

Safety in Undergraduate Laboratories

Universities have a legal duty to provide such supervision as is necessary to ensure the health and safety of ... undergraduate students. (CVCP Note of Guidance N/89/166). This is the policy of IMAPS, University of Wales, Aberystwyth. This document summarizes the safety regulations for students undertaking practical or project work in IMAPS. The responsibility for safety is shared by all staff and students working in undergraduate laboratories. These laboratories must be operated in a manner that is consistent with the safety procedures of the Institute. Students attend laboratories to carry out standard laboratory experiment modules, which are normally supervised as a class by one or more staff member, or individual projects, supervised by a specific named member of staff. In this document, the term supervisor applies to both situations.

The detailed University policy on health and safety can be found at:

www.aber.ac.uk/safety-environment

Responsibilities of Students

- Students are responsible for complying with both IMAPS and University safety procedures
- Students have the legal responsibility not to endanger themselves and others by their actions.
- Students must not run in laboratories
- Unauthorized experiments must not be carried out
- Food and drink are not permitted in laboratories
- Smoking is not permitted anywhere in IMAPS
- Students must wear protective clothing and other safety equipment when instructed to do so.
- Sensible footwear and clothing must be worn in laboratories.
- Floors, walkways and access areas must be kept clear
- All dangerous chemicals, particularly poisons, must be kept in a locked room or cupboard
- General working areas must be kept clean and tidy
- Projects must be risk assessed before any practical work is started
- Students must inform their supervisors of any new procedure they wish to carry out in IMAPS. They may not perform any procedure or use any potentially hazardous equipment without first obtaining permission from the relevant supervisor who must ensure adequate risk assessment has been carried out and adequate training received.

Working Hours

Laboratories are open to undergraduate students only during times set down for practical work (9.30 a.m. to 5.30 p.m. Monday to Friday excluding holidays). Students may be permitted to work alone only if the nature of the work has been assessed as of zero or low risk and at least one person is within hearing or visual distance and is kept informed of the work.

Out of hours working and Overnight Experiments

Out of hours access to laboratories may only be obtained by arrangement with the supervisor in consultation with laboratory technical staff. Each case must be assessed on its merits and a safe system of work established. For such work a second person **MUST** always be present. A logbook is provided to register those working outside normal working hours.

For any experiment left running overnight or weekends, an appropriate form must be filled in, giving full details of the apparatus, location and dates involved, and emergency instructions, including names, addresses and phone numbers of persons running the experiment. A copy of this form should be fixed in a safe position near the apparatus so that it can be seen clearly and safely by night security staff.

Closing Down Procedure

It is the responsibility of any person switching on equipment to ensure that it is **NOT** left on overnight or at weekends (unless it needs to be – see above). Any difficulties should be reported to the member of staff on duty, project supervisor or the senior person present, who will take ultimate responsibility for the closing down procedure in this case.

Staff Responsibilities

Effective or adequate supervision does not mean constant attendance. Where attendance is necessary, this can be carried out by the supervisor or an authorized nominee, who can be a member of the academic or technical staff, if suitably qualified and competent.

There are fundamental elements upon which supervisors must satisfy themselves.

- The laboratory work/project has been properly assessed to identify risks to health and safety and compliance with University and local procedures.
- Necessary precautions have been agreed with the student. Where work involves the use of specialist facilities, technical support staff should also be consulted and agree precautions.
- Students are following agreed procedures.
- Students are aware that changes to procedures must not be made without the formal agreement of the supervisor and appropriate modification made to the risk assessment document.
- Students fully understand that they have a legal responsibility not to endanger themselves or others by their actions.
- Temporary supervisors are appointed for students during an absence of more than one week of the regular supervisor.

Risk Assessment and Levels of Supervision

Laboratory and project work must be categorised with respect to the required level of supervision, based on the associated level of risk. Such a categorisation is given below:

- Work must not be started without direct supervision
- Work must not be started without the approval of the supervisor
- Care must be taken by students but they are considered to be adequately trained and competent in procedures involved.
- Risks are insignificant and carry no special supervision needs.

For all but the lowest category of work, the supervisor and/or student must perform and record a risk assessment before work commences. In standard laboratory practical work, evaluation of the safety of individual experiments should be carried out when the experiments are devised and appropriate instruction provided with the experimental methodology. In such cases, there is no need to perform a risk assessment every time the experiment is performed. In circumstances where a member of technical staff is present at the same time as a member of academic staff, the responsibility for supervision of the students present lies with a member of academic staff.

The steps in the process of risk assessment are summarised below

- Define what is being assessed
- Identify significant hazards and risks
- Identify who is at risk
- Evaluate the risk, considering the consequence of uncontrolled hazard
- Eliminate or reduce the risk by the use of control measures
- Review the assessment where necessary

The following definitions will help in this procedure.

- A hazard is anything with potential to cause harm to any person or damage or loss of property.
- A risk is the likelihood of harm from any particular hazard occurring under the circumstances of use.
- Risk control is any means of minimising the risk, reducing it to an acceptable level for the student and anyone else who might be affected by the work. The controls may be administrative, engineering or personal protective.

A full discussion of risk assessment is given on

http://www.aber.ac.uk/safety-environment/english/handbook/proc_and_pracs/gen_risk_ass/index.shtml

where risk assessment forms can be downloaded.

Control of Substances Hazardous to Health COSHH

The use of chemicals or other hazardous substances in the workplace can put people's health at risk. The law requires that the exposure of staff and students to such hazardous

materials is controlled and this means that the University and IMAPS must comply with the Control of Substances Hazardous to Health (COSHH) regulations, 2002. Risk assessment of all work that uses hazardous substances must be carried out by staff. Records of these assessments must be kept in the Institute General Office.

For further information and forms, go to:

http://www.aber.ac.uk/safety-environment/english/handbook/proc_and_pracs/coshh/index.shtml

Emergency Procedures

Emergency Services

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

- On any internal telephone during normal working hours, dial **222**.
When the operator answers, state “Emergency services required”, say where you are telephoning from, give your name or the name of the building, the room number and any other relevant information. The operator will then telephone for the service required.
- On any internal telephone outside normal working hours, dial **9-999**.
- On any public payphone (no charge), dial **999**.
- For Mobile Telephone users the Universal Emergency Number in Europe (inc UK): dial **112**

n.b. mobiles will connect to the best signal irrespective of network provider

If possible, a staff member should be informed if the emergency services are called so that staff can direct them to the location of the incident.

Accidents and First Aid

All accidents and near misses must be reported and logged in the accident book. It is the responsibility of students to familiarise themselves with the names and locations of designated first-aiders in their area and seek assistance if necessary. In the Physical Sciences Building, these are:

Location	Name	Extension/Room
Physical Sciences	Mr Steven Fearn	1835 Room 234
Physical Sciences	Mr. Matt Gunn	2817 Room 122

It is the responsibility of students to be aware of the location of first aid boxes. Only minor injuries may be dealt with by departmental personnel. However, in the event of some more serious injuries where rapid response is essential, you should note the following:

- Severe Cuts;** If necessary, a competent person should give immediate first aid to reduce shock and loss of blood. The patient must then be taken to the hospital casualty department as quickly as possible.
- Fractures:** **DO NOT MOVE THE PATIENT AT ALL** unless other hazards make movement essential e.g. fire. Incorrect treatment can do more damage than the original accident. Make the injured person as warm and comfortable as possible and summon medical assistance.
- Poisons:** Immediate treatment is often essential. Summon medical assistance and at the same time give the doctor details of the poison(s) involved.
- Heat burns:** Apply cold water or ice if the burns are not very extensive.
DO NOT APPLY CLOTHS, OINTMENTS, ETC. Summon medical assistance.

- v) **Chemical burns:** Neutralise immediately. Flushing with water is usually the safest immediate treatment until medical assistance is forthcoming.
- vi) **Damage to Eyes:** Flush out the eyes with warm water. Convey the patient to hospital without delay. **Fire Alert**

If the fire alarm sounds, all persons **MUST** leave the building as quickly as possible and in an orderly fashion by means of the stairs. Lifts must not be used and doors should be left closed. Do not waste time collecting personal belongings. Laboratory experiments should be left in a safe condition (e.g. electric power switched off) as long as this can be achieved quickly and without incurring personal danger.

All personnel must assemble opposite the Main Entrance on the far side of the road and remain there until accounted for by an authorized person. The first people to arrive at the assembly point must move towards the sports field so that congestion is avoided and the road kept clear. Under no circumstances should anyone re-enter the building.

The fire alarm must be sounded and the emergency services alerted. Do not attempt to use a fire extinguisher unless you have received appropriate instructions and training.

Portable fire fighting equipment is not designed to cope with extensive fires. Fire fighting should cease and the area evacuated as soon as the fire threatens the means of escape, the building structure, or there are other indications that the fire is out of control.

In the event of a fire appliance being used to fight a fire, the choice of extinguisher is important. The wrong choice can turn a minor fire into a disaster.

- Fires involving flammable liquids.
CO₂, dry powder, foam extinguishers or sand should be used.
- Fires involving ordinary furniture
The water hose reels may be used.
- Fires involving electrical equipment.
CO₂ extinguishers should be used.
- Fires involving clothing.
The person whose clothes are alight should be stopped from running, pulled down to the ground and wrapped in a blanket or heavy coat.

General Laboratory Hazards

Inflammable Materials and Solvents

- Large quantities of inflammable solvents must not be kept in individual rooms; keep only the amount you require and leave the rest in store.
- Inflammable materials should not be stored in standard refrigerators as they lack spark proofing form thermostats etc.
- Operations involving organic solvents must be carried out away from naked flames, electrical equipment that is likely to spark, or anything else, which might ignite solvent vapour. If possible, operations involving solvents should be carried out in a fume cupboard, or otherwise in a well-ventilated area.
- If substantial amounts of solvent are spilled, see that all possible sources of ignition are turned off in the laboratory, open all windows and doors and switch on all fans only if flame proof/certified for flammables.
- Do not pour solvent residues down the sink. Collect them in suitable bottles for disposal. You should note that it is a criminal offence, punishable by a fine or imprisonment, or both, to put down a sink substances that are potentially capable of polluting the environment.
- Do not put glassware, wet with organic solvents, into an oven to dry.
- Most laboratory chemicals are highly toxic. Avoid ingestion and skin contact.

Appropriate rubber or plastic gloves should always be worn. Avoid inhalation of solvent vapours. The use of benzene is totally prohibited. In most cases, toluene is a suitable alternative.

Electrical hazards

- Students should consult and observe the rules laid out in the University Safety Manual
- Any additional permanent wiring of the building must be carried out by an electrician and on no account by students.

Glassware

- Broken glassware must never be left in sinks but should be collected and disposed of in a suitable bin (Note, plasticine and sellotape are very useful for collecting small pieces of glass.) Cracked glassware must never be used for any process.
- Dangerous chemicals e.g. acid, alkalis, poison, sodium, etc., must be removed from all glassware on conclusion of experiments.

Radiation Hazards

- The use and storage of ionising radiation sources is subject to legislation and students should only use sealed sources in the laboratory in accordance with the direction of staff
- Anyone contemplating work with radio-isotopes or other radiation sources (e.g. X-ray machines) must first consult with the College Radiation Officer and the Institute Radiation Protection Officer, Dr.A.Evans

- Ultraviolet radiation of wavelength less than 340 nm is extremely damaging to eyes. Such radiation may come from electronic welding or mercury discharge lamps. Sources must be properly shielded and adequate protection must be worn.

Laser Safety in Undergraduate Laboratories IMAPS

A small number of lasers are used in undergraduate laboratories in IMAPS, Aberystwyth, both for practical work and experimental physics. Lasers have the potential for eye damage unless some simple precautions are employed. (See, for example, <http://www.derm.ubc.ca/laser/eyesafety.html>) The overall administration of laser safety in IMAPS is the responsibility of the Institute Laser Safety Officer.

Safety thresholds for lasers are expressed in terms of maximum permissible exposure (MPE) and lasers are generally divided into classes on the basis of this. Use of class 3B and class 4 lasers will be restricted to Laser Designated Area i.e. laboratories or other clearly defined areas that are set aside for the purpose, and where hazards can be effectively controlled. Laser Designated Areas are not normally required for work with Class 1,2 and 3R i.e. lasers with powers below 5 mW.

Lasers of class 3B and 4 are not to be used in undergraduate laboratories.

The laser classifications are as follows:

Class 1

A Class 1 laser is safe for use under all reasonably anticipated conditions of use; in other words, it is not expected that the MPE can be exceeded. Such lasers can produce no more than 40 μ W in the blue and 400 μ W in the red.

Class 1M

Class 1M lasers produce large-diameter beams, or beams that are divergent. The MPE for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow down the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed.

Class 2

A Class 2 laser emits in the visible region. It is presumed that the human blink reflex will be sufficient to prevent damaging exposure, although prolonged viewing may be dangerous. Such lasers will produce no more than 1 mW in the visible region.

Class 2M

A Class 2M laser emits in the visible region in the form of a large diameter or divergent beam. It is presumed that the human blink reflex will be sufficient to prevent damaging exposure, but if the beam is focused down, damaging levels of radiation may be reached and may lead to a reclassification of the laser.

Class 3R

A Class 3 laser is a continuous wave laser which may produce up to five times the emission limit for Class 1 or Class 2 lasers. Although the MPE can be exceeded, the risk of injury is low. The laser can produce no more than 5 mW in the visible region.

Class 3B

A Class 3B laser produces light of an intensity such that the MPE for eye exposure may be exceeded and direct viewing of the beam is potentially serious. Diffuse radiation (i.e., that which is scattered from a diffusing surface) should not be hazardous. CW emission from such lasers at wavelengths above 315nm must not exceed 0.5 watts.

Class 4

Class 4 lasers are of high power (typically over 500 mW or more if cw, or 10 J cm⁻² if pulsed). These are hazardous to view at all times, may cause devastating and permanent eye damage, may have sufficient energy to ignite materials, and may cause significant skin damage. Exposure of the eye or skin to both the direct laser beam and to scattered beams, even those produced by reflection from diffusing surfaces, must be avoided at all times. In addition, they may pose a fire risk and may generate hazardous fumes.

General rules for use of a particular class of laser

Class 1

- The laser must be correctly labelled
- No safety controls necessary

Class 1M

- The laser must be correctly labelled
- Avoid intrabeam viewing with condensing optics such as microscopes or telescope

Class 2

- The laser must be correctly labelled
- A beam stop must be used
- Keep path beams above or below eye level
- Prepare local rules following a risk assessment

Class 2M

- The laser must be correctly labelled
- A beam stop must be used
- Keep path beams above or below eye level
- Prepare local rules following a risk assessment
- Avoid intrabeam viewing with condensing optics such as microscopes or telescope

Class 3R

- The laser must be correctly labelled
- A beam stop must be used
- Keep path beams above or below eye level
- Prepare local rules following a risk assessment
- Avoid open beam paths wherever possible
- Affix warning labels at entrance to room
- Register the laser with the Laser Safety Officer
- Register the users with the Laser Safety Officer

Class 3B

- The laser must be correctly labelled
- A beam stop must be used
- Keep path beams above or below eye level
- Prepare local rules following a risk assessment
- Avoid open beam paths wherever possible
- Affix warning labels at entrance to room
- Register the laser with the Laser Safety Officer
- Register the users with the Laser Safety Officer
- Use laser safety glasses
- Use key control
- Provide a visible emission indicator at laser output

Class 4

- The laser must be correctly labelled
- A beam stop must be used
- Keep path beams above or below eye level
- Prepare local rules following a risk assessment
- Avoid open beam paths wherever possible
- Affix warning labels at entrance to room
- Register the laser with the Laser Safety Officer
- Register the users with the Laser Safety Officer
- Use laser safety glasses
- Use key control
- Provide a visible emission indicator at laser output

General rules for the operation of lasers

1. Before using a laser, determine its class and acquaint yourself with the special rules and restrictions applying to that class of laser. All lasers, except class 1, should be labelled with the following information:
 - Whether the output is visible, invisible or both
 - Maximum laser radiation output
 - Pulsed duration (if applicable)
 - Laser medium and principal emitted wavelengths
2. Ensure that you have studied any Risk Assessment or local rules relating to the laser. All users of class 3B and class 4 lasers must produce a risk assessment form. This must include the following information
 - Procedure for controlling access to any area where the laser beam is exposed
 - Details of warning lights, notices, etc.
 - Details of interlocks to control access and operate warning lights
 - Precautions taken to prevent specular reflection
 - Details of any eye protection provided and how and when it is used
 - Details of beam termination method
 - Name of person holding key to laser

3. Under no circumstances should the output of a laser be viewed along its beampath, either directly or by specular reflection or with the aid of an optical instrument
4. Always ensure that the laser beam cannot extend beyond its useful limit. A suitable beam stop must be used to prevent the beam leaving the experimental area.
5. Do not use a higher class of laser than is necessary
6. Do not tamper with the experimental set-up in such a way as to negate the safety precautions and beam limiting devices that have been incorporated.
7. Do not attempt to over-ride any shielding and interlocks on a laser.
8. At the end of an experiment, make sure the laser is switched off or returned to a safe condition.
9. Anyone found miss-using a laser in any way will be subject to disciplinary action and may be prevented from further use of lasers.
10. Always remember that you are responsible for the safety of others as well as yourself.
11. All incidents involving lasers that involve injury or the risk of injury must be reported to the Laser Safety Officer at once and no further work performed until an enquiry takes place.

Laser Designated Areas (LDA)

LDAs must be established for the control of hazards associated with Class 3B and Class 4 lasers. The purpose of the LDA is to minimise risk to persons working with lasers and to provide protection for all persons outside the LDA. Below are some general rules but an LDA may have its own, more comprehensive, local rules.

- A Laser Hazard warning sign must be incorporated into a suitable notice displayed at the entrance to each LDA. In addition, there should be a sign interlocked with the laser and illuminated to show that the laser is in operation.
- Entry to the LDA should be restricted to authorised persons appropriately educated in laser safety when the laser is in operation. It may be desirable to limit entry on other occasions.
- The laser must be positioned with care in relation to doors and windows. The beam must never be aimed at the door and must not traverse the room at head height unless it is totally enclosed and a beam stop is fitted.
- All surfaces away from the laser beam should be light coloured and have a matt surface. The general level of lighting should be as high as possible so that the pupil of the eye has its smallest possible diameter. Reflecting surfaces should be eliminated and a beam stop that is non-reflecting and fire-resistant must be fitted.
- Electrical equipment should be designed to eliminate trailing leads wherever possible.
- A clearly labelled Power Off button or switch must be fitted close to the laser.
- Controls that enable equipment to be isolated and made safe from outside the LDA must be available.

Institute of Mathematical and Physical Sciences Aberystwyth University

Please complete the sheet below and return it at the end of your first practical class. You will not be allowed to commence work in the laboratories in IMAPS until the signed declaration is received.

Universities are covered by the Health and Safety at Work Act; any infringement of safety regulations may result in disciplinary action by the college and/or criminal proceedings instituted by the Factories Inspectorate.

I have read and understood the copy of the IMAPS Safety Regulations and I undertake to abide by these regulations.

I note that, if I have, or develop during my course, any disability which might affect my safety or the safety of others during field work or in the laboratory, I should declare this to my supervisor/tutor in my department so that arrangements may be made for me to carry on my work without danger to myself or others.

I wish to inform IMAPS of my medical condition(s): (Yes / No)

Name (Block Capitals):

Signed.....**Date**.....

Aberystwyth Address: