may ignite on contact with the air and should be handled only in an inert medium.
2. Sodium and potassium react violently with water. Excess sodium should be destroyed by adding an excess of propan-2-ol and allowing the mixture to stand in a fume cupboard until the metal has dissolved. An equal volume of industrial methylated spirit should then be added and the mixture allowed to stand for several hours. The solution must be collected for subsequent disposal. Potassium may be disposed of similarly but is much more reactive than sodium; air should be flushed from the bottle by means of nitrogen before the addition of propan-2-ol.
3. Certain covalent halides, such as the boron trihalides, aluminium trihalides, tin tetrachloride, titanium tetrachloride and silicon tetrachloride react with water with explosive violence liberating hydrochloric acid fumes and appropriate care must be taken in their use.
4. Metal hydrides, including sodium hydride, lithium hydride and lithium aluminium hydride, react violently with water and other protic reagents to liberate large volumes of hydrogen. Accidental contact with water must therefore be avoided and care should be taken in the disposal of any excess of the hydride that may remain at the end of a reaction.
5. **WATER MUST NOT BE USED ON FIRES INVOLVING SODIUM OR OTHER BURNING METALS, HYDRIDES ETC.**

The above examples are not exhaustive. It is essential to know and understand the particular hazards associated with the reactivity of any chemical substance before using it.

25.9 Explosive Chemicals

Acetylenes, acetylides, azides, azo and diazo compounds, diazonium salts, chlorates, perchlorates, nitro compounds and peroxides are all potentially explosive. Experiments involving such compounds must be carried out with the use of a safety screen and away from other workers. The quantities of materials used should be kept to a minimum. Major damage can result from the explosion of only 0.1 g of material.

Ethers (*e.g.* diethyl ether, dioxan, tetrahydrofuran) and certain other compounds (*e.g.* propan-2-ol) form explosive peroxides by interaction with atmospheric oxygen. Such peroxides may accumulate in distillation residues and cause serious explosion. All such compounds should therefore be checked for the presence of peroxides, which

must be removed chemically, before distillation is attempted (*Vogel's Textbook of Practical Organic Chemistry*, 5th edition, Longman, London, 1989, p. 404). **Distillation of ethers should not be carried out to dryness. Partially filled bottles of ethers should not be stored for prolonged periods.**

25.10 Oxidising Agents

Powerful oxidising agents (*e.g*. perchloric acid, concentrated nitric acid, peroxides) may bring about violent and dangerous oxidation, or ignition, of organic materials. Explosion may occur. Experiments involving concentrated perchloric acid must only be carried out behind a safety screen and in a designated area away from other workers. Safety screens are normally stored in the chemical disposal room.

25.11 Compressed Gases

A more thorough treatment of the management of cylinders of compressed gases and their regulators is contained in Technical Guidance Note 4, available from the Health and Safety Office website. Gas cylinders containing hydrogen, oxygen, nitrogen *etc.* must only be transported in a suitable trolley and must be secured in a stand securely fixed to the bench and not left in the trolley when in use. The valves must only be operated by persons who have been instructed in their use and who fully understand their operation.

LUBRICANTS MUST NEVER BE USED ON CYLINDER VALVES OR REGULATOR FITTINGS. OIL OR GREASE WILL IGNITE VIOLENTLY IN CONTACT WITH OXYGEN UNDER PRESSURE.

Acetylene gas is highly flammable, forms explosive mixtures with air and can also explode under pressure. Cylinders of acetylene must be used only in accordance with the 20 point guidance code documented in the HSE publication, *Use of Compressed Acetylene.*

Hydrogen is highly flammable and forms explosive mixtures with air. Experiments involving catalytic hydrogenation must not be carried out without the specific approval of an experienced supervisor. Such experiments must be carried out only in designated areas, away from other workers and with adequate protection.

26 Biological Agents

The Control *of Substances Hazardous to Health Regulations* (COSHH) covers the use of biological agents as well as chemicals. Schedule 3 of the COSHH Regulations gives 'Special provisions relating to biological agents'. The definition of biological agent in the COSHH Regulations includes all pathogenic organisms, cell cultures or human endoparasites as well as those agents that may cause allergy, toxicity or any other risk to human health. In practice, the list may extend to include animals and the associated allergens and macromolecules such as naked nucleic acids and prion agents. This section covers work with microorganisms; body fluids, blood and other tissues (which may carry microorganisms); genetic modification and

gives a summary of different types of disinfectant. Reference is made in these sections to the (international) biohazard sign, which is reproduced in Section 12.

26.1 Microorganisms, Body Fluids, Blood and other Tissues

Microorganisms are widespread and some colonise humans. All microorganisms are potentially pathogenic, *i.e.* they may cause disease, and must be treated as such. The Advisory Committee on Dangerous Pathogens (ACDP), which advises the Health and Safety Executive on matters concerning pathogenic organisms, classifies microorganisms (or 'biological agents') into four 'Hazard Groups' (HG) on the basis of perceived hazard to healthy individuals. The degree of risk is increased when microorganisms are deliberately multiplied or 'cultured' in order that they may be more amenable to study.

HG1 A biological agent unlikely to cause disease.

HG2 A biological agent that can cause human disease and may be a hazard to employees; it is unlikely to spread to the community and there is usually effective prophylaxis or effective treatment available.

HG3 A biological agent that can cause severe human disease and presents a serious hazard to employees; it may present a risk of spreading to the community, but there is usually effective prophylaxis or treatment available.

HG4 A biological agent that causes severe human disease and is a serious hazard to employees; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available.

The ACDP publishes an 'Approved List' of microorganisms including bacteria, viruses, parasites and fungi in *Categorisation of Biological Agents according to Hazard and Categories of Containment* (4th edition), which is updated from time to time with 'Supplements' published on the Health and Safety Executive's website (currently http://www.hse.gov.uk/pubns/misc208.pdf). This list includes only those organisms classified in Hazard Groups 2, 3 and 4. Those organisms not listed in these groups are not implicitly classified in Hazard Group 1 (they simply may not have been classified). All staff involved with teaching or research in microbiology should ensure that they have a copy of this list.

The most significant threat from human material is posed by blood-borne viruses, in particular Human Immunodeficiency Virus (HIV) which is associated with Acquired Immune Deficiency Syndrome (AIDS), and the hepatitis B, C, D *etc*. viruses (HBV, HCV, HDV *etc.*) which all cause hepatitis, a most unpleasant and potentially fatal disease of the liver. It is estimated that 1 in 800 of the hospital population in Britain is seropositive for HBV, although they may not suspect that they are infected. The (usually) sexually transmitted disease AIDS, although statistically less significant in the laboratory, has very serious and inevitably fatal consequences. These and other viruses can be found in body fluids other than blood (serum/plasma) *e.g.* semen, vaginal secretions and breast milk and in urine and faeces. Other bodily secretions or excretions such as saliva, sputum, sweat, tears and vomit carry a minimal risk of infection, unless they are contaminated with blood. Care should still be taken as the presence of blood is not always obvious and there may be a risk from other hazardous microorganisms such as tuberculosis. The most likely routes of infection

in the laboratory are *via* puncture wounds to the skin from infected needles, sharps and scalpels, or through infected specimens coming into contact with broken or chapped skin. Laboratory technicians and cleaning staff are also at risk of infection, since they are responsible for the day-to-day maintenance of the laboratories. The General Considerations and Local Rules set out below are designed to protect, not only students, but all others who work in the biological laboratories, and must be adhered to rigorously.

26.1.1 General Considerations

1. The laboratories are classified at Containment Level 2 (CL2) and therefore can only be used for work involving biological agents of Hazard Groups 1 and 2. The laboratories are accessible only to authorised persons. **Work with Hazard Group 3 organisms may only take place in the Containment Level 3 laboratories and is subject to a separate Code of Practice. Work with Hazard group 4 biological agents is prohibited.**
2. Any room being used for work with microorganisms bears the biohazard sign. Non-essential personnel and casual visitors should be prohibited from entering.
3. Whenever possible, only biological agents in Hazard Group 1, 'laboratory strains', genetically weakened strains or avirulent mutants are used for teaching purposes (including final year and MSc projects). However, as good microbiological practice dictates that every microorganism handled should be considered to be potentially pathogenic, the Local Rules in Section 26.1.2 (in addition to all the normal safety procedures) apply to staff and students working in the laboratories. These rules have taken into account the physical and procedural features of laboratories of Containment Level 2 as described in Advisory Committee on Dangerous Pathogens (ACDP), *The Management, Design and Operation of Microbiological Containment Laboratories,* 2001*.*
4. Supervisors (those who have instructed that the work is to be done) must give appropriate oral and written instructions on risk factors and correct handling procedures to staff or students whom they require to handle potentially hazardous material/equipment and must agree a risk assessment which includes a scheme of work. The risk assessment will include, if necessary, a specific assessment for hazardous substances under the COSHH Regulations. A copy of the risk assessment must be sent to the Biological Safety Officer who will also advise on the nature of the information required and on the suitability and sufficiency of the assessment. The risk assessment should also specify at what times of day and where the work is to be done. The process of risk assessment must be done before work is started and supervisors must ensure that workers understand the procedures and conditions laid down therein. For taught practical classes, a statement should be included in the Module Information Book indicating that the risks to health and safety are minimal as long as the Safety Code of Practice and the specific safety instructions given in the Module Information Book are observed and that risk control measures are used as directed.
5. Consideration should be given in the risk assessment to those groups whose susceptibility to infection may be affected by such factors as; known allergic reactions, pre-existing disease, medication, compromised immunity,

pregnancy or breast-feeding. Although it is not legally required for them to declare any such condition, those in the above groups are advised that it is in their best interest to discuss their condition with their supervisor. The likely ill effects of work with microorganisms can then be taken into account and appropriate arrangements can be made to minimise any effects. Such arrangements **may** include exclusion from the laboratories.

6. The culturing of microorganisms should be kept to the minimum required for the particular work being undertaken and, unless there is a good reason for not doing so, cultures should be destroyed as soon as possible after the work has been completed.

26.1.2 Local Rules for Work Involving Biological Agents, Body Fluids and Tissues

In addition to the rules in Section 20, the following apply to work with biological agents, body fluids and tissues.

1. Low risk work may be conducted on the open bench surface, but all procedures must be carefully performed to minimise the production of aerosols.
2. Bench surfaces must be disinfected **by the users** at the end of every session of work involving microorganisms, body fluids or tissues. Bioguard disinfectant spray is supplied for this purpose in the laboratories. In addition, in the teaching laboratory, technical staff will disinfect the benches with a solution of Presept or other chlorine bleach at the end of each semester, or more frequently if required.
3. Students may not remove any material from the laboratory without the written permission of a member of staff.
4. Any human blood or tissues which have to be handled, besides students' own, will have been screened for the presence of certain potentially very harmful microorganisms. Note that negative screening results do not mean that the blood is completely safe.
5. During blood sampling, strict aseptic procedures must be followed. Used sharps and swabs must be placed immediately in the sharps bin, and the puncture site must be covered with a waterproof dressing.
6. Aerosol formation must be avoided – pipettes should be drained, not vigorously blown out, and sealed vessels must be used for vortex mixing, shaking and centrifugation. In addition, centrifuge rotor buckets must be sealed. If there remains a possibility of aerosol formation, the work must be performed in a microbiological safety cabinet.
7. If a research programme involves receiving samples through the post or by courier, leakproof containers with appropriate biohazard labels must be used and the packaging must be clearly marked with the name of the recipient. The University Post Room and/or Reception must be informed in writing of how to identify such samples, what to do with them when they arrive and the action to take if they appear to be damaged. Consideration should be given to samples which may arrive when the intended recipient is not available.

8. Alternatives to the use of potentially hazardous human material, *e.g.* fixed material, purified enzymes, material from animal sources, or screened human materials should be used whenever possible for teaching purposes.
9. For several reasons, negative screening results do not mean that the blood is completely safe: screening is only undertaken for certain pathogens – other infectious agents may be present; there is a period between infection and the appearance of detectable antibodies; antibodies may be present at levels below those detectable in the screening process and mistakes are not unknown.
10. Undergraduates undertaking taught practical classes are not permitted to handle unscreened human materials, other than their own.
11. In practical classes, undergraduate students may only sample and handle their own capillary blood. Sampling must be supervised by a member of the teaching staff in an area designated and equipped for that purpose. The skin of the subject should be disinfected with an appropriate agent before blood is taken and the puncture site covered by a waterproof dressing.
12. Only staff, postgraduates and final year project students may perform serial capillary blood sampling for research purposes, the procedures and conditions being stated in the risk assessment.
13. Staff and postgraduates who may, in exceptional circumstances, wish to sample venous blood, *e.g.* for research purposes, must have their proposals approved by the Biological Safety Officer. Venous blood samples should only be taken by a registered clinician, phlebotomist or other person trained and certified as competent by a registered medical practitioner. Samples should be taken in a suitable area set aside for this purpose (room SC1-23) preferably using the 'vacutainer' technique and should never be taken in laboratories where there are microbiological or chemical hazards or in non-clinical offices. If hypodermic syringes are used, no attempt should be made to re-sheathe the needle, which should be removed before discharging the syringe into the specimen container.
14. In taught courses, undergraduate students may only collect and analyse their own urine samples. Measurement of volume and preparation of aliquots must be performed either in a sluice room or in an area of the laboratory designated and equipped for that purpose.
15. Only staff, postgraduates and final year project students may analyse non-blood body fluids for research purposes from other individuals, the procedures and conditions being stated in the risk assessment.
16. Members of staff who may be at risk from exposure to unscreened human materials, other than their own, may be advised to seek vaccination against hepatitis B from the University's Occupational Health Service. This may be compulsory in some cases and must be written on the risk assessment. Vaccination is not a substitute for good working practices.
17. Staff or students who donate venous blood for research studies should be asked to sign a consent form (Appendix 5) prior to doing so. The study requiring venous blood donation must be approved by the Ethics Committee. A record should be kept of all venous donations giving the date and time of donation and the quantity of blood taken per individual.

18. Work involving the primary culture of human cells or tissues may only be undertaken after the approval of the Biological Safety Officer and, if necessary, the Ethics Committee. Individuals are strongly advised not to perform this type of work with blood from themselves or from close colleagues, or even from colleagues who work in the same or nearby laboratories because if cells that have been deliberately or inadvertently transformed or modified *in vitro* are then accidentally reintroduced into the original donor, the immune system may not recognise them as foreign.
19. Experiments on respiration should be conducted using disposable mouthpieces wherever possible. Such mouthpieces must be disposed of after every subject. Non-disposable mouthpieces must be changed between subjects and disinfected before re-use. All parts of the apparatus which could become contaminated with saliva must be disinfected after each experimental session. Moisture condensed from expired air is unlikely to be infective.

26.1.3 Spillages and Accidents Involving Biological Agents, Body Fluids and Tissues

1. The best way to deal with spillages is not to have one in the first place! Simple procedures such as good housekeeping (keeping the work area tidy and uncluttered) and using the correct means of transporting and storing samples will all help to reduce the probability of a spillage occurring.
2. Do not attempt to clear up a significant spillage yourself unless you have been trained to do so.
3. Disinfectants and paper towels must be available at each bench for dealing with very small spillages. Suitable materials for dealing with larger spillages are kept in a Hazardous Spill Response Kit (HSRK) 'spillage kit' in every laboratory. By law, the COSHH assessment must include the action to take in the event of a spillage and all research workers and project students should be trained to take the necessary action.
4. In the event of an accidental puncture wound (needlestick injury) involving microorganisms, body fluids or tissues, the individual must be taken at once to the Accident and Emergency Department of the Whittington Hospital, Archway Road with details of the material involved. Preliminary action should be taken to encourage bleeding from the wound using running water. The wound must then be covered with a waterproof dressing.
5. All accidents, including spillages, must be reported immediately to a member of staff or to your supervisor. A University accident/incident form will be completed, an investigation should be undertaken by the Departmental Safety Officer, who will forward it to the University Health and Safety Office. He will also ensure that a copy is sent to the Head of Department so that any further action may be taken.

26.1.4 Disposal of Biological Waste

1. Waste material of all kinds must be disposed of carefully into the correct containers. If in doubt, ask your supervisor.
2. **NEVER PUT ANY SHARP OBJECT IN AN ORDINARY WASTE BIN OR PLASTIC BAG – MEMBERS OF STAFF AND REFUSE HANDLERS WILL BE PUT AT SERIOUS RISK OF INJURY.**

3. **Contaminated Disposable Non-sharp Materials.** This category of waste includes surplus or redundant cultures of biological agents and their containers (*e.g.* Petri dishes), plastic Pasteur pipettes, pipette tips, plastic cuvettes and vials (*e.g.* Eppendorfs), plastic centrifuge tubes, disposable transfer loops, rods, paper towels and tissues and disposable gloves. All contaminated disposables **EXCEPT FOR SHARPS** must be placed in either a biohazardous waste bag (larger quantities), supported during use to avoid bursting or in a disposable transparent container *e.g.* Disposafe® (smaller quantities), usually without disinfectant, unless specified in the risk assessment. The bags have a blue label and bear the biohazard sign and a statement indicating that the contents are biohazardous waste for autoclaving. The bags and contents will be autoclaved by trained personnel, then sealed in yellow bags bearing the biohazard sign for collection by cleaning staff and subsequent disposal by incineration. The disposable transparent containers will also be autoclaved and disposed of via the yellow wheely-bins for incineration.
4. **Contaminated Sharps.** This category of waste includes hypodermic and other needles, disposable knives, scalpels, blades, glass Pasteur pipettes, microscope slides and cover slips, broken glass, ampoules and vials that have been used in conjunction with microorganisms. All contaminated sharps must be placed by the user in a 'sharps' container. The 'sharps' container must be sealed when three-quarters full (or if it is not going to be used for one month) and then stored in a secure cupboard or room until collected for disposal as in 3 above. The date of sealing must be written on the 'sharps' container and it must not be kept on the premises longer than seven months.
5. **Contaminated Non-disposable Glassware.** All contaminated re-useable glassware (beakers, flasks, haemocytometer slides *etc.*) must be disinfected, if possible by total immersion overnight in an appropriate disinfectant solution and autoclaved or washed at high temperature.

26.2 Microbiological Safety Cabinets (MSCs)

The European Standard on MSCs (BS EN 12469) defines them as ventilated enclosures designed to protect the user and the environment from the aerosols arising from the handling of potentially hazardous microorganisms.

There are three basic types of MSCs, classified according to the type of protection they afford:

Class I cabinets protect the operator from exposure by continuously drawing air into the front of the cabinet and exhausting clean air through a High Efficiency Particulate Air (HEPA) filter.[1]

Class II cabinets protect the operator from exposure and the work from contamination. Inward air is directed downwards into a plenum below the work surface and is HEPA filtered before being (mostly) redirected into the work area as a laminar down flow of clean air providing an air curtain at the open front. A proportion of the air is exhausted in a similar way to a Class I cabinet.

[1] Originally High Efficiency Particulate Arrestance filter.

Class III cabinets are totally enclosed and operations are conducted through gloves attached to ports. Air enters the cabinet through a filter at the side or rear of the cabinet and is exhausted in a similar way to a Class I cabinet.

THERE IS NO RELATIONSHIP BETWEEN THE CLASSIFICATION OF MICROBIOLOGICAL SAFETY CABINETS AND THE HAZARD GROUP CLASSIFICATION OF MICROORGANISMS.

Most of the MSCs in the Science Centre (certainly all those in the teaching laboratory) are Class II and may normally only be used for work with HG2 organisms. If the laboratory is fully occupied, project students may use the MSCs for HG1 organisms. Some MSCs are specifically reserved for tissue culture work and are labelled as such. There are a few Class I MSCs in the Containment Level 3 research laboratories.

Laminar flow hoods provide a filtered air flow which is intended for product protection only and must not be confused with MSCs. They have no inflow and the air passes over the product being worked on (*e.g*. cell culture). They offer no operator protection and must not be used with any pathogenic biological material or organisms.

Before starting work or placing any biological material in a MSC, the user must be trained in the use of the cabinet and understand the operation of its controls. Generally the following procedure must be adopted.

1. Prepare for the work by assembling all the equipment needed, including containers for contaminated waste and an appropriate disinfectant. Large equipment should not be used inside the cabinet.
2. Remove the night door and slide it underneath the cabinet.
3. Switch on the fan by pressing the fan switch (green bordered with a pictogram that looks like a french horn!). An alarm will sound until the needle on the airflow gauge is in the safe (green) sector.
4. Switch on the interior light (yellow bordered switch with a lamp pictogram).
5. If gas is needed (*e.g*. for sterilising inoculation loops), press the black bordered switch bearing a flame pictogram to activate the gas solenoid valve. The gas tap in the cabinet will then be operable. It must be remembered though, that bunsen burner flames affect the airflow and will reduce the protection afforded to the user. Only low profile microburners equipped with a lever control to give full flame only as required should be used.
6. Work as near to the centre of the work area and stand at least 15 cm from the front.
7. Avoid sudden or rapid movements in front of the cabinet – they will interfere with the air flow.
8. When the work is finished, the cabinet must be emptied – remove samples for incubation, wipe down flasks, containers, etc. with disinfectant.
9. Wipe all surfaces with disinfectant.

10. Leave fan on for 5-10 minutes, then switch off cabinet and replace night door.

26.3 Genetic Modification Operations

As well as conforming to the Local Rules in the Section 26.1.2, all work involving genetic modification is also subject to the *Genetic Modification (Contained Use) Regulations* 2000. Risk assessments for proposed work of this nature must be referred to the Genetic Modifications Safety Committee and may require notification to (and possibly approval by) the Health and Safety Executive.

26.4 Laboratory Disinfectants

The supply and availability of laboratory disinfectants is controlled by the *Biocidal Products Regulations* 2001 and certain preparations have been banned for disinfection purposes. The use of disinfectants in the University's laboratories has been reviewed to ensure compliance with these regulations. Disinfectants must be of proven efficacy and, if diluted from a concentrate, must be labelled with the concentration and date of preparation. It must be remembered that the disinfectants themselves may be hazardous to health and the risk assessment must include them.

The following are the main types of disinfectant that may be used in the laboratories.

1. Peroxygen-based disinfectants (*e.g*. Virkon®) – effective on a wide range of viruses, bacteria, fungi and spores. Working solutions of 1% w/v have low toxicity and no irritancy. Virkon® has a built-in colour indicator for effective disinfection capacity and has detergent properties that combine cleaning with disinfection.
2. Tertiary alkyl ammonium salts *e.g.* the benzalkonium chloride in Bioguard® disinfectant cleaning solution is effective against a wide range of bacteria, mycobacteria and viruses when used at the concentration supplied. **Bioguard® is the preferred type of disinfectant in the laboratories and is available on the benches when required.**
3. Hypochlorite solutions (bleach) – suitable for many activities except where organic matter is involved (the organic matter will inactivate the hypochlorite). These solutions should be freshly prepared (no sooner than the day before they are to be used). The presence of chlorine in the solution may be checked with starch-iodide papers (they change from white to blue). Undiluted hypochlorite solution is suitable for emergency spillage use. Hypochlorite solutions must be inactivated before autoclaving. **Hypochlorite is suitable for disinfecting solutions containing blood or body fluids and containers will be made available when required.**
4. Chlorine-releasing powders and granules based on sodium dichloro-isocyanurate (Presept®) – for disinfecting spillages. **Solutions of Presept® are suitable for cleaning benches as an occasional alternative to Bioguard®.**
5. Clear soluble phenolics (Hycolin, Stericol, Clearsol) – these were all withdrawn from the European Union market in 2006 and must not be used.
6. Aldehydes (Cidex, glutaraldehyde, formaldehyde) – These chemicals all have toxic and irritant properties and are not suitable for routine use. Cidex has been taken off the market. They may have a place in specialised usage, but

alternatives should be considered. They must be stored in closed containers and used in hoods or fume cupboards. Workplace exposure limits (WELs) have been set for glutaraldehyde and formaldehyde (see HSE Guidance Note EH40).

7. Vaporised hydrogen peroxide (VHP) is used by contractors to disinfect the microbiological safety cabinets in the Science Centre laboratories.
8. Alcohols (*e.g.* ethanol, propan-2-ol, industrial methylated spirits) – the efficacy of alcohols as disinfectants is generally poor. Because of their flammability they should not be used on large surfaces. They are not generally recommended.

26.5 Autoclaves

Autoclaves are commonly used in microbiological and biomedical laboratories to inactivate microorganisms by treating them with pressurised steam. They are used both for sterilising growth media (*e.g*. agar gels, broths and associated solutions) before use and for sterilising waste prior to disposal *via* incineration. **Anything containing corrosives or solvents and other volatile substances must not be autoclaved.** All the autoclaves are subject to an annual inspection by an engineer contracted by the Department and to pressure testing by an engineer contracted by the University's insurers.

Before using any of the autoclaves in the laboratories, it is essential that training in their safe use is undertaken. This training is given by a member of the technical staff, who will maintain a register of trained personnel. It is not possible to give detailed instructions here on the use of autoclaves because there are so many different types available.

The general information given below is not intended as an alternative to the training but simply as an *aide memoire*.

26.5.1 General Autoclave Safety Practices

1. Check the inside of the autoclave for anything left by previous users.
2. Check there is sufficient water in the chamber.
3. Load the autoclave according to the instructions given during training, checking particularly that plastic articles are compatible with the autoclave and will not melt.
4. Loosen caps on vessels containing liquids.
5. When autoclaving waste use a suitable solid-bottomed tray to contain contents and catch spillages.
6. Make sure autoclave is properly closed and that the correct cycle is selected.
7. Do not leave the machine until it has reached its cycling temperature.
8. Wear heat-resistant gloves and a face shield or visor when opening the autoclave door and handling items.
9. Record your usage and sign the users book (which is kept next to the autoclave).
10. Report any problems to a member of the technical staff immediately.

26.6 Laboratory Centrifuges

There is no specific legislation covering laboratory centrifuges other than the general provisions of the *Provision and Use of Work Equipment Regulations, 1992*. Specific standards to be expected are to be found in BSEN 61010-2-020 1995 "Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2, Particular requirements for laboratory centrifuges". All centrifuges purchased for use in the University conform to the British Standard.

26.6.1 General Centrifuge Safety Practices

1. All users must be properly instructed in the correct use of the centrifuge.
2. The buckets, adapters and centrifuge tubes must be matched and the tubes must be compatible with the amount and nature of the sample, *e.g*. most plastic tubes are not suitable for use with non-aqueous solvents.
3. The centrifuge must be balanced across the axis of rotation.
4. Access to the rotor assembly whilst it is in motion is prevented by means of an interlock on the lid.
5. Centrifuges must never be operated above the maximum recommended speed.
6. Any undue noise or vibration during the operation of a centrifuge should result in the operator shutting down the apparatus. A competent person should be called to diagnose and correct the fault before it is put to further use.
7. More extensive training is required to use the high speed centrifuges and a record of trained personnel is maintained.
8. A record of use must be kept for all high speed centrifuges.
9. The manufacturer's recommendation for cleaning and, where necessary, for decontamination should be closely followed.
10. All centrifuges receive regular maintenance by the technical staff and annually by an engineer contracted by the Department. Records are kept of all maintenance work whether such work is carried out in-house or not. Maintenance should also include electrical safety inspection of the supply lead and the plug.
11. The access lid of the centrifuge must be strong enough to withstand any internal impact that may occur should a breakage in the rotor assembly or bucket occur during use. The lid should contain the contents of the rotor assembly and bucket during any such impact.

Appendix 1: Emergency Spillage Procedure

If correct procedures for storing, moving and handling hazardous substances are rigorously followed, there should never be a need for this procedure to be put into operation. However, accidents do happen and people do drop things. In the event of a major spillage of a hazardous substance, the following approach must be adopted to protect yourself and others. The first six steps should only take a very short time. An Accident/Incident Report must be completed following a spillage and an investigation will be held to find out how the procedures failed and how to prevent a recurrence.

DO NOT CLEAR A SPILLAGE YOURSELF UNLESS FULLY COMPETENT.

1. Get away from the immediate area. The further the better, depending on the nature and size of the spillage.
2. Identify what was spilt (so that the hazards may be publicised).
3. Get help. Send someone for appropriate assistance, supervisor or senior member of technical staff. Do not leave the area unattended.
4. Seal off the area. Use the warning signs in the spillage kits (available at various locations throughout the laboratories). Do not allow others to enter. In extreme cases, the whole floor or even the building may have to be evacuated.
5. Obtain first aid treatment if necessary and remove any contaminated clothing.
6. Identify the hazards of the substances involved and inform the people who will be clearing up the spillage. **The next four steps are for these personnel.**
7. Prepare a plan of action considering the following:
   Can we deal with this ourselves? If so:
   a) what Personal Protective Equipment (PPE) is necessary for cleaning up the spillage? *e.g.* gloves, goggles, pvc suit, footwear, respirator, escape apparatus;
   b) what neutralisers and/or absorbents are required? and;
   c) what else will be needed? *e.g.* fire extinguishers, brooms, mops, shovels, containers.
8. Assemble the equipment and materials.
9. Contain the spill to prevent it spreading.
10. Clean up the spillage by absorption, treatment and collection.

Appendix 2: Use and Disposal of Ethidium Bromide (EtBr)

Ethidium bromide (2,7-diamino-10-ethyl-9-phenylphenanthridium bromide) is a fluorescent dye widely used for the visualisation of nucleic acids. EtBr fluoresces red under ultraviolet light – the fluorescence intensifying when it is bound to double-stranded DNA. EtBr is used either dissolved in an aqueous buffer and/or incorporated in agarose or acrylamide gels for electrophoresis.

EtBr is a strong mutagen and must be considered as a possible carcinogen and reproductive toxin (risk phrases, R22, R26, R36/37/38 and R68). Wherever possible, ready-made solutions of EtBr should be purchased or solutions should be prepared from tablets in order to minimise likely contamination and inhalation of dust from spillages when weighing out the powder. Preparation of solutions from powdered EtBr is not permitted.

The COSHH assessment for activities involving EtBr must state whether EtBr is added directly to the gel before electrophoresis (preferred) or whether staining is performed using a buffered aqueous EtBr solution after electrophoresis. The assessment must take into account the safe disposal of gels and buffer solutions and the decontamination or disposal of tanks, casting trays and combs.

As all the laboratories are classified at Containment Level 2, all staff and students working in them must be wearing a fastened laboratory coat, safety spectacles and nitrile gloves. A second pair of gloves must be worn when handling EtBr or anything containing or contaminated with EtBr.

Disposal and Decontamination

Contaminated disposables and gels must be disposed of in Disposafe jars, or, if they will not fit through the opening, must be double-bagged and put in the yellow clinical waste bags for incineration.

Disposal of EtBr solutions into the sinks is strictly prohibited. Experienced research workers may consider decontamination of waste buffer solutions using commercially available filters or de-staining bags specially designed for the purpose, following the manufacturer's instructions. The decontaminated buffer can then be poured down the drain, provided that there are no other hazardous components in the solution. If, because other hazardous chemicals are present, disposal to drains is not an option, then the solutions must be collected for disposal *via* the waste chemicals route.

Cleaning of Equipment and Benches and Spillage Clean-up

Benches, glass, stainless steel and transilluminator filters can be decontaminated using the following technique.

1. Unplug electrical equipment.
2. Prepare the following solution: sodium nitrite (4.2 g), hypophosphorous acid (50% solution, 20 cm^3) in water, (300 cm^3). A small amount of dinitrogen tetroxide (brown gas) may be evolved when the solution is first mixed, so prepare the solution in a fume cupboard. The solution is acidic (pH 1.8) and

therefore corrosive, so consider the effect on the surface to be decontaminated.

3. Wash the surface once with a paper tissue soaked in the solution, taking care to avoid wetting any electrical components. Wash with water-soaked tissue five times, using a fresh tissue each time. Check that decontamination has been successful with an ultraviolet lamp (absence of fluorescence).
4. Electrical equipment must be inspected and/or electrically tested by a technician before being put back into use.
5. Dispose of the tissues, gloves and the remaining solution in a Disposafe® jar, label it and consign it to the chemical waste.

Appendix 3: Risk and Safety Phrases

The following standard risk (R) and safety (S) phrases from the *Chemicals (Hazard Information and Packaging for Supply) Regulations* 2002 (CHIP) are often found on labels of hazardous substances. Some suppliers use the full risk or safety phrase while others simply use the R- or S- number. There are also standard combination risk or safety phrases derived from the above, *e.g*. R39/27/28 Very toxic; danger of very serious irreversible effects in contact with skin and if swallowed, S1/2 Keep locked up and out of the reach of children. Safety phrases with [...to be specified by..] are often given an alphabetical extension by the manufacturer.

Risk Phrases

R1	Explosive when dry.
R2	Risk of explosion by shock, friction, fire or other sources of ignition.
R3	Extreme risk of explosion by shock, friction, fire or other sources of ignition.
R4	Forms very sensitive explosive metallic compounds.
R5	Heating may cause an explosion.
R6	Explosive with or without contact with air.
R7	May cause fire.
R8	Contact with combustible material may cause fire.
R9	Explosive when mixed with combustible material.
R10	Flammable.
R11	Highly flammable.
R12	Extremely flammable.
R14	Reacts violently with water.
R15	Contact with water liberates extremely flammable gases.
R16	Explosive when mixed with oxidising materials.
R17	Spontaneously flammable in air.
R18	In use, may form flammable/explosive vapour-air mixtures.
R19	May form explosive peroxides.
R20	Harmful by inhalation.
R21	Harmful in contact with skin.
R22	Harmful if swallowed.
R23	Toxic by inhalation.
R24	Toxic in contact with skin.
R25	Toxic if swallowed.
R26	Very toxic by inhalation.
R27	Very toxic in contact with skin.
R28	Very toxic if swallowed.
R29	Contact with water liberates toxic gas.
R30	Can become highly flammable in use.
R31	Contact with acids liberates toxic gas.
R32	Contact with acids liberates toxic gas.
R33	Danger of cumulative effects.
R34	Causes burns.
R35	Causes severe burns.
R36	Irritating to eyes.
R37	Irritating to respiratory system.
R38	Irritating to skin.
R39	Danger of very serious irreversible effects.
R40	Limited evidence of carcinogenic effect.
R41	Risk of serious damage to eyes.
R42	May cause sensitisation by inhalation.
R43	May cause sensitisation by skin contact.
R44	Risk of explosion if heated under confinement.
R45	May cause cancer.

R46 May cause heritable genetic damage.
R48 Danger of serious damage to health by prolonged exposure.
R49 May cause cancer by inhalation.
R50 Very toxic to aquatic organisms.
R51 Toxic to aquatic organisms.
R52 Harmful to aquatic organisms.
R53 May cause long term adverse effects in the aquatic environment.
R54 Toxic to flora.
R55 Toxic to fauna.
R56 Toxic to soil organisms.
R57 Toxic to bees.
R58 May cause long term adverse effects in the environment.
R59 Dangerous for the ozone layer.
R60 May impair fertility.
R61 May cause harm to the unborn child.
R62 Possible risk of impaired fertility.
R63 Possible risk of harm to the unborn child.
R64 May cause harm to breastfed babies.
R65 harmful: may cause lung damage if swallowed.
R66 Repeated exposure may cause skin dryness and cracking.
R67 Vapours may cause drowsiness and dizziness.
R68 Possible risk of irreversible effects.

Safety Phrases

S1 Keep locked up.
S2 Keep out of reach of children.
S3 Keep in a cool place.
S4 Keep away from living quarters.
S5 Keep contents under ... [appropriate liquid to be specified by the manufacturer].
S6 Keep under ... [inert gas to be specified by the manufacturer].
S7 Keep container tightly closed.
S8 Keep container dry.
S9 Keep container in a well ventilated place.
S12 Do not keep the container sealed.
S13 Keep away from food, drink and animal feeding stuffs.
S14 Keep away from ... incompatible materials [to be indicated by the manufacturer].
S15 Keep away from heat.
S16 Keep away from sources of ignition - No smoking.
S17 Keep away from combustible material.
S18 Handle and open container with care.
S20 When using, do not eat or drink.
S21 When using, do not smoke.
S22 Do not breathe dust.
S23 Do not breathe gas/fumes/vapour/spray [appropriate wording to be specified by the manufacturer].
S24 Avoid contact with skin.
S25 Avoid contact with eyes.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S27 Take off immediately all contaminated clothing.
S28 After contact with skin, wash immediately with plenty of ... [to be specified by the manufacturer].
S29 Do not empty into drains.
S30 Never add water to this product.
S33 Take precautionary measures against static discharges.
S35 This material and its container must be disposed of in a safe way.
S36 Wear suitable protective clothing.
S37 Wear suitable gloves.
S38 In case of insufficient ventilation, wear suitable respiratory equipment.

S39 Wear eye/face protection.
S40 To clean the floor and all objects contaminated by this material use — [to be specified by the manufacturer].
S41 In case of fire and/or explosion, do not breathe fumes.
S42 During fumigation/spraying wear suitable respiratory equipment [appropriate wording to be specified by the manufacturer].
S43 In case of fire use ... [indicate in the space the precise type of fire-fighting equipment. If water increases the risk add 'Never use water'].
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S46 If swallowed seek medical advice immediately and show this container or label.
S47 Keep at temperature not exceeding ... ºC [to be specified by the manufacturer].
S48 Keep wetted with ... [appropriate material to be specified by the manufacturer].
S49 Keep only in the original container.
S50 Do not mix with ... [to be specified by the manufacturer].
S51 Use only in well-ventilated areas.
S52 Not recommended for interior use on large surface areas.
S53 Avoid exposure - obtain special instructions before use.
S56 Dispose of this material and its container to hazardous or special waste collection point.
S57 Use appropriate containment to avoid environmental contamination.
S59 Refer to manufacturer/supplier for information on recovery/recycling.
S60 This material and its container must be disposed of as hazardous waste.
S61 Avoid release to the environment. Refer to special instructions/Safety data sheet.
S62 If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.
S63 In case of accident by inhalation: remove casualty to fresh air and keep at rest.
S64 If swallowed rinse mouth with water (only if person is conscious).

Appendix 4: Hazardous Substance Warning Symbols

Substances with known hazards are labelled in accordance with the *Chemicals (Hazard Information and Packaging for Supply) Regulations* 2002 (CHIP3) and must show hazard symbols. The symbols and explanations of their meanings are reproduced below.

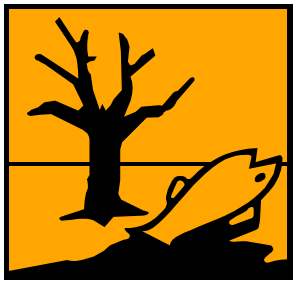
Very toxic Substances which can cause extremely serious acute or chronic effects, even death, when inhaled, swallowed or absorbed through the skin.

Toxic Substances which can cause serious acute or chronic effects, even death, when inhaled, swallowed or absorbed through the skin.

Harmful Substances which, if inhaled, swallowed or absorbed through the skin, can have limited effects on health.

Irritant Substances which can cause inflammation on immediate, repeated or prolonged contact with mucous membranes or skin.

Corrosive Substances which can destroy living tissue.



Dangerous for the Environment Substances that may have a detrimental effect upon ecosystems.

Explosive Substances which explode on contact with flame or are more sensitive to impact or friction than dinitrobenzene.

Oxidising Substances which produce highly exothermic reactions in contact with other substances, especially flammable or combustible materials.

Extremely flammable Liquids with a flash point ≤ 0 ºC and a boiling point of ≤ 35 ºC.

Highly flammable Liquids with a flash point < 21 ºC.

Flammable Liquids with a flash point of ≥ 21 ºC and ≤ 55 ºC.

Substances which are spontaneously combustible in air at ambient temperature and solids which readily ignite after brief contact with flame or which evolve highly flammable gases in contact with water or moist air are also labelled as highly flammable.

Appendix 5: Blood Sampling Form

BLOOD SAMPLING FORM

This form should be completed before a blood sample is taken.

Donor details:

SURNAME	FIRST NAME	
MAIDEN NAME (if different from above)	DATE OF BIRTH (day/month/year)	
SEX (Please tick box)	Male	Female

Reasons for blood sampling:

Precautions taken:

Personal protective equipment	Gloves		Other		Other	

Biological Information:

Is there any reason to suspect that the donor's blood may be hazardous? (*e.g*. HIV status, hepatitis B/C etc.) Please tick one box.	YES	NO

Blood sample taken by (name)
Signature:
Blood donor’s signature:
Date: