School of Science
Birkbeck,
University of London

Biological Sciences

A Code of Practice for Safe Working in the Laboratories of Malet Street Main and Extension Buildings

Version: September 2012

IN CASE OF EMERGENCY:
RING 555 from a College phone

Inform the DUTY ATTENDANT
of the nature of the emergency,

Give YOUR NAME and LOCATION.

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1. AREAS OF RESPONSIBILITY

1.1. Main Duties of the College

The ***Health and Safety at Work Act 1974*** covers all aspects of safety for employees. It imposes on the College a duty to ensure the health and safety of all employees. The ***Control of Substances Hazardous to Health Regulations 1994*** give a number of specific requirements designed to prevent or limit the exposure of anyone to hazardous substances in the workplace. While the primary responsibility for health, safety and welfare rests with the College as employer and institution, all persons have a duty under the Act for his or her own safety and health as well as that of his or her colleagues . Supervisory staff and/or their designated deputies are in a special situation of care over the people they are overseeing who will often be inexperienced workers.

A full account of the duties of the College with regards to safety is given in the College's Health and Safety Policy document, available from the Safety Office's web pages on the Intranet www.bbk.ac.uk/so

This document is intended to give instruction and guidance to all who work in Biologal Sciences' research and teaching laboratories at Birkbeck.laboratories in the Malet Street Main building.

1.2. Responsibilities of Schools

The **College Health and Safety Policy (section 3.4**) states:

At school level, the responsibility for safety matters rests with the **executive deans** and through them to the **heads of academic departments**, institutes and centres. Heads of 'Professional Services' departments and units carry the same responsibility. This responsibility includes:

1. **Defining clear responsibilities for the management of health and safety** including appropriate supervisory arrangements for staff, students and visitors and the appointment of a local safety coordinator, a display screen equipment assessor and a sufficient number of fire marshals, including deputies, to cover the accommodation of the school/department and adjacent common areas.

2. **Not permitting any work to start unless a suitable and sufficient assessment of the risks involved in the work has been carried out**. This should include the arrangements for staff working in workplaces under the control of other employers. This may necessitate obtaining the hazard and risk information from host employers that they are required to provide under Regulation 12 of the Management of Health and Safety Regulations (1999).

3. After appropriate risk assessments, **defining the standards of operation relevant to the degree of risk associated with each operation** within any workplace under their control whether the workplace is on or off Birkbeck premises.

4. **Maintaining awareness within the School of relevant regulations/codes of practice** by drawing up and circulating to staff and students a safety statement accompanied where necessary by codes of practice regarding the control of hazards within the school.

5. **Providing the resources needed to comply** with the requirements and prohibitions that may be imposed by or specified by statutory provisions.

6. **Instituting suitable inspection, monitoring and reporting procedures** to ensure the requirements of this policy are being met including arranging for "safety" to be a standing agenda item at staff and management level meetings.

7. **Promoting, advising and providing training on the practices and procedures** to be adopted in health and safety matters relevant to the School; this to include ensuring that all new members of staff are made aware of the College's fire action procedures. This is normally achieved by reading and acknowledging by email the fire safety information and on-line induction pack sent to all new employees by the Health and Safety Officer.

In those Schools containing laboratories or workshops the Head of School is also responsible for:

9. **Making arrangements for periodic safety checks** on major mechanical and electrical items of laboratory and workshop equipment.

10. **Appointing**, in those Schools using radioactive substances or equipment that can produce ionising radiations, **a radiation protection supervisor**.

1.3. Duties of Supervisors of Undergraduate and Postgraduate Students

Supervisors must oversee the work of those in their care on a daily basis and must appoint a deputy whenever they are likely to be absent. The supervision needs to be both detailed and close when students are involved in practical exercises; it is not sufficient for a supervisor to assume that a dangerous activity would not be attempted. **Supervisors should ensure that all part-time research students and project students understand the principles and observe the practices within this code of practice**. Particular attention should be drawn to Section 5 on **General Laboratory Practice**, as this will be applicable to most, if not all, such students.

1.4. Duties of Teachers/Lecturers/Tutors

Normally, new students will be advised initially of general safety issues (especially re: practical and field work, and fire safety) during pre-term induction sessions held at the start of each Academic Year. If students are absent from this event, or if attendance is for some reason inappropriate (e.g. post-graduates do not normally attend these sessions), it is the responsibility of the student's Supervisor or Personal Tutor to give this advice (e.g. via dissemination of relevant handbooks).
Lecturers, including bought-in teachers, are responsible for identifying hazards and minimising risks to demonstrators and students during practical classes. All teachers must be aware of their responsibilities regarding Fire Safety and should always know the evacuation procedures for any rooms in which they hold a class (*see* Section 14, Fire Instructions). For reference, written evacuation instructions are posted in all teaching rooms.

1.5. Duties of Laboratory and Other Workers

Laboratory workers are, in many cases, the "first line of defence" in matters of lab safety. Workers must read and understand the parts of this code that relate to their work activities and must follow the relevant guidelines. They should report any potentially or actually hazardous activities to the Safety Coordinator at the first opportunity and should assist the Safety Coordinator in rectifying any problems.

At the same time, ***all*** workers have the right to be informed of the known physical and health hazards of the hazardous chemicals and apparatus in their work areas and to receive adequate training to work safely with such substances and equipment.

1.6. Duties of the Area Safety Coordinators

See Section 2: Administration of Safety.

2. ADMINISTRATION OF SAFETY

2.1 Head of Department

Professor Gabriel Waksman is responsible to the Executive Dean of the School of Science for all matters of health and safety within the Department of Biological Sciences. These responsibilities are set out in the "College Statement of Safety Policy" and include appointing departmental safety coordinators, DSE assessors and fire marshals and also arranging for "safety" to be a standing agenda item at departmental meetings.

2.2 Area Safety Coordinators

Area safety coordinators are in general charge of safety within areas of their schools or departments. They advise their heads of school or department on safety matters and act as liaison officers in the exchange of information between their schools/departments etc and the Health and Safety Officer. The responsibilities of area safety coordinators are set out in the "College Statement of Safety Policy" Area safety coordinators in Biological Sciences are:

Chemistry (6th floor): Dr Salvador Tomas
Biology & Microbiology (3rd floor): Mrs Marie Maugueret-Minerve
Crystallography – (basement): Dr Jim Pitts

2.3 Laboratory Managers & academic line managers

Laboratory managers, supported by the senior academic associated with their laboratory, are responsible for ensuring health and safety within their labs and have the full authority of the Head of Department to take such reasonable measures to enable them to do so. The current list of lab managers is set out below.
Dr T. Daviter – Biophysics Centre
Dr D. Houldershaw – Computer Services
Dr Luchun Wang – EM Lab
Dr R Sarra – Rayne Wolfson Lab & Spectroscopy Lab
Dr S Geddes – Rosalind Franklin Lab
Dr N Cronin – X-ray Lab
Mr D Shipp – Chemistry Teaching Labs
Mrs Marie Maugueret-Minerve – Micobiology Research Labs
Mr Martin Cullum - Biology Teaching Labs
Mr Frank Barretto – Chemistry Research Labs
Ms Gita Panchal - Biological Instrumentation Labs

2.4. Radiation Protection Supervisor

Each department where ionising radiation is used has a Radiation Protection Supervisor (RPS) appointed by the College to oversee the safe use of ionising radiation within their department. The Departmental RPS is Dr Jim Pitts

2.5. Departmental GM Safety Officers

The duties of Departmental GM Safety Officers are laid down by the HSE and are set out in the College's Code of Practice for work in GM Laboratories. The duties include ensuring that local rules are drawn up and followed for the safety of users of GM. The Department has two GM Safety Officers:
Dr Sanjib Bhakta – microbiological laboratories
Dr Rennos Savva – crystallography laboratories

2.6. Display Screen Equipment (DSE) Assessors

Each area of the College has one or more a DSE assessors appointed by the Head of the school/department/area and trained by the College Health and Safety Officer. DSE assessors ensure that the legal requirement for carrying out risk assessment of DSE workstations is implemented within their areas. The DSE assessors in Biological Sciences are Dave Houldershaw, Martin Cullum and Yvonne Dove.

2.7. Zone Fire Marshals

Zone Fire Marshals and their deputies are appointed by heads of department and trained by the Collge Health and Safety Officer. They have duties within defined areas of the Collegethat include monitoring fire safety compliance within their zone and sweeping the zone if the fire alarm sounds to ensure everyone has left. The College Health and Safety Officer maintains a list of all zone fire marshals within Biological Sciences' areas.

2.8 Responsibilities of individual staff, students and visitors

All employees have a legal responsibility to take reasonable care of themselves and others who may be affected by their acts and/or omissions and to co-operate with their employer with regard to health & safety matters i.e. the arrangements for health and safety set out in this document and its associated codes of practice; all students and visitors are placed under the same obligations when on Birkbeck premises.

2.9. College Health and Safety Officer (CHSO)

The College Health and Safety Officer (also the College Fire Officer), is responsible to the Secretary and Clerk to the Governors for general safety matters throughout Birkbeck. The CHSO is Tom McCartney. The CHSO is assisted in his role by the College Radiation Protection Adviser (currently also Tom McCartney), College Biological Hazards Officer (currently Dr Jane Nicklin), College Laser Safety Officer (currently Dr Jim Pitts), College GM Safety Adviser (also Dr Jim Pitts) and the College Chemical Hazards Officer (currently Dr Salvador Tomas).

The role of the CHSO and the advisory officers are set out in the "College Statement of Safety Policy".

2.10. College Safety Committees

The membership and terms of reference of the College Health and Safety Comittee, the GM Safety sub-Committee and the Radiation Protection sub-committee are set out on the College Committees web page - http://www.bbk.ac.uk/committees/alphabetical

2.11. Departmental Safety Committee

There are several individuals in this group of laboratories with special responsibility for safety and they sit on the Safety Sub-Committee:

Chairman	- Professor Gabriel Waksman
Deputy Chairman	- Dr Salva Tomas
Safety Coordinator (Chemistry labs)	- Dr Salva Tomas
Safety Coordinator (Biology labs)	- Marie Maugueret
Technical Services Manager	- David Renouf
Genetic Modifications Coordinator	- Dr Sanjib Bhakta
College Genetic Modification Safety Coordinator	- Dr. Jim Pitts
College Biological Safety Officer	- Dr. Jane Nicklin
Biology technical staff representative	- Martin Cullum – to be confirmed
Chemistry technical staff representative	- Don Shipp – to be confirmed
Postgraduate student representative	- To be appointed
Radiation Protection Supervisor	- Dr Jim Pitts

All lab managers not listed above are also to be invited to attend meetings of the sub-committee.

The Sub-Committee will be called to meet bi-annually. The Head of Department, Professor Gabriel Waksman should also be invited to chair the Sub-Committee meetings and in any case should receive the minutes of the meetings, which will be forwarded to the next departmental staff meeting.

2.12. Safety Inspection of the Workplace

The area safety coordinators will arrange an annual Safety Self-Inspection of the labs and associated offices and stores. This normally will be scheduled during or shortly after the end of Summer Term, although other inspections may be called at any time to consider specific issues such as electrical safety or COSHH assessments. An inspection party will be assembled, comprising the area safety coordinator, the Technical Services Manager and a representative from another department. A trade union representative and the College Safety Officer may also be invited to participate. Any identified hazards will be recorded and their risks assessed. Necessary remedial action will be agreed between the members of the party and a report of the inspection findings will be prepared by the safety coordinators. The report will be circulated to the College Safety Officer and all staff within the area covered as the report will also contain general safety information that the College wishes to bring to the attention of staff on a regular basis. The following meeting of the area sub-committee will consider the inspection report and initiate a program of remedial action, if still necessary.

2.13. Publication and Dissemination of this area Safety Code

This Safety Code of Practice will be published among the Biological Sciences and the Safety Office web pages and will be reviewed annually to incorporate any recommendations from the last safety inspection and any new practices/procedures that may have arisen. The attention of all laboratory staff in the relevant area will be drawn to the Code of Practice and it will be mandatory for all relevant staff to read and follow it.

2.14. Induction of New and Visiting Staff

The relevant academic supervisor or appropriate line manager in the case of technicians will ensure that on Induction, all new or visiting staff and students receive all relevant safety information including this code of practice and it will be mandatory for all concerned to read and follow it. New staff must be informed of the requirement to attend any safety induction sessions, and of the necessity to perform risk assessments of their work (*see* Section 6: Risk Assessment and COSHH). If appropriate, new staff should be directed to undergo health screening, particularly if their work involves allergens or certain radiochemicals (see Section 6.4). Arrangements for health screening are the responsibility of the relevant academic supervisor or appropriate line manager in the case of technicians. Advice and assistance can however can however be requested from Birkbeck HR and the College Health and Safety Officer.

2.15. Risk Assessment and COSHH

The safety coordinators will periodically check that all supervisors of projects have fully assessed the risks and filed COSHH forms for all laboratory projects, including practical and field work performed in undergraduate and taught-post-graduate classes. *See* Section 6 for further information on Risk Assessment and COSHH.
The Genetic Modification Coordinator informs staff on a regular basis of requirements relating to risk assessment in any projects involving genetic modification.

2.16. Fire Safety Reminders

All staff will periodically receive reminders from the College Safety Officer on the general Fire Safety procedures which can also be found here:
http://www.bbk.ac.uk/so/guidance/fireinfo/FIREACTION . A copy of these procedures should accompany contracts sent to bought-in teachers. Teaching staff should inform demonstrators of fire safety procedures. Fire safety is covered in more detail in Section 14.

2.17. Safety Information

Further information about College safety policies and guidelines can be found on the College Safety office web page, http://www.bbk.ac.uk/so/ COSHH, incident and general risk assessment forms can be downloaded from the web pages here: http://www.bbk.ac.uk/so/forms/

3. ACCESS TO FACILITIES

3.1. General Advice

Because of the arrangement of many offices in located "inside" laboratories – it is essential that staff remind students and other visitors that all normal rules of laboratory safety are applicable even when a laboratory is being used only as a passage to an office.

3.2. Staff and Students

Staff and students may freely enter the Main Building and the department during normal working hours (*see* Section 4: Hours of Work). During some periods of official closure, it is necessary to arrange prior permission to enter the building. Within the laboratory areas covered by this code access is restricted by keys which are made available at the discretion of the Technical Services Manager.

3.3. Visiting Researchers

Visiting researchers should be advised by their supervisor/local collaborator of local rules and procedures relating to laboratory safety. If visiting researchers will be working on-site for an extended period, the Safety Code of Practice should be brought to their attention as per 2.4 above. Supervisory staff should be reminded of the need to include such workers on COSHH forms.

3.4. Visitors/members of the public

Visitors and company representatives should first report to Main Reception on entering the building. Other visiting members of the public, especially children, should be under the supervision of a member of staff. Visitors should never enter laboratories unless accompanied by a member of staff. Children are not allowed entry to any laboratory without a specific risk assessment being carried out beforehand.

3.5. Cleaning Staff and Repair Workers

It is important that risks are minimised for workers who have little knowledge of laboratory hazards, but who must routinely enter laboratories. The best way to achieve this is by following good laboratory practice: keeping the lab tidy, keeping hazardous materials properly confined, following the correct waste disposal procedures plainly and accurately labelling reagent bottles, etc. Recall that laboratory staff — not cleaning staff — are responsible for cleaning laboratory work surfaces, refrigerators, freezers and apparatus. Some labs will contain separate bins for "ordinary" waste and for "hazardous" waste. Hazardous waste bins should be plainly labelled as to their contents and cleaning staff should be advised to leave these alone.

3.6. Disabled persons

Particular safety issues may arise for disabled workers or visitors. It is best to review these on a case-by-case basis in collaboration with the College Disability Coordinator.

4. HOURS OF WORK

4.1. Normal Hours

Normal hours of work are between Monday to Friday 9.00 a.m. to 9.30 p.m. in term time and 9.00 a.m. to 5.00 p.m. in vacation.
NOVEL OR PARTICULARLY HAZARDOUS OPERATIONS ARE ABSOLUTELY FORBIDDEN OUTSIDE NORMAL WORKING HOURS.

4.2. Working alone

Generally, solitary workers should not be exposed to significantly more risks than employees that work together, and it is the employer's duty to provide appropriate control of the work.
Consequently, working alone in the laboratories outside normal working hours is allowed only where the work has little or no attendant risk.
Permission to work alone cannot be assumed and must be sought by the worker involved.
Routine work such as the cultivation of plants in greenhouse and growth cabinets, the maintenance of animal collections, the inoculation and checking of microbial cultures, microscope work, and literature/computer work may be regarded as ***low risk*** activities. However, some seemingly innocuous activities – for example cleaning of glassware – nevertheless are a source of accidents. Workers with medical problems that may incapacitate them are also at risk even in carrying out routine activities. When working alone every attempt should be made to advertise your presence to other people in the building so that workers may check each others' well-being regularly. It is much better, however, if there is someone in your vicinity who can be made aware of your presence in the Laboratories. Also you should be aware of the procedures necessary to respond to an emergency (*see* Section 14). Supervisors should note their special responsibility for students, either undergraduate or postgraduate (M.Sc. and Ph.D.).
Both categories of student must seek permission to work alone from their supervisor or a designated deputy.
Permission will only be given after a risk assessment has been carried out (*see* Section 6), placing limits to the work and agreeing safe practice, including whether the attendance of the supervisor is required. ***This risk assessment is additional to the normal COSHH. Risk assessment carried out for a project and should refer only to defined procedures on particular dates.***

4.3. Unattended/overnight experiments

Although best avoided wherever possible, it is recognised that certain experimental work may require that various operations run unattended for periods of time, including overnight. A key principle is to design a system of work that ensures any failure of the equipment or services in use results in the apparatus shutting down safely (fail-to-safety mode). The following points must be addressed when preparing experiments that will be left unattended:
(a) All electrical wiring must be sound, with no bare wires, and plugs fused at the correct rating.
(b) Water-cooling hoses must be sound new rubber or plastic, preferably reinforced, and wired securely to the apparatus, and to the tap, unless permanently plumbed in. Precautions should be taken to see that any cooling water flow does not stop or change. Avoid leaving water running unattended if not required, to reduce the risk of flooding.
(c) Gas heating is not permitted. Any heating must be electrical. If a heating bath is used it must be graphite bath or silicone oil bath (not liquid paraffin), in order to reduce the danger of fire.

(d) All supports must be firm and securely fitted.
(e) Any gas cylinders used must be securely clamped to the bench or to a stand. Proper arrangements must be made to see that the gas flow remains constant and that waste gas is properly trapped or exhausted safely.
(f) Any vacuum required must be supplied from a rotary vacuum pump. The use of water pumps is not permitted, nor should the Departmental vacuum supply be used.
(g) Chemical reactions must be housed in a fume cupboard if at all possible.
(h) When electrophoresis equipment must be left running for extended periods, a great deal of heat may be generated, producing a risk of ignition. Always ensure that adequate precautions are taken to cool such apparatus.
(i) Centrifuges and vacuum pumps often must be left running for lengthy periods. Workers must ensure that such apparatus is in good working order (adequate coolant and/or oil present) before using such apparatus.
(j) Samples left in centrifuges, vacuum evaporators, chromatography systems, scintillation counters, etc. must be clearly labelled so their content and owner is known to any other worker who may encounter them.

5. GENERAL LABORATORY PRACTICE

5.1. Introduction

The ***Control of Substances Hazardous to Health Regulations 1994*** place an emphasis on the ***prevention*** of the exposure of workers to substances hazardous to health, or where this is not reasonably practicable, the exposure should be ***adequately controlled***. Prevention or adequate control can only be maintained by good laboratory practice.

It is the responsibility of all personnel to familiarise themselves with any special safety procedures relevant to the laboratory in which they are working.

This section is applicable to all laboratory workers, including undergraduate and postgraduate students, and should be brought to their attention by supervisors.

Because of the diversity of practices in Department of Biological Sciences, this short guide will not be comprehensive, but should cover many of the most important points. It is up to workers to seek expert advice – which may include discussions with the School Safety Coordinator or the College Safety Officer – when they are uncertain of the risks of any new procedures.

5.2. Eating, Drinking and Smoking

These activities are forbidden in ALL laboratories. In addition, laboratories may not be used as food or drink storage areas. Food and drink may be stored ONLY in designated refrigerators. Laboratory glassware must not be used for the preparation or storage of food or beverages. Always wash your hands before leaving a laboratory. Recall that smoking is generally forbidden throughout the College, except in a small number of officially designated smoking areas. The College's Smoking Policy can be found on the Safety Office Web site.

5.3. Tidiness

A general principle governing all good laboratory practice is tidiness. It is especially important to keep areas in general use such as sinks, fume cupboards and balances clean and uncluttered. Ensure that any chemical spills, however small, are immediately cleaned up (this applies especially to preparation areas and balances) and that decontamination procedures, if required, are followed. Return chemicals to the appropriate shelves or cupboards, and dispose of empty containers promptly. Keep aisles clear of obstacles including apparatus, boxes, etc. Avoid slipping hazards by clearing liquid spills promptly. **Laboratory staff — not cleaning staff — are responsible for cleaning laboratory work surfaces, refrigerators, freezers and apparatus**. Remember that many facilities are *shared* and therefore you must leave common work areas in a tidy state for the convenience and safety of others. Do not allow paper (e.g. computer paper, or spectra) to accumulate so that it becomes a fire hazard.

5.4. Washing Up

Care must be taken that glassware contaminated with noxious chemicals is rinsed before being left for washing up. There is a special practice for the cleaning of glassware contaminated with micro-organisms. Such glassware must be sterilised by soaking in bleach or by autoclaving before being washed (*see also* Section 9.1).

5.5. Storage of samples in refrigerators and freezers

All materials stored in refrigerators and freezers should be labelled to indicate their identity/contents, the date on which they were stored, and their owner. Flammable materials must not be stored in non-spark proof refrigerators. Hazardous materials must be clearly labelled as such; it may be appropriate to segregate such items within containers or jars.

5.6. Safety Clothing

5.6.1. Policy on laboratory coats and protective gloves

For general good laboratory practice to protect lab workers and also to comply with COSHH & GM regulations, the following rules have been drawn up for the wearing of lab coats and gloves within the various areas of Biological Sciences. For similar reasons and also to prevent concern among colleagues and visitors, rules for where lab coats and gloves must not be worn are also set out below. A very few specific exceptions to the general rules on where lab coats must not be worn have been included since it is neither possible to have all lab facilities self-contained nor thought practical to require changes of coat for very brief periods.

This policy has been endorsed by the Head of Department, the College Biological Hazards Adviser, the College GM Adviser, the College Health and Safety Officer and key laboratory managers in Biological Sciences.

A. Where staff are required to wear lab coats as part of their duties they must be provided with a suitable lab coat free of charge. In Category 2 Biohazard and GM labs, lab coats must be available for visitors, such as service engineers, to borrow as a condition of entry to the lab. Areas not able to supply free lab coats to students may develop their own charging policy for this. However, the HSE views postgraduate students as 'workers' entitled to free coats.

B. Category 2 Biohazard labs - suitable lab coats must be worn at all times. Additionally, gloves must be worn if the risk assessment requires this measure. Suitable lab coats must be available for visitors to borrow for use while in the area as a condition of entry to the lab. Upon leaving the lab both gloves and lab coats must be removed and hands washed in the wash hand basin provided. Coats used in Category 2 Biohazard labs may not be worn or taken outside the laboratory except for autoclaving and cleaning and the safety procedures in place for this must be followed.

C. Genetic Modification labs - suitable lab coats must be worn at all times. Gloves may also be worn, but this is not conditional for GM work to be undertaken. Suitable lab coats must be available for visitors to borrow as a condition of entry to the lab. Lab coats will normally be confined to the GM areas except for autoclaving and cleaning and the safety procedures in place for this must be followed. Upon leaving the area both gloves (if worn) and lab coats should be removed and hands washed in the wash hand basin provided. For specific exceptions to these requirements see section (E) below.

D. All other laboratories - suitable lab coats must be worn when staff, students or visitors are engaged in any bench work or other general lab work task. Lab coats must be worn in the sample

preparation areas for Confocal and Electron Microscope rooms but need not necessarily be worn at the microscopes themselves unless the risk assessment dictates otherwise. Suitable arrangements must be made for cleaning all laboratory coats on a regular basis. Lab coats should not normally be worn outside laboratories - for specific exceptions to this rule see section (E) below.

E. After an assessment of the potential risk to health and considering the need for a practical solution to ensure good compliance, the following specific exceptions will be allowed subject to regular reviews of how the policy is working in practice.

E.1 For the Rayne Wolfson laboratory workers may, by the shortest route, move between the lab and the adjacent cold room areas in their lab coat but gloves must be removed.

E.2 For the 3rd Floor laboratories workers may, by the shortest route, move between labs (except biohazard cat 2 labs) in their lab coat to access the fridges and freezers in the central corridor but gloves must be removed.

E.3 Clean lab coats can and must be worn when staff are engaged in exceptional work in non-lab areas such as transporting 25 litre drums of waste solvent through the building.

F. Staff wearing a lab coat outside a lab under the variations in (E) above must pay due regard to others using the corridors, etc., and make their safety and concerns paramount. Note:- Lab coats must not be worn when transporting samples and cultures etc through corridors and between labs. This is unnecessary as the transported materials should be double-contained and would therefore not pose a risk to staff or the general public from a spill.

G. Protective gloves for laboratory use must never be worn outside of any laboratory. Gloves are inexpensive and can easily be taken off, disposed of and replaced by fresh ones. Gloves can spread contamination or cause concern that they might be spreading contamination. They are not necessary for the transportation of samples, etc., as these should be double-contained for safe transportation anyway.
Make certain to change gloves frequently and carefully to avoid contaminating yourself, apparatus or lab surfaces. Gloves are also required to protect the skin from UV light sources (*see* Section 5.14). Appropriate gloves must also be selected and used for protection when handling hot materials or glassware (such as when unloading an autoclave). Gloves are also required to protect workers from extremes of cold, for example when loading or removing samples from –70°C freezers and when working with liquid nitrogen (*see* Section 7.9).

5.6.2. Eye Protection

Safety goggles should be worn at all times where there exists a danger of splashes from hazardous chemicals, i.e at ***all times when working in chemistry laboratories***.
Particularly hazardous operations are the mixing or dilution of strong acids and alkalis and the opening of sealed containers, especially those which have been shaken or heated. Contact lenses should not be worn during these operations as they may impede flushing of the eye should a splash occur.
In event of accidents affecting the eye, as a first step the eye should be well douched using the plumbed **eye wash taps** if present. Otherwise, initially use hand-operated eyewash "squirt

bottles" that are located in most laboratories. Because such bottles cannot provide an adequate supply of water, any unaffected workers should plan to move the victim to the nearest eye wash tap once the bottle has been emptied. If an eye wash tap is not available nearby, use an ordinary tap to flush copious amounts of water over the eye. **For subsequent treatment, *see* First Aid, Section 13.**

In situations where hazardous substances may contact the face, a full ***visor*** should be worn. In particular, a UV-protective visor is required when working with unprotected UV light sources (*see* Section 5.14). Face protection should also routinely be worn when re-filling liquid nitrogen tanks and when using a Cryobank (*see* Section 7.9.2).

5.6.3. Masks and Respirators

It is essential to wear a mask or respirator when working with materials or chemicals which may produce dust, as the particles may cause irritation to the airways or produce an allergic response (*see* Section 9.4).

5.6.4. Shoes

It is not normally necessary to wear special protective shoes in laboratories. It is, however, prohibited to wear open-toed shoes, clogs, flip-flops or sandals in any laboratory.

5.7. Centrifuges

The force acting upon a moving centrifuge rotor can be similar to that acting upon a 200 mm shell fired from an artillery gun. An incorrectly loaded centrifuge can move rapidly across a lab if the rotor disintegrates. Rotors can disintegrate if weakened by seemingly minor corrosion. It is essential that users are aware of these facts!

To minimise risks, rotors should be inspected regularly. Owing to accumulated stresses over time, maximum rated speeds of rotors must be reduced as the rotor ages (i.e. the rotor is "de-rated"); manufacturers' documentation should be consulted for advice. Never use a rotor that exhibits any cracks or other visible signs of deterioration.

Loads to be centrifuged must always be carefully balanced. Bottles/tubes must be rated to withstand the centrifugal force, compatible with the solvents employed, and should be inspected before each use to ensure there are no incipient or actual cracks. Note that some tubes require filling to a certain ***minimum*** level for safe use. On the other hand, most tubes can handle only a certain ***maximum*** weight of material. Users should consult the documentation available from tube suppliers/manufacturers.

5.8. Electrophoresis

All electrophoresis equipment should be inspected and tested for electrical safety on a regular basis. Connectors must be of the "shrouded-sleave" variety. Users must never modify equipment in any way that might compromise or defeat its safety features.

5.9. Fume Cabinets

These are principally designed as ***working*** areas and in general should NOT be used for the ***storage*** of chemicals, concentrated acids, ammonia etc. It is permissible, however, to keep

slowly-fuming substances, e.g. fuming sulphuric acid, in those fume cabinets that are permanently switched on.
Experimental operations which are liable to create heat or pressure, or give rise to toxic fumes, should be carried out inside the fume cabinets with the cabinet closed as far as is practicable.
Marks on the fume cabinet frame indicate the level at which the sash should be set to permit a safe inward airflow.
There are a number of free-standing, that is ***unducted***, fume cabinets in the School. Before using these you should check the filter codes in the top left-hand front corner of the fume hood to establish the suitability of the fume hood for the chemicals being used. This can be confirmed by reference to the booklet attached to the apparatus. Some fume hoods have filters for particulate material and are required, therefore, for materials such as acrylamide, silicone, and osmium.
For extended periods of working in fume hoods, ducted cabinets should be used.
Fume cabinets should be tested on a regular basis to ensure adequate air flow. Any problems with the operation of fume cabinets should be reported at once to the Technical Services Manager who will notify Estates of the need for attention.

5.10. Greenhouses

All electrical equipment to be used in the greenhouses must be checked and connected by the College electricians. It is the responsibility of greenhouse users to read and follow manufacturers' instructions when using pesticides.

5.11. Lifting

When lifting moderate loads manually it is important to keep the back straight throughout the lift. Lifting and moving of heavy loads requires skill and proper handling equipment. The ***Manual Handling Operations Regulations 1992*** require that a risk assessment be performed prior to moving loads.

5.12. Pipetting of Fluids

There should be no mouth pipetting of any substance. Always use pipettes fitted with appropriate fillers. To prevent aspiration of hazardous materials into the barrels of automatic pipettors, use aerosol-resistant pipette tips.

5.13. Sonicators

Sonic baths and, especially, probe-type sonicators produce intense and unpleasant sounds that can be damaging to hearing. Such equipment should be enclosed in reasonably sound-proof compartments to limit the sound level. If such enclosures are not available, ear defenders should be worn when using the equipment. In such a case, it is important to ensure that no unprotected workers are present.

5.14. Ultraviolet light sources

Ultraviolet light causes conjunctivitis and more serious damage to the eyes and skin. Special UV-excluding goggles must be worn by anyone exposed to a source but, **most important**, the source must be adequately shielded. The **skin** as well as the **eyes** must be protected for UV light. Users

must take care not to expose lamps if other staff are working nearby without UV protection. Ventilation must be provided for high-intensity sources to remove the ozone which is formed.

5.15. Solvent Stills

Stills, used in the laboratory to provide dry flammable organic solvents, are potentially very hazardous. The safety of the Building and, more importantly, personal safety can be put at risk unless the operation of such stills is carefully controlled.

Remember that hot flammable organic solvent, containing alkali metal or reactive metal hydride, is often separated from water only by thin glass. If, because of breakage, water in the condenser comes into contact with the drying agent in the organic solvent, a major fire and possible explosion will result.

The following rules must be followed when operating a flammable solvent still:

1. The still should be set up in a fume chamber and clamped securely. No other experiments must be carried out in the fume chamber while the still is in operation.
2. The fume chamber must be kept tidy. It must not be used for the storage of other flammable solvents, thus minimising the effects of any fire.
3. The solvent still should be operated with the fume chamber sash fully down.
4. If the still contains drying agent it must be cleaned out regularly, by an experienced person, and the drying agent disposed of safely.
5. Stills containing alkali metals or metal hydrides as drying agents must be labelled appropriately.
6. Hoses providing the water supply to the condenser should be wired/clipped on securely. Preferably, a safety interlock valve should be provided to switch off the electricity supply to the still if the water supply fails.
7. The 13 amp plugs connected to the heating mantles of these stills must be specifically labelled with the words SOLVENT STILLS.
8. **Inexperienced research workers should always seek advice and help before using or cleaning out a solvent still.**
9. Supervisors are urged to consider alternative means of providing dry, oxygen-free solvents and attention is directed to the paper by A.B. Pangborn et. Al., *Organometallics*, 1996, **15**, 1518-1520.

5.16. Noise

Working in a noisy environment can be stressful and a health hazard. If noise is perceived to be a problem, the following strategy should be adopted prior to calling in specialist advice:

1. Identify all significant sources of noise within each affected area.
2. The simplest methods of noise control involve restricting the number of machines in use at any given time.
3. Staff and students using machinery in these areas must be encouraged to take frequent breaks away from the noise. They must also be provided with quiet havens where they can do written work.
4. Ensure that all mechanical sources of noise are part of a planned preventative maintenance programme. Efficient routine maintenance should eliminate drumming and rattling from loose machine parts and high frequency background noise. Some noise may be reduced by improved lubrication.

5. If a machine stands on or is fixed to a hard surface, noise may be transferred through the mounting blocks to the surrounding surface. A possible solution is to insert vibration isolators between mounting points and the operating surface.
The emphasis in this strategy is on cheaper options; however, if these make no perceptible difference to noise levels, it may be necessary to consider the following:
6. An enclosure for either the whole part of the machine, i.e. the source of the noise, to insulate it from the surroundings. This method must take account of the ventilation and exhaust requirements of the machine.
7. Absorption materials, which reduce sound reflection, may be placed on walls, ceiling or floor. It may be necessary to consider placing screens of absorptive material between machines or between machine and operator.

5.17. Miscellaneous Points

• Never leave a lighted Bunsen burner unattended and make sure it is isolated from the bench on a heat resistant sheet. A luminous flame should always be maintained when the Bunsen is not being used for heating purposes.
• The ends of glass rods and tubing should be fire-polished before use. Use a metal sleeve (e.g. cork borer) when inserting tubing, thermometers etc. into bungs.
• **Never** carry Winchesters solely by the neck. Always use an approved carrier.
• It is dangerous to clamp any glass vessel of more than 500 mL capacity solely by the neck. Always support the base.
• Other than Buchner flasks, conical shaped glass vessels should never be pressurized or depressurised. Pressurised glass vessels should be caged or otherwise protected (e.g. wrapped in several layers of cling film). This will counter the effect of explosion or implosion. Evacuated desiccators must be caged. Allow air to re-enter evacuated desiccators slowly. A small piece of filter-paper held over the inlet during the opening of the stop-cock facilitates this.
• Do not leave running water to apparatus unattended without making secure (*see also* Section 4.3). Ensure that all hoses attached to taps have two jubilee clips holding them in place. A strip of coloured tape should be placed at the join of the hose and tap. A gap between tape and hose will indicate slippage of the hose. Cracked or hard hose should be replaced. If running water to waste in a sink always make sure the sink is clear of debris.
• Where tubing is attached to glass fittings, cable ties are acceptable (use two where possible). For push-on joints there should be regular checks for slippage, and on reconnecting hoses the last 1/4 inch should be cut off to ensure a tight fit. Stills should not be run over the weekend (*see also* Section 4.3).

6. RISK ASSESSMENT AND COSHH

6.1. COSHH Requirements

The ***Control of Substances Hazardous to Health (COSHH) Regulations 1994*** require that an assessment of risk must be made ***before work begins*** with chemicals or infectious agents; that exposure to hazardous substances must be prevented or adequately controlled; and that if necessary there must be monitoring of the workplace or surveillance of the health of employees.
These requirements place a particular responsibility on supervisors and/or their designates for the health and safety of people in their charge.

6.2. COSHH Forms

To regulate compliance with COSHH, the College operates a procedure that requires any supervisor, intending to work or intending to give others work with potentially hazardous substances, to complete one of the College's purpose-designed risk assessment forms. The latest version of the COSHH form is available here: http://www.bbk.ac.uk/so/forms/COSHH
All experimental procedures relating to a ***project*** (*see* below for a definition) should be formalised in writing with the potential hazards described in full, and the form signed by the project supervisor. Workers using these procedures are identified on the COSHH form and are asked to initial it to confirm that they have seen the risk assessment.
All staff and students are required to sign a current COSHH form including:

- Research students working here (including MPhil/PhD and Mres students)
- Office staff and research staff whose work is based on computers
- Any visitors who work in the department including visiting studentsand interns

Once completed the original versions of COSHH forms for the department are kept in G54. If you are unsure about which COSHH form(s) you should sign contact your line manager/supervisor in the first instance.

For the purpose of completing the COSHH form, a **PROJECT** may be:
• a whole research programme, including a number of different anticipated stages and experiments, such as a research student or undergraduate project might undertake
• part of such a programme
• a procedure or set of procedures routinely carried out in the School Laboratories
• the preparative procedures undertaken for a laboratory practical class.
Patterns of safe laboratory practice which are described in this ***Safety Code*** need not be detailed on the COSHH form. Relevant text in the ***Safety Code*** may be referred to by citing the corresponding Section numbers in the latest edition of the ***Code***. Please consider the following with respect to COSHH forms:
• Forms should be prepared ***as and when new projects are initiated***, i.e. throughout the year rather than just prior to any audit of forms.
• A completed COSHH form, is ***renewable annually*** so long as the work to which it relates continues.
• The COSHH form must be revised where unanticipated changes in a project occur ***prior to the regular annual renewal*** of the COSHH form.
• Copies of the COSHH forms should be stored in an accessible place – preferably in the laboratory in which the project work is normally undertaken – so that they may be consulted by workers as required. The School Safety Coordinator may require that project supervisors regularly submit copies of their COSHH forms for record-keeping purposes.

6.3. Projects Involving Genetic Modification

The following is excerpted from the ***College Code of Practice for Work in Genetic Modification Laboratories***:

"All members of staff or their students who intend to carry out genetic modification experiments for the first time should, before commencing work or obtaining genetically modified material from other laboratories, ***inform their Departmental Genetic Modification Safety Officer*** (DGMSO). He/she will assist in the preparation of a submission to the College's Genetic Modification Sub-Committee whose prior approval is required before any work is undertaken."
For further definitions and advice, please contact the School Genetic Modification Safety Coordinator and the ***College Code of Practice for Work in Genetic Modification Laboratories***, which can be found on the Safety Office web site: http://www.bbk.ac.uk/so/policies/#G

6.4. Health surveillance

It is a requirement under the COSHH regulations that staff exposed to a substance hazardous to health be subject to health surveillance. All workers exposed to biological materials capable of generating allergic responses are required to complete a confidential Pre-Employment Health Surveillance Questionnaire prior to commencement of work and to complete an annual Follow-up Questionnaire subsequently. The questionnaires are submitted to the Personnel Officer, and the annual follow-up must take place no later than the end of the third week of the Summer Term. If you have participated in COSHH-regulated health surveillance, you are required to complete a follow-up questionnaire for a full session after the end of your monitoring, if you are still a College employee. The completion of health surveillance questionnaires is ADDITIONAL to inclusion on the appropriate COSHH form.

7. CHEMICAL HAZARDS

Because of the limited scope of this document, only general guidelines pertaining to commonly used and/or mis-used chemicals can be given here. It is the responsibility of each worker to discover the potential hazards of chemicals he or she is going to use ***before they are purchased***. The Merck Index and/or Material Safety Data Sheets (often available on the company website) are good sources of information. Chemical catalogues (e.g. Aldrich, BDH, Fluka) list the hazardous properties of the compounds they provide, and some publish collections of this information. More detailed information can be obtained from reference books: L. Bretherick "Handbook of Reactive Chemical Hazards", and N.I. Sax "Dangerous Properties of Industrial Materials". On receipt of an order, you will also receive a copy of the Material Safety Data Sheet (MSDS), which will contain safety information on the chemical. In cases of doubt, exercise added caution: restrict contact to yourself and others by the use of fume cupboards and by wearing safety clothing.

In writing a specific risk assessment to cover the handling of very toxic or otherwise dangerous substances, the following points should be covered:
(a) Details of the experiment.
(b) The hazards involved.
(c) Quantities involved - should be reasonable, considering the hazards involved.
(d) Safe storage of hazardous substances - a lockable cupboard marked POISON is necessary for S1 poisons.
(e) Precautions to protect the research worker. Personal protective equipment, primary and secondary lines of defence (e.g. fume chamber **plus** facemask), should be included.
(f) Precautions to protect others.
(g) Disposal of waste materials - safe methods should be detailed.
(h) Emergency procedures.

7.1. Prohibited Chemicals

The ***Control of Substances Hazardous to Health Regulations 1994*** PROHIBITS the use of:
• 2-naphthylamine
• benzidine
• 4-aminodiphenyl
• 4-nitrodiphenyl
• their salts, and any substance containing any of these compounds in a total concentration exceeding 0.1%.
A list of substances for which maximum exposure limits have been assigned can be obtained from the College Safety Officer.

7.2. Procurement of Chemicals

All purchases should be made via the appropriate lab manager. Chemical orders will be recorded and Material Safety Data Sheets are normally sent with purchased chemicals and passed on to the purchaser. Special arrangements (licenses, etc.) may be necessary for the procurement, use and/or storage of certain chemicals. Radioactive materials requiring legal registration and authorization **must not be ordered** as the College is no longer registered or authorised to hold, use or dispose of radioactive materials such materials. Consult the College Radiation Protection

Adviser **before** ordering any radioactive materials that are exempt from registration and authorization or unsure of their status.

7.2.1. Transport of Chemicals

If it is necessary to transport chemicals out of the College, this must be included in the risk assessment, and consideration given as to the most appropriate method. It may be necessary in some circumstances to send chemicals via an appropriately licensed courier.

7.3. Storage and Labelling of Chemicals

Storage of chemicals in laboratories is essential if work is to proceed efficiently. However, if poor working habits allow the number of chemicals to rise above a safe limit, or to clutter working areas, the chances of accidents occurring are much increased. The aims of all persons working in laboratories should be as set out below.
1. To ensure that only those chemicals needed for the project in hand are kept in the laboratory, that there is sufficient safe storage to accommodate them, and it is so arranged as to minimize hazards caused by accidental spillage or breakage.
2. To return all chemicals to their rack, or other storage, immediately after use.
3. To ensure that all containers are correctly labelled to show their contents.
4. To ensure that all empty containers (including gas cylinders), surplus chemicals, and waste solvents are promptly removed, and disposed of.
5. In general, to ensure that the laboratory in which they work is kept clean and tidy.
All chemicals and solutions for storage must be properly labeled with chemical name and date of preparation (*see also* Section 10.6 re: fridge/freezer storage). Certain chemicals must NEVER be stored together or combined in mixtures. A list of some common **incompatible chemicals** is given in **Appendix A**.
The notes below give a more detailed guidance on aspects of the above.

General. Only the minimum of chemicals required should be kept in the laboratory. Unless required for immediate use, not more than one bottle of each chemical should be kept. The bottle racks above the benches are best suited to bottles of up to one litre (or one kilogram) capacity. Other containers can be stored in the underbench cupboards or in suitably designated areas on the floor. Be careful to store chemicals which might react with each other apart, in case of accidental breakage. Bottles containing concentrated acids should always be kept in drip trays.

Flammable Solvents. The law requires that these are kept in metal containers of approved design. Flammable solvents may be kept in laboratories only in these cupboards, from which it follows that you must not have more bottles than there are storage spaces. Bottles must always be in the containers or cupboards except while actually being used.

Poisons. By law, certain poisons, including cyanides and arsenic-containing compounds, must be kept in a locked cupboard. Common examples of such poisons are given in Appendix C. A list of the contents should be kept inside the cupboard and the additions and withdrawals noted therein.

Offensive Toxic Chemicals must be stored in a fume cupboard or vented cabinet. If stored in a fume cupboard, the number kept must not be so great as to make it difficult or dangerous to carry out chemical manipulations therein.

Heat-sensitive Materials should be kept in a deep freeze or refrigerator as appropriate. If flammable or explosive materials are involved, a flashproofed model should be used (it should be so marked on the door).

It is dangerous to store such materials in a non-flashproofed refrigerator.

Labelling. All chemicals kept in laboratories should be labelled clearly as to content. This is **most** important.

It is vital that **all** containers of chemicals are clearly labelled; that loose and defaced labels are replaced; and that where necessary the labelling conforms with the EU regulations (The Classification, Packaging, and Labelling of Dangerous Substances Regulations 1984), (it is not usually necessary to obey these to the letter unless material is to be sent outside the School). Within the School the following information should be given on a label for safety reasons:

the chemical name of the contents, the name of the person who made it or bottled it, the name of his supervisor/affiliate, and the date it was bottled. Any known hazards should also be noted.

It is particularly important that any samples placed in refrigerators should be fully labelled and no samples should be stored in a refrigerator indefinitely. Re-labelling of bottles for the storage of different chemicals is potentially hazardous. A recent accident at UCL was caused because a bottle which originally contained isopropyl alcohol had been refilled with water. The bottle had been re-labelled, but only by writing on the original label using a marker pen. This had been washed off by solvent spray, with the result that water was added accidentally to sodium metal in the belief that isopropyl alcohol was being added.

If bottles are re-used for different substances, the old label must be completely removed and replaced, or the old label must be completely and securely covered by a new label.

Never leave any sample, particularly an unlabelled one, that has to be disposed of by someone else at a later date.

7.3.1. Absolute Alcohol

This is purchased on licence by the College and stored securely in the basement bonded store. Only minimum quantities essential for routine use should be left on open benches.

7.3.2. Acids

It is advisable that only limited quantities be kept in laboratories in appropriately labelled (corrosive!) metal cabinets. ***Formic acid*** slowly decomposes to carbon monoxide and gas pressure can be sufficient to rupture a sealed glass container; modern containers incorporate a degassing valve.

7.3.3. Flammable Liquids

These must not be stored in non-spark proof refrigerators. Winchesters of flammable liquids must be kept in appropriately labelled (flammable!) metal cabinets. A reserve solvent store is located outside the Rayne Wolfson laboratory in the Extension Building basement.

7.3.4. Poisons

Poisons must be stored in a locked cupboard with an inventory inside. Ensure that newly purchased poisons are correctly labelled and added to this list. Toxic chemicals should be kept out of view.

7.4. Noxious, Toxic, Carcinogenic or Mutagenic Chemicals

Operations involving the use of such substances should be carried out in a fume cabinet, as should spraying procedures, e.g. those used in paper or thin-layer chromatography. Make certain that you use a cabinet suitable for the intended purpose. This and the effective working opening are indicated on each fume cabinet.
Dusts arising from chemicals can be toxic or allergenic. The risks of exposure are minimised by working in a fume cupboard or by wearing a mask (*see also* Section 5.6.3). The silica often used in thin-layer chromatography are like asbestos in that they are lung irritants or worse. Spent chromatography materials must be packed in sealed bags before disposal.

Toxic Chemicals
Scales which are quoted for toxicity are the TLV (threshold limit value), which is the concentration of a chemical to which people may be repeatedly exposed without adverse effects, and the LD50 or LC50 which is the dose given orally, or breathed as a concentration in air, that is lethal to 50% of rats. Common toxic substances include alkaloids, aromatic amines, arsenic and its compounds, asbestos, beryllium, bromine, carbon monoxide, carbon tetrachloride, cyanides and hydrogen cyanide, diazomethane, dimethyl and diethyl sulphate, hydrogen halides, hydrogen sulphide, lead compounds, mercury and its compounds, metal carbonyls, osmium compounds, phosgene, pyridine, sulphur dioxide, and thallium compounds.
Highly toxic compounds (e.g. cyanides, thallium compounds) should be kept in a locked cabinet, and an inventory kept of their use.
Any research worker who needs to use a compound that is known to be very toxic (e.g. inorganic cyanide, arsenic or thallium compounds, or alkaloids such as strychnine), must consult the School Safety Coordinator and the College Health and Safety Officer, who will authorise its use, provided that the use of the chemical is covered by an adequate Risk Assessment. The chemical must then be kept in a locked cupboard marked POISON. A list of S1 poisons is attached (Appendix C).

Carcinogens, Mutagens, Teratogens
Research workers wishing to use known or suspected carcinogens must consult their supervisor or staff associate before starting work. Such substances must always be handled in fume cupboards or in closed containers. Vessels containing them must be clearly labelled **cancer inducing** and after use must be thoroughly washed and kept separate from other equipment. Persons using such compounds must wear gloves and other appropriate protective clothing and must ensure that all clothing is properly disposed of or cleaned if it becomes contaminated.
The College reserves the right not to allow use of certain compounds on safety grounds.
An MRC list of known carcinogens is attached (Appendix B). Please bear in mind that it is not exhaustive.

7.5. Highly Reactive Chemicals

A variety of compounds are particularly corrosive, or may react violently with other reagents. Protective gloves, as well as glasses and laboratory coats should be worn. If corrosive compounds come in contact with the skin, they should be washed off with copious amounts of water then medical aid should be sought.

7.5.1 Acids and Alkalis
Strong Acids (hydrochloric, hydrobromic, hydrofluoric, sulphuric, nitric, perchloric, trifluoroacetic) are very corrosive, and sulphuric acid can react violently with water. Hydrofluoric

acid should be handled only according to the special instructions and the special first aid kit must be at hand. Nitric acid should never be allowed to mix with organic solvents, particularly ethanol and methanol with which it reacts violently after a short period. Perchloric acid can cause wood and other organic materials to inflame; the bottles should be kept in glass or ceramic dishes, and the acid should be only used in designated fume cupboards. Concentrated acids should always be added slowly to water with stirring to water. NEVER add water to acids. If spilled, acids are best cleaned up by using spillage granules. Cover the spillage with the granules and, after total absorption, sweep up granules and dispose of in the normal way. If granules are not available, the spilled acid should be neutralised with solid sodium bicarbonate.

Strong Bases (sodium hydroxide, potassium hydroxide, calcium oxide) are corrosive. They react exothermically with water, and particularly with acids. Sodium amide and sodium hydride are similarly reactive and corrosive, and further liberate large volumes of gas. The alkali metals react with water and other protic reagents, often violently. The reactivity increases greatly in the sequence lithium < sodium < potassium. This causes a fire hazard, and may eject the strongly caustic metals or hydrolysis products. Strong solutions of ammonia ("880 ammonium hydroxide") are caustic and the vapour can be overwhelming. The bottles may be under pressure and should be opened cautiously in a fume cupboard. Special instructions should be followed if liquid ammonia is to be used as a solvent. If spilled, alkalis should be neutralised with acetic acid (no stronger than half-concentrated) before sweeping/wiping the affected surface.

7.5.2 Metal Halides and Hydrides

Metal Halides. Some metal halides such as BBr_3, $AlCl_3$, $SnCl_4$, $TiCl_4$ and $SiCl_4$ may be hydrolysed explosively if they come into contact with water.

Metal Hydrides. Some metal hydrides, in particular sodium hydride, lithium hydride, and lithium aluminium hydride react violently with water and other protic reagents, liberating large volumes of hydrogen. Particular care should be taken when destroying the excess of lithium aluminium hydride after a reaction. A number of explosions related to the use of lithium aluminium hydride have been reported. Extreme care should be exercised when heating any mixture containing $LiAlH_4$. Except in special circumstances, such mixtures should never be heated above 70°C and, even then, an oil bath must be used to avoid "hot spots".

In general, calcium hydride is an adequate and much safer alternative to $LiAlH_4$ for drying solvents.

7.5.3. Explosives

The quantities used in experimental work must be kept to a minimum. Explosion of even 0.1 g of material can do serious damage. Safety screens and protective equipment must be used.

Acetylene and Acetylides: Acetylene gas is explosive under high pressure, and is supplied in cylinders in which it is dissolved in acetone adsorbed on kieselguhr. Advice should be sought if you wish to use such cylinders. Terminal acetylenes (alkynes) form acetylide salts with heavy metals which are dangerously explosive and acetylene gas should not be allowed to come into contact with metallic copper or copper alloys.

Azides: Hydrazoic acid and many metal azides (excluding sodium azide) are very sensitive explosives. Silver azide may be formed in silvering solutions containing ammoniacal silver nitrate.

Azo and Diazo Compounds: Azo and diazo compounds are usually explosive and should be treated as such. Diazomethane, which is a yellow gas, is explosive as well as highly toxic.

Chlorates and Perchlorates: The alkali metal salts are not explosive, but salts of heavy metals, or salts of metals carrying organic ligands, or mixtures of perchoric acid with organic compounds

may be sensitive to shock or heat. Perchloric acid is issued only on the signature of the DSO or his deputy. See also Section 7.17.
Ethers: Diethyl ether, dibutyl ether, diisopropyl ether, dioxan, and tetrahydrofuran each react with aerobic oxygen to form peroxides which accumulate in the residues of a distillation and may then explode. Never leave partially filled bottles of these solvents for a long period. Never distil solutions in these solvents to near dryness. Put the date on the bottle when it is opened, and dispose of the contents within one year.
Nitro Compounds: Nitro compounds such as trinitrobenzene and picric acid should be kept wet. The complexes which picric acid forms with compounds such as aromatic amines may be explosive when dry.
Peroxides: Concentrated aqueous hydrogen peroxide may decompose violently in the presence of some metal ions. Hydrogen peroxide forms explosive solutions or mixtures with many organic solvents, and the concentration of hydrogen peroxide in organic solvents should never be allowed to exceed 20% w/w. Organic peroxides are potentially explosive, particularly when the ratio of C and H to O is low. These compounds should be handled on only a small scale. Benzoyl peroxide, which is used as an initiator for polymerisation and for brominations by *N*-bromosuccinimide, should be kept damp.

7.5.4. Highly Flammable Chemicals

The special danger here is from **volatile solvents** with low flash points (the lowest temperature at which the vapour will ignite). Safety carriers must be used for transporting Winchesters of solvents. Diethyl ether, pentane, and light petroleum b.p. 40-60˚C are particularly hazardous, and their vapours can be ignited by a hotplate or heating mantle. Carbon disulphide must be handled only in the fume cupboard: it is toxic, and the vapour can be ignited by a hot electric light bulb or steam pipe. Follow the usual precautions of not working alone, having a fire extinguisher close to hand, clearing the work area of anything else flammable, and giving the experiment your continuous undivided attention. When any highly flammable chemical is involved, if at all possible, do the experiment in a fume cupboard.
Finely Divided Metals, such as Raney nickel, may be pyrophoric or may cause adsorbed solvents to ignite. This is a special hazard when carrying out catalytic hydrogenations and when disposing of the used catalyst. Follow the special instructions for these reactions.
Organometallic Compounds , such as butyllithium or trimethylaluminium, may ignite if they come in contact with air and should be handled only in the presence of a second person who is accustomed to handling them. Any fires should be tackled with a dry powder extinguisher, or smothered with dry sand.
Sodium and Potassium react violently with water and are very common causes of fire. They should be disposed of by the method described in Section 8.2.1.

7.6. Acrylamide

Acrylamide, commonly used in electrophoretic procedures, is a neurotoxin with cumulative effects and in addition may be carcinogenic. Extreme caution should be used when handling this chemical, particularly in its unpolymerised state. ALWAYS wear gloves when handling acrylamide. Weigh the solid material in a fume cabinet and wear a dust mask. If any of the chemical is spilled, mop up carefully with a moist paper towel, place the paper towel in a small plastic bag, and discard in the laboratory waste (small quantities only!). After adsorbing the acrylamide, wash thoroughly the surface on which it was spilled. To minimise the risk of exposure, it is advisable to never work with the most-dangerous crystalline form, especially as liquid acrylamide preparations are commercially available (and are very convenient to use). An

even safer approach is to purchase pre-cast acrylamide electrophoresis gels, although this can be rather expensive.
To dispose of excess acrylamide powder or solution (i.e. when it has passed its use-by date) polymerise it and discard the solid gel that forms, taking care to first wrap this in a plastic bag prior to disposal in the laboratory waste. When polymerising the acrylamide, take note that this process can generate a reasonable amount of heat, especially if the concentration of acrylamide is >10%, w/v. It is therefore advisable to use Pyrex glassware.

7.7. Ethidium Bromide

Ethidium bromide (EtBr) is a powerful mutagen, widely used in laboratories for visualizing nucleic acids. It is harmful by inhalation, ingestion, and skin absorption and should be handled only when wearing rubber gloves and non-vented chemical goggles with work being done in a chemical fume hood. It is also irritating to the mucous membranes and the respiratory tract. Handle EtBr with extreme care! To further minimise the risk of exposure, it is recommended that crystalline EtBr is NEVER purchased; tablets or pre-made solutions are much safer and more convenient. If EtBr is spilled, it should be adsorbed using paper towels and the contaminated paper bagged separately and discarded with other hazardous waste. In electrophoresis/staining of nucleic acids, waste buffers may become contaminated with EtBr. This may be disposed of by washing down the sink with copious quantities of water to ensure adequate dilution.

7.8. Fixatives, Resins, etc.

These substances are used in various types of histological and cytochemical work; particularly noted here are hazardous chemicals used in electron microscopy.

7.8.1. Fixatives - HAZARDS

Some examples are given.
Primary fixatives
• Sodium cacodylate - contains arsenic and liberates it when in contact with acids.
Arsenic is poisonous (TLV 0.2 mgm^{-3}) and accumulates in the body.
• Formaldehyde - (possibly carcinogenic in its own right) forms a carcinogenic gas on exposure to hydrochloric acid.
• Glutaraldehyde - harmful due to cross-linking of proteins.
Secondary fixatives
• Osmium tetroxide - toxic and highly volatile, cross-links proteins, affects the eyes, lungs and skin.

7.8.2. Fixatives - PRECAUTIONS

Fixatives must be weighed out, prepared, dissolved and pH-adjusted in a fume cabinet. Osmium tetroxide should be bought in sealed glass ampoules as the 2% pre-prepared solution. Disposable gloves, laboratory coat and gas-tight goggles must be worn when using this chemical. Alcohol should be available to neutralise spills of osmium tetroxide solutions. Fixative solutions should be stored in a working fume cupboard in robust containers with tightly fitting caps. Waste solutions containing osmium should be reduced with excess alcohol in a robust container with a screw cap lid prior to disposal in the same way as other flammable solvents. Primary fixatives should be disposed of down a sink which connects directly to the sewer.

7.8.3. Resins - HAZARDS

These fall into three broad groups: epoxy, polyester and acrylic. The hazards associated with the use of resins include: carcinogenesis, primary irritancy, systemic toxicity, environmental pollution and fire. Resin blocks that are not fully polymerised present a particular hazard. Data can be accessed on the internet outlining the relative toxicity of resins, hardeners and cross-linking agents used in electron microscopy and should be consulted.

7.8.4. Resins - PRECAUTIONS

Resins should be stored in tightly capped, unbreakable bottles in a well-ventilated area. It is essential to handle these substances in a fume cupboard in the absence of naked lights and to ensure that ovens for curing, etc. are vented to the outside. All vessels, pipettes and gloves should be disposable (discard in a heavy-duty polythene bag) to avoid cross-contamination and the need for washing up. Waste resin containers should be available to store excess resin prior to polymerization. Work should be carried out on an impermeable surface and spills absorbed with sand or vermiculite and then polymerized. Resin blocks should be sawed in a fume cabinet and dust washed down the sink with excess water.

7.8.5. Propylene oxide

This chemical has a low flash point (37°C), is toxic, and is a suspected carcinogen. A fume cabinet, disposable gloves, and eye protection must be used. Propylene oxide produces an explosive, exothermic reaction with phosphotungstic acid. It therefore must never come into contact with this chemical (either by exposure to blocks stained with or tissues contaminated by phosphotungstic acid) or be stored in the same fume cabinet with it (*see* **Appendix A**: **Incompatible Chemicals**, for a list of other incompatible chemicals).

7.8.6. Stains - HAZARDS

Particularly hazardous stains include:

- Lead citrate
- Uranyl acetate
- Phosphotungstic acid
- Toluidine Blue
- Methylene Blue

These are toxic variously by ingestion, dust or mist inhalation and absorption through the skin.
Uranyl acetate gives off beta and some gamma radiation. For phosphotungstic acid see propylene oxide above (and refer to Appendix A).

7.8.7. Stains - PRECAUTIONS

Solutions should be made up in the fume cabinet using eye protection and disposable gloves. Spills should be contained in a tray. Uranyl acetate should not be allowed to dry before disposing or cleaning of glassware which should be done in the sink in the radiochemical lab which leads directly to the sewer. Lead citrate must not be disposed of down the sink, but as for other nonflammable hazardous wastes.

7.9. Liquid Nitrogen

Liquid nitrogen (liquid N_2) presents a number of significant hazards. A **College Code of Practice for the Safe Use of Liquid N_2** has been published (*see* the Safety Office web site, http://www.bbk.ac.uk/so/policies/liqn2). Much of what follows has been borrowed from this document.

7.9.1. Liquid Nitrogen - Hazards

The most important hazards include:

• Liquid N_2 can cause severe frostbite and cold burns. Never put any part of your body in front of a liquid N_2 supply. Never touch an uninsulated pipe or vessel containing liquid N_2; the cold metal may stick fast and tear the flesh when you attempt to withdraw from it. Safety glasses and appropriate gloves (see below) must be worn when handling liquid N_2.

• Liquid N_2 boils off very quickly. Because of the pressure so-generated, this precludes storage of liquid N_2 in tightly closed containers. Glass may shatter spontaneously if placed in liquid nitrogen.

• Liquid N_2 can rapidly be converted into gas at 700 times the liquid volume. It may then kill by asphyxiation. When the oxygen concentration in the air is sufficiently low, a person can become unconscious without first experiencing dizziness or other warning symptoms. Special care must be taken to avoid release of liquid N_2 in confined spaces, including lifts (*see* Transport, below).

7.9.2. Liquid Nitrogen - Precautions

Avoid risks by using liquid N_2 only when absolutely necessary; i.e. use solid CO_2 instead, if possible. Systems which are open to the air should never be cooled in liquid nitrogen, since the condensation of oxygen from the atmosphere can cause serious explosions. Explosions can also occur in tightly sealed containers. Always handle liquid N_2 in well-ventilated areas to prevent excessive concentrations of gas.

Take great care to avoid spills. Note: The cloudy vapour that appears when liquid N_2 is exposed to the air is condensed atmospheric moisture, not the gas itself. Users of Cryobanks must always were faceshield and gloves, use an allotted canister, and cryosleeves over canes to protect against explosion.

All rooms where volumes in excess of 25 litres of liquid N_2 are held should be equipped with oxygen monitoring. The sensors have a life of only 12-18 months. Systems in continuous use must be checked monthly and the results recorded. Systems not in regular use and only used for short periods should be tested before use each time. One or more members of staff must be appointed to carry out these tests.

Containers. Liquid nitrogen should always be used and stored in an insulated container/vacuum flask/Dewar flask to prevent overactive boiling. Glass Dewar vessels may shatter violently, projecting sharp glass fragments. The Dewars must be thoroughly bound with protecive tape, or better, be secured in a strong container. The container should have a loose fitting cork or expanded polystyrene bung to prevent explosion. Do not put liquid N_2 in vessels that cannot withstand the intense cold and pressure. Thermos flasks designed for food/beverage storage are NOT safe containers for liquid N_2! For storage of biological samples in liquid N_2, use only appropriate cryovials/tubes (i.e. not ordinary microfuge tubes!). Cryovials can explode on removal from liquid N_2 storage as it boils off inside the vial; punch holes in the caps of vials before use to permit the gas to vent.

Gloves. Insulating gloves and safety glasses ***must*** be used when handling liquid N_2, solid CO_2, or anything that has been cooled by it. Employ only gloves specifically designed for cryogenic use. These will have close fitting, ribbed cuffs to prevent liquid N_2 from entering and collecting inside

the glove. The surface of the gloves should be textured to provide a sure grip on cold, slippery surfaces. Use plastic rather than metal forceps to handle cryogenic material.

Decanting. TWO people must be involved in the transfer of liquid nitrogen from the 50L Dewar to smaller Dewar flasks. Never overfill a Dewar. Be sure to leave sufficient headroom to replace lids/tops on storage containers, especially for lids that insert a considerable distance into the vessel. Take care to avoid spills and splashes which may damage surfaces (or you!) and can set off oxygen monitors. Moving Dewars away from the oxygen monitors before topping up and taking care to minimise splashing will prevent alarms being set off unnecessarily.

Transport. Only use closed "onion" (25 litre) Dewars and "transport" Dewars when moving liquid N_2. Use special care when transporting liquid N_2 or solid CO_2 in a lift, as any release in such a confined space produces a risk of asphyxiation to any lift occupants. To avoid such risk altogether, use the following transport procedure:

• Always work in pairs.

• Use the Goods lift whenever possible. If the Main lift must be used then it must only be used between ground and basement level. This will avoid the lift being stopped and entered by a member of the public at other floors.

• One person should send and another should be waiting to receive the Dewar at the floor destination. No one should accompany the Dewar in the lift.

Therevis also a College wide policy on liquid nitrogen that is mandatory to follow: http://www.bbk.ac.uk/so/policies/liqn2

7.9.3. Liquid Nitrogen - First Aid

In the case of skin/eye contact, immediately flush thoroughly with water for 15 minutes. In case of frostbite spray with water for at least 15 minutes, apply a sterile dressing obtain medical assistance.

7.10. Mercury

Poisoning can result from breathing mercury vapour. Mercury is a virulent poison that is readily absorbed through the respiratory tract or through unbroken skin. It acts as a cumulative poison since the element is eliminated from the body only very slowly. The present accepted threshold limit for mercury in air is 0.05 mg m^{-3}. (N.B. air saturated with mercury vapour at 20 ºC exceeds the toxic limit by 100 times.) High concentrations of vapour may cause a metallic taste, nausea, abdominal pain, vomiting, diarrhoea and headache. Chronic effects from continual exposure to small concentrations can cause severe nervous disturbance, insomnia, loss of memory, irritability and depression. Mercury should normally be handled in a fume chamber and gloves should be worn. Apparatus containing mercury should be placed in a tray, so that any spillage is contained. Spilled mercury rapidly develops a film of grease and dirt which reduces the vapour pressure, but this film is readily broken by vibration. Any spillage of mercury should be cleaned up immediately. A small aspirator fitted with a capillary tube and connected to a water pump or the house vacuum can be used for sucking up droplets. Mercury spilt into floor cracks can be made non-volatile by putting zinc dust down the cracks to form the amalgam. Smooth surfaces may be decontaminated by scattering and sweeping up a mixture of equal weights of zinc dust and dry sand or sawdust, which should then be disposed of as toxic waste.

Mercury Checklist

• Mercury must only be transported in small quantities in **plastic containers** (glass bottles are unsuitable because breakages will result in spillage over a large area).

• Always handle mercury in a well-ventilated area and in a suitable plastic tray (mercury may react with a metal tray or may be absorbed into a porous material e.g. wood). Do not breathe the vapour.
• Avoid skin contact, wear disposable gloves. Wash hands thoroughly after using mercury, especially before eating, drinking or smoking, to avoid ingestion.
• Use secondary containment on all apparatus containing mercury, (e.g. manometers and McLeod gauges). Take care with mercury in glass thermometers.
• The exhaust from vacuum pumps on systems containing mercury must always be vented either to the outside or into a fume cupboard (this is good practice for all vacuum pumps in any situation).
• Clear up all spills immediately.
• Mercury **compounds** are also highly toxic.

7.11. Poisonous Gases

When experiments involving poisonous gases are contemplated, seek the help of the College Safety Officer, who will be able to advise on safe working procedures and respirators.

7.12. Radiochemicals

Radioactive materials requiring legal registration and authorization **must not be ordered** as the College is no longer registered or authorised to hold, use or dispose of radioactive materials such materials. Consult the College Radiation Protection Adviser **before** ordering any radioactive materials that are exempt from registration and authorization or unsure of their status.

7.13. Solvents

It is important to minimise exposure to volatile organic solvents. This is especially important if the worker has an infection such as a sore throat because it increases the risk of kidney disease (glomerulonephritis) occurring as a rare complication following throat infection by the bacterium *Streptococcus pyrogenes*. Some solvents present special hazards because of their flammability or toxicity. They include:

7.13.1. Acetonitrile
Commonly used in HPLC, acetonitrile is highly flammable and is toxic by inhalation, in contact with the skin and if swallowed. Care should be taken to minimise the escape of vapours from solvent bottles attached to HPLC apparatus. This can be achieved by using special bottle caps with air-tight passages through which the tubing may be threaded.

7.13.2. Benzene
This is a chronic poison if the vapour is inhaled in small quantities over long periods and it is also a carcinogen. Benzene can also be absorbed through the skin. Toluene is a possible alternative solvent which is less toxic.

7.13.3. Ether
Because of its extreme flammability and the ease with which its heavy vapour travels along benches and floors, ether should be poured in a fume cupboard. Diethyl ether and some other ethers are also hazardous in that they tend to form highly explosive peroxides on contact with air

in the presence of sunlight. It is recommended that procedures involving the use of ethers should be completed as quickly as possible. It is not permissible to store bottles of ether for long periods, particularly if they are only partially filled.

• Suspect ether should be treated with caution and tested for the presence of peroxides before use.

• Never store any ether in bottles other than of dark glass and never with ground glass stoppers. The distillation of ether-containing mixtures must be taken to dryness.

• Di-isopropyl ether may not be brought onto College premises without the consent of the College Safety Officer.

• Tetrahydrofuran and Dioxan are both ethers and must be treated as such.

7.13.4. Halogenated Hydrocarbons

Chlorinated hydrocarbons such as chloroform and carbon tetrachloride produce highly toxic vapours. Mixing of halogenated hydrocarbons with acetone and other similar compounds should be avoided, as this may cause violent reactions. Chlorinated hydrocarbons (nonflammable) are disposed of separately from other solvents (flammable) to avoid this hazard.

7.13.5. Methylene chloride (Dichloromethane)

This solvent can often be used instead of diethyl ether, so avoiding many of the above mentioned hazards. Though a halogenated hydrocarbon, methylene chloride is exceptional in having a relatively low toxicity. It is often therefore a safer solvent of choice and substitutes well not only for chloroform but for benzene and other aromatic hydrocarbons.

7.14. Cyanides

As little as 50 to 150 mg of cyanide salts can cause death. Poisoning can occur by inhalation of mists of cyanide solution and by inhalation of HCN produced by the reaction of metal cyanides with acid and with water. Symptoms of non-lethal poisoning include weakness, headache, dizziness, rapid breathing, nausea and vomiting. These compounds are not regarded as having good warning properties! Training in the safe handling of cyanides is absolutely essential before these materials are used. If in any doubt, consult your supervisor. The HSE first aid procedures for suspected exposure to cyanides are reproduced below.

Cyanide in contact with skin

1. Drench the affected area with clean running water for at least 10 minutes and until no chemical remains in contact with the skin. Use soap if the substance is oily.
2. Remove contaminated clothing, provided it is not stuck to the skin, as soon as practicable after commencement of washing.
3. If there is any injury or if skin absorption is suspected treat as follows.

(a) Administer oxygen, if available.

(b) Keep casualty warm and at rest.

(c) If casualty has stopped breathing, start artificial respiration - **not** mouth to mouth – using oxygen and a suitable mechanical device such as a bag and mask.

4. Transport casualty to hospital.

Cyanide in contact with eyes

1. Flush the eye with clean running water for at least 10 minutes.
2. Administer oxygen, if available.
3. Keep the casualty warm and at rest.
4. If casualty has stopped breathing, start artificial respiration - **not** mouth to mouth - using oxygen and a suitable mechanical device such as a bag and mask.
5. Transport casualty to hospital.

Cyanide swallowed

1. Do not give anything by mouth.
2. Administer oxygen, if available.
3. Keep the casualty warm and at rest.
4. If casualty has stopped breathing, start artificial respiration - **not** mouth to mouth - using oxygen and a suitable mechanical device such as a bag and mask.
5. Transport casualty to hospital.

Cyanide inhaled

1. Remove the casualty from exposure, **provided there is no risk to yourself.**
2. Administer oxygen, if available.
3. Keep the casualty warm and at rest.
4. If casualty has stopped breathing, start artificial respiration - **not** mouth to mouth - using oxygen and a suitable mechanical device such as a bag and mask.
5. Transport casualty to hospital.

Cyanide Checklist

- Metal cyanide salts and the more toxic organic cyanide salts must not be stored on open shelves in the laboratory. They should be kept in a locked cupboard labelled POISON.
- A Special Risk Assessment must be completed and approved by the School Safety Coordinator and the College Health and Safety Officer before any new use of these materials.
- Procedures involving these materials must never be attempted by an untrained person.
- Procedures involving these materials must never be attempted out of normal working hours.
- Procedures involving these materials must never be attempted by someone working alone and, for larger scale operations, workers should operate in pairs.
- All operations, including weighing material, must be carried out in a fume hood.
- Appropriate personal protective equipment, i.e. impermeable gloves, lab coat and safety glasses, must be worn.
- A container of 10% w/v aqueous ferrous sulphate solution must be kept at hand for the immediate immersion of all equipment which has contained or contacted this material (paper, spatulas etc.) and for disposing of small spills.

7.15. Hydrogen Fluoride (Hydrofluoric Acid)

Hydrofluoric acid has a number of properties which make handling particularly difficult. HF attacks glass, concrete, most metals and organic compounds. HF damage to the body causes **long term pain** and burns which are slow to heal. Burns around the finger tips are reputed to be particularly painful and may require the surgical removal of finger nails. Fluoride ions are both acutely and chronically toxic so that even 1% solutions of HF (or metal fluorides) must be handled with care. The ability of HF to carry fluoride ions through intact skin increases greatly with increasing concentration. Above 10% concentration, the dangers of handling HF increase sharply and any contact with the skin for more than a few seconds can result in latent burns which may take hours before they start to cause pain. Manufacturers commonly supply HF as a 48% (28M) aqueous solution and sometimes as a 73% (44M) solution. Handling HF at these concentrations is **far more dangerous** than handling any other common concentrated acids.

HF Checklist

- Hydrofluoric acid of >10% (5M) concentration must be stored in a cool, well-ventilated area in a screw-capped polyethylene (or equivalent) container. It is inadvisable to keep such acid at all in a laboratory unless an appropriate COSHH assessment covering its possible use by each of the workers in the laboratory has been made.

- A detailed COSHH Risk Assessment must be completed and approved by the School Safety Coordinator and the College Health and Safety Officer before any use is made of hydrofluoric acid. Even if only dilute (5%) acid is to be used, the assessment must define how the commercially-available concentrated acid is to be diluted safely. (The main danger in this operation is spilling or splashing the concentrated acid or breathing HF fumes).
- Adequate supplies of calcium gluconate gel must be available to counteract the effects of any accidental contamination of the skin.
- **Procedures using hydrofluoric acid must never be attempted by an untrained person.**
- **Procedures using hydrofluoric acid must never be attempted out of normal working hours.**
- **Procedures using hydrofluoric acid must never be attempted by someone working alone and for larger scale operations, workers should operate in pairs.**
- All procedures must be carried out in a fume hood.
- It is strongly advised that procedures which are new to the HF-user should be practiced as a "dry run" and written down as a protocol before working with the acid itself.
- Appropriate personal protective equipment must be worn i.e. safety glasses or preferably a face shield, PVC or Neoprene gloves (which are frequently and carefully checked for damage, especially pin holes), a lab coat and preferably a chemical-proof apron.
- Washing hands and gloves frequently with water is wise when working with even dilute HF.
- **Disposal:** Unless large quantities of HF have been used, spent acid is best added slowly to a copious flow of water running down a drain in a fume chamber. The flow of water must be continued for some time afterwards to ensure that all of the acid has been cleared from the glass sink-trap.

7.16. Lead Compounds

All work with lead or its compounds must, by law, comply with the Control of Lead at Work Regulations 1980. Therefore anyone who wishes to work in this field must first seek advice from the College Health and Safety Officer.

7.17. Perchlorates

All experiments with perchlorates must be treated as potentially hazardous. There have been reported explosions of perchlorate complexes, including those of chromium, iron, osmium and ruthenium, and the rapid disintegration of many other perchlorate complexes has occurred.
Only experienced research workers, or research workers under direct supervision, should perform experiments involving the preparation and handling of perchlorates. To ensure that maximum care is taken when handling perchlorates the following rules and safety tests have been devised at UCL. The perchlorate ion should be used only if there is no other suitable anion. When handling perchlorates, plastic spatulas should be used. Perchlorates must never be scraped from sintered glass filters. Perchlorates must never be heated or ground in the dry state. Whenever possible, use perchlorates in aqueous solution; when this is not possible test the perchlorate in the organic solvent on a small scale (<100 mg) before employing the solvent for the reaction.
Before a perchlorate is prepared on a large scale (>100 mg), the sample must pass certain safety tests. The product (<100 mg), having been prepared behind a safety screen, must be subjected in <1 mg quantities to the hammer and anvil test, heating on a metal spatula, and mixing in an organic solvent (e.g. DMSO). If all of these tests have been satisfactory, that is, there have been no explosions, the experiment may be scaled up to say, 1 g.

7.18. Peroxides

All reactions involving organic peroxides or concentrated (i.e. >30% w/v) aqueous hydrogen peroxide must be conducted in a fume chamber **and** behind a safety screen. An appropriate risk assessment must always be carried out before beginning the experiment and this assessment must be recorded in writing in the laboratory notebook.

7.19. Thiols and Other Obnoxious Chemicals

Chemicals which have an obnoxious odour should be handled only in an efficient fume chamber. Residues should not be put into solvent waste drums or down the sink.

Working with Thiols

When working with volatile thiols, sulfides, selenides and related compounds, it is **essential** to keep any discharge into the atmosphere via the fume chamber exhaust to an absolute minimum. In some circumstances the odour of thiols can become detectable outside the Department at building level and below, and this can result in the Fire Brigade being called to deal with a suspected leak of domestic gas. Whenever possible, volatile sulfur compounds should be removed from a vapour stream using a cold trap, or a trap filled with aqueous alkaline potassium permanganate or with household bleach solution, in order to prevent discharge into the atmosphere via the fume chamber. Unwanted thiols, sulfides and selenides should be destroyed and rendered odourless by treatment with aqueous alkaline potassium permanganate or with household bleach solution.

8. WASTE DISPOSAL

8.1. Organic Solvents

The disposal of organic solvents down the sink is dangerous and illegal.
The College operates a scheme for the collection and disposal of non-radioactive waste organic solvents from science departments **(*separate arrangements exist for collection and disposal of radioactive wastes*** -- contact the College Health and Safety Officer for details). Each laboratory using organic solvents should be equipped with two ***separate*** Winchesters for disposal of organic solvent waste: one for **nonhalogenated** solvents and another for **halogenated** solvents where in use (each labeled accordingly). For the purposes of disposal, mixtures of the two types are treated as halogenated. HPLC waste comprising aqueous/organic mixtures should be collected separately. Waste solvents should be taken to the College waste solvent store (as of May 2007 located outside the Rayne-Wolfson Laboratory on the west side of the basement level in the Extension Building). This requires a key card to enter the the Crystallography area, as well as an access card for the laboratory. One copy of each is kept in the Microbiology section (see Marie), and in the Chemistry technicians' office. Waste solvents should be taken through this lab to the outside storage area (take care – the door to the storage area has no handle on the outside!). The keys for the storage cabinets are kept by Tom McCartney, so contact him in advance to collect them. The waste solvent drums are stored in the far left cabinet. Waste solvents should be carefully decanted into the appropriate 25 litre drum - flammable non-chlorinated, chlorinated, mixed aqueous/organic (i.e. HPLC waste). The empty Winchester bottles should be returned to the laboratory of origin. Collection of full waste drums by a licensed contractor is arranged by the College Safety Officer, and spare waste drums are currently stored in the proposed basement solvent storage area (contact Dave Renouf to obtain one).

8.1.1. Halogenated vs. Non-Halogenated Wastes

Halogenated and non-halogenated solvents MUST be disposed of separately in the specifically labelled containers provided. Non-halogenated solvents present the greater fire risk. Halogenated solvents produce harmful vapours. Certain mixtures of the two types (e.g. acetone and chloroform) can react chemically to cause explosions. Commercial waste disposal contractors require the separation of solvent types.

Examples of Non-halogenated Solvents

Acetone**,** Benzene, Carbon disulphide, Dioxane, Ethanol, Ethers, Ethyl acetate, Methyl ethyl ketone, Methanol, Nitrobenzene, Petroleums, Pyridine, Toluene, Xylenes

Examples of Halogenated Solvents

Bromoform, Bromobenzene, Chloroform, Dichloromethane, Trichloroethylene

For purposes of disposal, treat mixtures of halogenated and non-halogented solvents as being HALOGENAT ED.

8.1.2. Temporary Storage of Waste Solvents

Waste solvent should be kept in VENTED, labeled Winchesters in your laboratory, with halogenated and non-halogenated solvents stored separately. Each bottle should have a label listing the contents of the bottle as far as possible. Use the usual Winchester tops to close the bottle, with a hole drilled through the top to prevent pressure build-up. Do not use rubber stoppers as they swell and become useless if exposed to organic solvent vapours other than for a short time. Swollen stoppers either self-eject or, worse, become impossible to remove.

It is important to use vented storage bottles to prevent build-up of pressure in the bottle. This can result in the bottle exploding. This has occurred after recycling of acetone from a cooling bath that still containied dissolved carbon dioxide. The acetone was placed in a sealed container which exploded, projecting glass shards a considerable distance. There are many other possible situations where the contents of a waste bottle can generate pressure.

8.1.3. Safe use of waste solvent containers

Waste-solvent containers (of either type) must be sited away from all sources of heat (including sunlight) and ignition. Most organic solvents are volatile. Many common solvents will ignite at low temperatures. A few caveats follow:

• Never overfill containers. Over-full containers can spill their contents, especially during transit, thereby creating a serious hazard.

• Never introduce mineral acids into the containers:

– The introduction of even dilute nitric acid is especially dangerous, as devastating explosions could result. Solutions of hydrofluoric acid will attack the glass of the containers.

– Neutralise any active solutes before introducing solvents into the containers. Take care not to pour unreacted hydrides, anhydrides, oxidising agents, acids or bases into the containers.

– You may wish to consult **Appendix A** for a list of Incompatible Chemicals.

8.2. Disposal of Chemicals other than Solvents

8.2.1. Alkali Metals

Sodium (such as in the form of wire in anhydrous solvent bottles). Carefully add at least 200 cm^3 of isopropyl alcohol, swirl well, and leave for several hours in a **fume cupboard**, swirling occasionally until the wire has dissolved. Next add at least 200 cm^3 of industrial methylated spirits and leave to stand for several hours. After addition of the methylated spirits and when the liquid is completely clear, decant off the alcohol into a beaker in successive small amounts which are flushed down the sink with copious amounts of water. Rinse the bottle successively with industrial methylated spirits and water before discarding.

Potassium metal is much more reactive than sodium and the points (a)-(f) must be borne in mind when handling or disposing of potassium metal.

(a) Potassium metal reacts violently with water and with wet organic solvents to liberate hydrogen gas which **usually ignites.**

(b) Explosions have occurred when old, heavily-crusted potassium metal has been cut with a knife. This is probably because the crust contains potassium superoxide. **Always use fresh material. Consult the School Safety Coordinator and the College Health and Safety Officer for disposal of old potassium.**

(c) Always handle and dispose of potassium metal in an uncluttered fume chamber **that has been cleared of all unnecessary chemicals, in particular flammable liquids.**

Have a CO_2 fire extinguisher near to hand.

(d) **Small** quantities of potassium metal or sodium-potassium alloy may be disposed of by careful treatment with **dry** isopropyl alcohol, preferably under an atmosphere of inert gas (nitrogen or argon).

(e) Finally, the handling and disposal of potassium metal should only be undertaken by a research worker who has received appropriate training in these operations. If you have **any** doubts about your competence to handle potassium metal safely consult your supervisor before attempting any work.

All bottles or flasks of solvents which contain alkali metals or metal hydrides used as drying agents must be properly labelled to show their contents, the name of the owner and the date when the drying agent was added.
Solvent stills must be cleaned out frequently to avoid possible build-up of peroxidic residues which are potentially explosive.

8.2.2. Waste Silica (Including TLC Plates)

Wash the silica column thoroughly with organic solvents including methanol, let dry then mix the silica with wet plaster of Paris in a plastic bottle or metal can. Let dry, seal, then dispose of with the general waste. If potentially hazardous residues cannot be washed off, then collect the silica in a plastic bottle for disposal as hazardous waste. If in doubt, consult your supervisor.

8.2.3. Other Chemicals

See the School Safety Coordinator and School Technical Services Manager for advice on the disposal of any other chemicals.
Disposal of ***acrylamide*** is discussed in Section 7.6.

8.3. Disposal of Animal Waste

Fresh carcasses should be macerated in the macerator which is located in room 415a. See the School Technical Services Manager for access.
Before the disposal of insect debris, e.g. fresh or old cultures, the material should be frozen. This eliminates the possible spread of these animals or disease. The waste is then bagged and collected by College staff.
Used animal litter/sawdust must be bagged and is collected by College staff.

8.4. Disposal of Broken Glass and Sharp Objects

Two types of special container should be present in each laboratory:
• a container for broken glass and empty aerosol cans
• a container for sharp objects (CIN BIN) such as razor blades, hypodermic needles etc.
When full the special boxes containing broken/waste glass should be sealed, labelled clearly as BROKEN GLASS, and taken out to the College bins. Empty bottles should be disposed of without delay. They should be disposed of as broken glass. However, before disposal, **all** bottles should be emptied of any residual content, rinsed and their caps discarded. It is particularly important that any drying agent is removed and particular care should be taken to destroy any sodium wire and remove all traces of residue (see Disposal of Alkali Metals).

CIN BIN's are not ordinary waste. When full, the container must be closed and labelled, then you should contact Marie Maugueret to arrange for disposal. Ordinary waste, such as used paper, should be deposited in the rubbish bins provided in each room; this waste is collected by College staff daily.

8.5. Disposable pipette tips

These must be collected in a labelled container separate from rubbish bins; when full the container must be sealed. It may then be disposed of via the waste bins emptied by College staff daily.

9. BIOLOGICAL HAZARDS

9.1. Micro-organisms

Before work is commenced reference should be made to the publication ***Categorization of pathogens according to hazard and categories of containment*** (published by ACDP) to check the degree of containment available is suitable for the micro-organism to be used. The School Genetic Modification Safety Coordinator or the College Biological Hazards Officer should be consulted before commencing any such work.
Although the appropriate precautions for experiments involving different micro-organisms may vary, it is advisable to treat ALL MICRO-ORGANISMS as if they are potentially PATHOGENIC. Work should only be carried out in laboratories which are provided with impervious bench surfaces. All procedures must be performed so as to ***minimise the production of aerosols***.
Safe practice includes:
• never leave lids off Petri dishes or tubes
• never leave pipettes on the bench
• don't cool a hot loop on agar containing bacterial growth
• sterilise loops in Bunsen flame after use
• use a rubber bulb when pipetting suspensions of bacteria
• swab spills of bacterial culture with absolute alcohol or dilute hypochlorite, then inform a member of staff
• carry out operations with the minimum of air disturbance
• after use all contaminated materials must be sterilised
– plastic Petri dishes, slides, tissues and other disposables should be put in the autoclavable plastic bags provided.
– leave pipettes in chlorsan filled containers
– other glassware should be left upright on bench or plastic bowls provided.
There are a number of local restrictions designed to prevent microbial cross contamination.

9.2 Genetic Modification

Special rules govern experiments in genetic manipulation of micro-organisms or the use of genetically modified organisms. In the first instance, proposals for work in this area should be discussed with the School Genetic Modification Safety Coordinator. However, all staff or students intending to carry out genetic modification experiments for the first time MUST , ***before commencing work*** or ***obtaining genetically modified material from other laboratories***, INFORM the School Genetic Modification Safety Coordinator, who will assist in the preparation of a submission to the College's Genetic Modification Sub-Committee. All proposals for work in this area require PRIOR approval by this Sub-Committee.
All work of this kind must be carried out in Room 305 or 303 of the Main Building.
All workers in genetic manipulation are subject to a health examination prior to commencing work. Guidelines on safe practice are contained in the College ***Code of Practice for Work in Genetic Modification Laboratories*** and workers must be fully conversant with these regulations concerning work with, and disposal of, these organisms.

9.3. Work with Animals

The housing and the use of vertebrates for scientific procedures must be licensed by the Home Office according to the Animals (Scientific Procedures) Act, 1986. The procedures used must be agreed and approved by the Home Office Animals Inspectorate and work can only be carried out in areas specified. **The College does not have a licence to work with vertebrates and does not engage in such work.**

9.4. Allergic Responses

Workers should be aware of the dangers of allergic response to biological materials, especially dust and debris. The College takes possible allergic responses to biological materials very seriously. As part of the annual completion of the COSHH form workers exposed to allergenic risks are required to complete an extra medical surveillance form to send to HR. This is confidential and will be sent via the HR to Birkbeck's Occupational Health consultants.

Workers should make strenuous efforts to maintain high standards of hygiene and restrict their exposure to potentially allergenic materials. Disposable masks are freely available, as are disposable gloves. There are also Racal type ventilators and gauntlets which are obviously more cumbersome but more effective. ***They should be worn by all workers during procedures that involve raising dust and debris***. Workers who have a family or past history (however mild) of asthma, eczema or hay fever would also be advised to use them as they are seen as potentially allergic subjects and are more likely to develop skin or chest complications.

Any worker who develops **wheezing** for the first time (however mild) should visit his or her doctor as soon as possible. The same is true for a worker noticing an unexpected worsening of his or her asthma or hay fever. If workers are seen at this stage, treatment is usually available. Any worker developing dermatitis should likewise be seen sooner rather than later. There are various causes, many easily treated, so that an accurate diagnosis and early appropriate treatment is advisable.

9.5. Human Body Fluids and Tissue

Experiments involving the collection or use of human body fluids such as blood and saliva or human tissue (e.g. cheek epithelial cells) should be avoided. Permission for such experiments must be sought from the College Health and Safety Officer who will need to be satisfied that there is no possibility of cross infection before permission is given.

10. EQUIPMENT AND APPARATUS

10.1. General Advice

It is forbidden to undertake any work outside the worker's own expertise. Before using any piece of equipment for the first time all workers must either consult the appropriate manual or seek advice from someone already familiar with the piece of equipment. Installation or maintenance of electrical or mechanical equipment may be undertaken only by the appropriate trained staff.
Other than refrigerators, freezers, incubators and ovens no piece of apparatus should routinely be left running unattended overnight, especially if it incorporates a heating element (*see* Section 4.3 re: Unattended/Overnight Experiments).

10.2. Electrical safety

We are REQUIRED by the College to have a scheme for checking the
electrical safety of portable equipment (PAT testing). The College has a fair number of easy to use PAT testers including 2 in Biological Sciences and others can be borrowed from the College Health and Safety Officer. Visual inspections will be carried out by Lab Managers periodically and arrangements made to carry out PAT testing as necessary according to College guidelines: http://www.bbk.ac.uk/so/policies/pat

10.3. Display Screen Equipment (DSE)

The College has DSE guidance at: http://www.bbk.ac.uk/so/guidance/DSE2 which is brought to the attention of all new staff and annually to all staff via the annual safety inspection report. All staff are advised to follow the guidance. Martin Cullum has been trained as a DSE assessor and can advise on the correct set-up of computer work-stations and whether additional equipment is required.

10.4. Gas Cylinders

Before using gas cylinders, individuals must seek instruction from an experienced user.
Laboratories should not contain more gas cylinders than is absolutely necessary. Arrangements should be made to obtain replacement cylinders when they are almost empty. Cylinders are usually delivered the day after ordering.
Guidelines relating to the use of cylinders are as follows:
• Cylinders must always be clearly labelled so that the identity of their contents can be easily and quickly determined by any laboratory worker. If there is any confusion as to the contents of any cylinder, the cylinder should be plainly labelled "Contents Unknown" and the supplier should be contacted at once regarding appropriate procedures. The contents may be toxic, flammable or fire-promoting. Sudden or slow escape may lead to fire, explosion or deadly concentration of toxic gas.
• **All** cylinder **valve spindles** have right-hand threads.
Non-combustible gas cylinder **heads** have *right-handed* threads.
Combustible gas cylinder **heads** have *left-handed* threads.

• The number of cylinders held in a laboratory must be kept to a minimum and wherever possible they should be located against an outside wall. Cylinders not currently in use should be returned to the store.
• Cylinders must be secured ***at all times*** against falling, either by use of a bench clamp, anchor chains, or by an appropriate cylinder stand. Apart from the risk of physical injury, a falling cylinder could sustain a fracture in the neck region, which would convert it into a devastating, pressure-driven missile. Within laboratories or workshops, cylinders must be kept away from sources of heat and corrosion. Cylinders must not be used as rollers, work supports or jacks.
• Lecture bottles while in use must be clamped to a suitable stand, unless handheld; when not in use they must be stored in a suitable rack, away from any source of heat (and not kept hidden in a drawer). Lecture bottles containing toxic, offensive, or corrosive materials are best stored in a fume cupboard.
• Cylinders should never be completely emptied; a slight residual pressure should be retained. Cylinders having reached this state should be returned as promptly as possible to the store, with the valve closed, for collecting and recharging.
• Cylinders other than those for liquefied gases should always be used in conjunction with a regulator (cylinder head). The cylinder valve must not be used to regulate the gas flow. The regulator should be attached using the correct spanner supplied by the manufacturer. Excessive force should be avoided. The spanner is shaped to allow a few blows from the palm of the hand for tightening purposes. The use of hammers and mallets for this purpose merely damages the threads and gauges. The valve on the cylinder should be tested for leaks by using a dilute solution of detergent. All cylinders must have a key attached to them. Where regulation of gas-flow is required, this is achieved by a needle valve fitted to the outflow side of the regulator. If rubber tubing is used it must be inspected for cracks or perishing and be securely attached.
• Cylinders should never be left with the valve open and without a valve key in position. This is to ensure that a speedy closure can be made in an emergency. Always turn off a cylinder at the main valve after use and release excess pressure in the regulator.
• Cylinders of liquefied gases must always be stored in an ***upright*** position. They may, depending on the supplier's instructions, be used with or without a regulator.
• Cylinder valves or regulator fittings must ***never*** be lubricated or greased (by law), or sealed using PTFE tape.
• Cylinders should be transported on trolleys, adequately secured and with the valves closed and regulators removed.
• If gas under pressure is fed into apparatus containing glass or other frangible components, protection against possible explosive fragmentation must be provided, e.g. wire, plastic mesh or cling film.
• Where gas is delivered from a cylinder by dip tube into a liquid, the regulator and cylinder must always be protected against possible suck-back by a trap of adequate capacity. For further advice consult the School Safety Coordinator.

Acetylene and Liquified Petroleum Gas (LPG)

• Before using acetylene, you must consult the College Safety Officer. Never use an acetylene cylinder without a flash-back arrestor. Cylinders of acetylene or liquefied petroleum gas must always be used in an upright position. They must be stored upright apart from all others in a separate compartment of the cylinder store. Acetylene must not be used with piping or joint fittings that contain copper or silver.

Cylinder Checklist

- Check that the cylinder you use contains the gas you want (check the label).
- Transport the cylinder on an approved trolley by pushing and **not by pulling.**

• Make sure the cylinder is firmly secured in an approved location. Cylinders must not be used from the trolley in a laboratory.

Cylinders must never be left freestanding

• Check the pressure regulator. Is it designed for the gas you are using? Check the pressure rating. Is it capable of coping with the pressure in the cylinder?

• Never use oil or grease especially on an oxygen cylinder: **the result can be catastrophic.**

• Turn the regulator to zero before opening the valve at the cylinder head and when finished close the valve at the cylinder head.

• **Never** transport the cylinder with its regulator in place.

10.5. Microwave Ovens - Autoclaves

It is forbidden to use the microwave ovens to heat liquids or melt agar and agarose in ***closed*** vessels. Tops of vessels such as screw-top bottles must be removed before such vessels are used. Vessels should not be filled above half-way. Instructions on the settings used for heating (on the ovens) should be followed. Heat resistant gloves (the gauntlet type) should be used to remove vessels from the oven. Users should be aware of the dangers of superheated liquids boiling over on being disturbed. Great care should be exercised in the use of autoclaves.

10.6. Refrigerators and Deep-Freezes

All items should be clearly labelled with the nature of the substance, the name of the owner and the date, and should be kept no longer than is necessary. The label should also indicate any hazard likely to follow from the failure of the refrigeration system. Vessels containing substances likely to evolve corrosive or poisonous vapours must additionally be placed inside a further protective container and a warning notice on the refrigerator door.

Refrigerators and deep-freezes which are not spark-proof must not be used for storage of highly inflammable solvents, even in closed vessels. This particularly applies to ether.

Food and drink may be stored only in specially designated refrigerators.

10.7. Shakers

Care should be taken in the use of shakers. Shaking of some mixtures and solvents poses as great a hazard as the heating of these materials. Care must be taken in the fixing of containers to shakers. Where fumes are likely to be evolved, shaking must take place in a fume cupboard.

10.8. Repair and Service of Equipment

No item of equipment may be serviced within the College, dispatched for repair, or disposed of, unless it has been adequately cleaned, decontaminated (if required), or otherwise made safe. Contractors may require that a certificate stating that an item of equipment is cleaned/decontaminated is provided. This should be signed only by someone who has reasonable grounds for believing this to be so, normally the research supervisor or School Safety Coordinator.

10.9. Seized (Stuck) Glass Apparatus

A common cause of minor, and sometimes very serious, cuts is when force is used to free seized-up glass joints, taps and desiccators. Always be extremely careful when applying any force to glassware using your bare hand. **Do not attempt to free seized taps, joints, stoppers or desiccator lids without consulting your Supervisor.**

10.10. Magnetic Fields

The strong fields associated with the superconducting magnets of modern NMR spectrometers can be hazardous. In particular, stray magnetic fields from these spectrometers can affect heart pacemakers. Warning notices should be on display where strong magnetic fields are present.

11. EXCURSIONS, FIELD WORK, FIELD COURSES

11.1. Code of Practice

A separate code of practice for fieldwork is provided as **Appendix 1**. This must be provided to all students undertaking fieldwork.

11.2. Student Declaration Form

The fieldwork code of practice contains a student declaration form, which must be filled in by each student detailing any known medical conditions and naming next of kin. This must be signed by the student and returned to the course leader before the start of the course.

11.3. Insurance

The excursion or field course leader should inform the College's Assistant Finance Secretary (who looks after the College's insurance policies) of any excursions to be made and/or field courses running and should provide a definitive list of those attending.
Although the College has appropriate statutory insurance cover for employers' liability and for public/ products liability, this does not extend to health, travel or property insurance for course participants.
Thus, personal insurance is recommended for students undertaking fieldwork in the U.K. (e.g. personal risk insurance) and is considered essential when going abroad (travel and health).
If a landowner requires a disclaimer before allowing an individual or a group on to a field site, this will not be honoured by the College. No disclaimers should be signed on behalf of the College.

11.4. First Aid on Field Courses

A trained first aider, with portable first-aid kit, must accompany parties of students on field courses .

11.5. Driving of College and Hired Vehicles on Field Courses

Only drivers meeting the licensing criteria defined in the ***College Code of Practice for Driving College and Hired Vehicles*** (1999) may drive a College vehicle or hired vehicle on College business. This restriction applies to field courses. Furthermore, such drivers must be ***approved*** by the Head of School. The driver's license must also be sent to the College's Assistant Finance Secretary for approval. See: http://www.bbk.ac.uk/so/policies/drive

12. REPORTING OF ACCIDENTS

Accidents to staff, students or visitors involving personal injury requiring first-aid or medical attention must be reported to the College Health and Safety Officer. An incident form is available on the School safety web page at: http://www.bbk.ac.uk/so/forms/accident/printable

In addition, 'near miss' incidents must be reported whether or not anyone is injured especially, the type of incidents most likely to occur in a scientific laboratory:
• explosion, bursting or implosion of a closed vessel at pressures greater or less than atmospheric
• fire or explosion involving an electrical short or overload
• fire or explosion resulting from the processing of materials
• uncontrolled release of any toxic or injurious substance, agent or pathogen
In recording the incident, report the date, time and location of the accident, and a description of the circumstances. If injury has occurred, name the person who has administered the first aid. Also to be recorded are the name and occupation of the injured person(s), as well as the nature of the injury.
Note that the College as an employer has a duty under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) to report certain serious injuries, diseases, and dangerous occurrences directly to the Health and Safety Executive. Any injury that results in unfitness for work for more than 7 days is also reportable. The College Safety Officer determines which events are reportable under RIDDOR and must therefore be informed promptly of all incidents that may fall into these categories.

13. FIRST AID

13.1. General Advice

Take care not to become a casualty yourself while administering first aid. Be sure to use appropriate protective clothing and equipment where necessary. If you are not a trained first aider, send immediately for the nearest first-aider if one is available. A list of first aiders is available at the reception desk, on the Intranet (via the Safety Office web pages). Normally, lists are also posted in the lifts.
If the assistance of medical or nursing personnel will be required, send for an ambulance immediately by ringing the Duty Attendant on extension **555**. Tell him what has happened, what service is required AND **WHERE YOU ARE**. He will call the emergency services and direct them to you.
If possible, try to obtain a First Aider's Certificate. It may enable you to save one of your colleagues or yourself from permanent injury.

13.2. Reporting Accidents

An entry of each case of injury resulting from an accident. See Section 12 above.

13.3. Advice on Treatment

Hygiene - When possible, wash your hands before treating wounds, burns or eye injuries. Take care, in any event, not to contaminate the surfaces of dressings. Wash your hands afterwards as well.

Minor Injuries - Casualties with minor injuries, of a sort they would attend to themselves if at home, may wash their hands and apply a small, sterilised dressing from a First Aid Box.
Breathing Apparatus - The College Attendants are trained in its use. There is always an attendant on duty at the desk in the entrance hall. **Ring 555**. Apparatus is kept in two places - outside Room 303 and near the lift on the lower ground floor in the extension building.

13.4. While Waiting for Medical Assistance

13.4.1. Bleeding

If bleeding is more than minimal, control it by direct pressure - apply a pad of sterilized dressing or, if necessary handkerchief, with direct pressure on the bleeding point. Raising a limb if the bleeding is sited there will help reduce the flow of blood (unless a bone is fractured).

13.4.2. Broken Bones

Unless the casualty is in a position that exposes them to further danger, do not attempt to move a casualty with suspected broken bones.

13.4.3. Unconsciousness

Where the patient is unconscious, care must be taken to keep the airway open. This may be done by clearing the patient's mouth and ensuring that the tongue does not block the back of the throat. Turning the patient onto his or her side propped up by the upper leg being bent, in the recovery position will ensure that the airway will remain clear even if vomiting occurs.

13.4.4. Other Injuries

Burns and Scalds - Small burns and scalds should be treated by flushing the affected area with plenty of clean, cool water until the pain completely subsides.
Chemical Burns - remove any contaminated clothing which shows no sign of sticking to the skin and flush all affected parts of the body with plenty of clean, cool water, ensuring that all the chemical is so diluted as to be rendered harmless.
Chemical in the Eye - Flush the open eye AT ONCE with clean, cool water, using the eye-wash station or a length of tubing attached to an appropriate tap; continue for at least 5 to 10 minutes and, in any case of doubt, even longer.
Foreign Bodies in the Eye - Irrigate with clean, cool water, using the eye wash station.
Electric Shock - Ensure that the current is switched off. If this impossible, free the person using something made of rubber, dry cloth or wood or a folded newspaper; use the casualty's own clothing if dry. *Be careful* not to touch the casualty's skin before the current is switched off.
Gassing - move the casualty to fresh air ***but make sur e that whoever does this is wear ing suitable respiratory protection*.**

14. FIRE INSTRUCTIONS AND OTHER EMERGENCIES

14.1. General Advice

First and foremost, all members of the College should at all times take care to ***prevent*** fire occurring. All persons using the buildings should know the fire instructions, how to use the fire extinguishers and all routes of escape. Fire safety training is provided by the College Safety Officer to all staff on a regular basis.
Members of staff who are responsible for students or visitors should inform them of the fire procedures. All bought-in teachers should receive copies of fire procedures from the School Office along with their contracts of employment.
Familiarise yourself with the positions of the extinguishers. In the event of fire, if it is safe to do so, **AFTER THE ALARM HAS BEEN RAISED**, use these to attack the fire (*see* **Section 14.6** for details of types of extinguishers and their use). Otherwise leave the building immediately. Green fire exit signs are posted in corridors and above doorways to inform you of escape routes.

14.2. If you discover a fire

Immediately operate the nearest fire alarm. Fire alarms can be found on each floor at the foot or head of the stairs. RED (water) fire extinguishers can also be found at these fire points.
Ensure that the fire is reported to the Duty Attendant at the entrance to the main building.
RING 555 and TELL THE DUTY ATTENDANT:
• WHERE YOU ARE
• WHERE THE FIRE IS
The Duty Attendant will call the fire brigade and direct them to the fire.
Attempt to extinguish the fire using an appropriate fire extinguisher, but ONLY if there is no risk to yourself or others in doing so. If the fire is not extinguishable, leave the building via the nearest exit. **DO NOT USE THE LIFTS**.

14.3. If you hear the fire alarm

If you are NOT in charge of students or visitors, leave your area at once, closing windows and doors as you go. If you are exiting a laboratory, make safe whatever equipment you are using by switching off electricity, gas, water, etc. Do not gather belongings, but head straight for the nearest fire exit. **DO NOT USE THE LIFTS**. Once outside the building, stand well clear (at least 100 m from the entrance), but avoid standing in the road. Ensure you know your escape route.
If you are teaching a class (or are otherwise in charge of students or visitors) stop the class and gather the register. If the class is laboratory-based, make safe the laboratory by shutting off apparatus, gas, water, etc. Do not pause to gather belongings. Direct the students (or visitors) to the nearest exit (**DO NOT USE THE LIFTS**), and accompany them to the outside of the building. Guide students well-clear of the building and discourage them from standing in the road. If there is a real emergency (i.e. not a drill) call the register. If any students are missing, inform a Fire Marshal at once.

14.4. Assisting disabled persons during evacuations

People having disabilities which make use of the stairs difficult should wait on the landings and tell someone to inform the Duty Attendant of their location. Fire Marshals or firefighters will assist them to safety.

14.5. Re-entering the building after an evacuation

Do not re-enter the building unless told that it is safe to do so by a senior College Official or an Officer of the Fire Brigade.

14.6. Fire Extinguishers

There are different types of fire extinguisher which have different functions and are colour coded with an identifying band around the red body of the extinguisher:
RED BAND- Water/Carbon Dioxide Extinguishers
These discharge water under carbon dioxide pressure. They are not suitable for chemical fires or where electricity is involved, but are the most effective against normal combustibles.
BLACK BAND - Carbon Dioxide (CO_2) Extinguishers
The CO_2 excludes air and smothers the fire, leaving no mess. They are suitable for normal combustibles, or where electrical apparatus is involved. They can be used for burning liquids but care must be taken that the force of the extinguisher does not spread or splash the liquid so spreading the fire. They cannot be used in the presence of substances such as sodium, potassium, or metal hydrides which react with CO_2.
BLUE BAND - Dry Powder Extinguishers
These are most suitable for burning liquids and can be used on electrical fires, but are less effective on commonly combustible materials.
Before tackling a fire assess whether the burning liquids (solvents, oils, etc.) or electrical apparatus is involved. If so, use CO_2 or dry powder extinguishers only. If the fire is limited to ordinary combustibles - wood, paper, fabric, etc. - all types of extinguisher can be used and where appropriate these may be supplemented with water from the tap.
If a person's clothing is on fire, use a blanket, rug, or similar article and wrap it round the person, who should be laid on the ground to prevent flames reaching the head.
If electrical fittings are involved in a fire, be sure that the current is switched off before they are touched or the fire dealt with.

14.7. Explosion, Major Spillage or Other Imminent Danger

(a) Evacuate the room.
(b) If fire occurs sound the fire alarm and proceed as outlined above.
(c) Call for assistance for any injured person.
(d) In the case of major spillage contact the School Technical Services Manager, the School Safety Coordinator and the College Health and Safety Officer.

14.8. Release of Toxic Substances

(a) Evacuate the room and all others subject to any danger.
(b) If the release is widespread, sound the fire bells to evacuate the building. Ensure that all personnel keep clear of the imminent danger zone whilst so doing.
(c) Act as outlined in **14.7.** above.

14.9. Aftermath

All serious incidents must be reported without delay to the College Health and Safety Officer. It is important that the cause of any incident be established to prevent recurrence. Therefore, once an area involved in an incident has been rendered safe, if is important that there is no further disturbance of the site that may in any way destroy evidence, until the incident investigation has been carried out.

APPENDIX A: INCOMPATIBLE CHEMICALS

Chemical	Keep Out of Contact With:
Acetic acid	Nitric acid, Chromic acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali Metals and earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, the halogens
Ammonia, Anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Bromine	Same as chlorine: ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Butyl lithium	Water
Carbon, activated	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
Chromic Acid, chromium trioxide	Naphthalene, camphor, glycerin, turpentine, alcohol, flammable liquids in general
Chlorine	Same as bromine: ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids, organic or inorganic
Cyanides (Na, K)	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, other oxidizing agents
Fluorine	Isolate from everything
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidant
Hydrocarbons (benzene, butane, propane, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid	Ammonia, aqueous or anhydrous
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia

Nitric Acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, nitratable substances
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury and their salts
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, sulfuric acid, organics
Peroxides, organic	Acids (organic or mineral), also avoid friction, store cold
Phosphorus (white)	Air, oxygen
Phosphorus pentoxide	Alcohols, strong bases, water
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium perchlorate	Acids (see also chlorates)
Potassium permanganate	Glycerin, ethylene glycol, benzaldehyde, sulfuric acid
Propylene oxide	Phosphotungstic acid
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, ammonium compounds
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin (glycerol), ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)

APPENDIX B: COMMON CARCINOGENIC SUBSTANCES

Omission from this list does not imply that a compound is **not** carcinogenic.

2-Acetylaminofluorene
ß-Propiolactone
4-Aminobiphenyl
bis-(Chloromethyl) ether
Benzidene
Chloromethyl methyl ether
3,3'-Dichlorobenzidene
4,4'-Methylene-bis(2-chloroaniline)
4'-Dimethylaminoazobenzene
Ethyleneimine (aziridine)
a-Naphthylamine
*Asbestos
ß-Naphthylamine
Benzene
4-Nitrobiphenyl
*Coal tar volatiles (coke oven emissions)
N-Nitrosodimethylamine
Vinyl chloride

The following have also been identified as strong carcinogens:

Benz(a)pyrene
2,4-Diaminotoluene
Dimethylcarbamoyl chloride
1,1'-Dimethylhydrazine (and its salts)
Dimethyl sulphate
Hexamethylphosphoramide
Hydrazine (and salts)
N-(2-Hydroxyethyl)ethyleneimine
Methylhydrazine (and salts)
2-Nitronaphthalene
Nitrosoamines
1,3-Propane sultone
Propyleneimine (2-methylaziridine)

The following compounds have been identified as experimental carcinogens:

Acrylonitrile	Thiourea
Lead chromate	Dioxane
3-Amino-1,2,4-triazole	o-Toluidine
Methylenedianiline	Epichlorohydrin
Carbon tetrachloride	Trichloroethylene
Styrene	Ethylene dibromide
Chloroform	Vinylcyclohexene dioxide
Tetramethylthiourea	Ethylenethiourea
1,4-Dichloro-2-butene	Zinc chromate

* Standards classifying these as carcinogens have been proposed, but have not been adopted.

APPENDIX C: EXAMPLES OF S1 POISONS

The list is not complete but includes compounds which are known by the general public to be poisons. When issued these compounds must be kept in a locked cupboard and details of usage noted in the poisons inventory which should be kept therein.

(a) Alkaloids and derivatives, e.g. Aconitine, Atropine, Brucine, Hyoscine, Strychnine
(b) All compounds of arsenic.
(c) *Metal carbonyls (e.g. nickel carbonyl).
(d) All inorganic cyanides, (e.g. potassium, sodium and silver cyanides).
(e) Digitoxin, digitonin.
(f) Paraquat.
(g) *Phosgene.
(h) Osmium compounds.
(i) Thallium compounds.

* Should be kept in a secure fume cupboard in a lockable laboratory.

Research workers are expected to take suitable precautions with all known highly toxic compounds in their possession, whether or not they are listed above.