Safety *in* Science Laboratories

Education Bureau
2013

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PREFACE

This safety handbook is a revised edition of the one published in 2002. There have been changes and additions to cater for the latest requirements in laboratory safety in schools and the way forward in curriculum development of science education.

The aim of this handbook is to enhance the standard of safety in school laboratories by drawing laboratory users' attention to the necessary safety precautions to be taken. It also promotes the awareness of potential hazards to minimise risks and advises on how to effectively deal with any accidents which may occur. We must, however, emphasise that the advice and information offered in this handbook are by no means exhaustive and do not preclude the need for exercising care and good judgement at all times in safeguarding against accidents.

The Education Bureau gratefully acknowledges the assistance given by the following departments / organisations in preparing this handbook:

Agriculture, Fisheries and Conservation Department
Department of Health
Electrical & Mechanical Services Department
Environmental Protection Department
Fire Services Department
Health, Safety and Environment Office, The Hong Kong University of Science and Technology
The Chinese Foundation Secondary School (Photograph)

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1 INTRODUCTION

In recent years, the learning and teaching of science in secondary schools has undergone rapid changes towards a much greater emphasis on open-ended investigation and experimental approach. It is, therefore all the more important for science teachers, laboratory technicians and students to pay attention to safety precautions when working in the laboratory or during a field study.

Schools are held responsible for taking all the necessary safety precautions to maintain a safe learning and working environment in the laboratory. Responsible persons of secondary schools should pay particular attention to Regulations 21, 24, 26, 27, 31, 32 and 33 of the *Education Regulations* in connection with safety in school laboratories (for ease of reference, these regulations are reproduced in Appendix I). The Regulations require, among other things, that responsible persons of secondary schools should ensure that all necessary safety precautions have been taken in science laboratories. Teachers in charge of science laboratories should assist the principals to ensure that the safety requirements are complied with, and supervise the work of the laboratory technicians under their charge.

In addition, schools should ensure that the requirements of the *Occupational Safety and Health Ordinance* are observed so as to ensure the occupational safety and health of their employees working in laboratories. Further information about the Ordinance can be found in Appendix II.

Apart from making sure that students are in compliance with the safety rules in laboratories, science teachers and laboratory staff should set good examples in this regard, and update themselves with the latest developments in laboratory safety. The following chapters provide guidelines and information on various aspects of laboratory safety and management for the reference of science teachers and laboratory staff. Other guidelines and information can be found on the website of "Resources on Laboratory Safety and Management" at *http://cd1.edb.hkedcity.net/cd/science/laboratory/content_safety.html*.

2 SAFETY MANAGEMENT

In order to ensure that safety measures adopted in secondary schools are properly implemented and any emergencies occurring in science laboratories are dealt with in an effective and efficient manner, every school should have an effective safety management system in place (e.g. a standing committee on laboratory safety) to monitor the standard of laboratory safety, to draw up and implement an emergency plan (including emergency measures, evacuation procedures and escape routes) and conduct inspections and evacuation drills regularly in school.

2. 1 Standing Committee on Laboratory Safety

The following guidelines on setting up a standing committee on laboratory safety are by no means prescriptive and exhaustive. It is the responsibility of each school to formulate proper safety and emergency management measures in light of its practical situation. In order to have better co-ordination of safety procedures, schools may group the Standing Committee with other related safety management groups, such as a Safety Management Committee or Fire Drill Group. In any case, the Standing Committee on Laboratory Safety (or its equivalent) must have adequate delegation from the principal to implement all safety and emergency management measures.

The Standing Committee on Laboratory Safety should be headed by a Laboratory Safety Coordinator chosen from among the science teachers. The membership should comprise all science teachers and laboratory technicians. To properly cater for the requirements of students with special educational needs in the school, one of the Standing Committee members should be knowledgeable in supporting students with special educational needs or the Standing Committee should invite a member of the Student Support Team to sit in the meetings.

The duties of the Standing Committee are as follows:

- convene regularly to discuss various issues related to laboratory safety such as the formulation or revision of laboratory safety policies and laboratory rules, the evaluation of laboratory accidents experienced and preventive measures that can be taken;
- plan and conduct laboratory safety training programmes regularly for school staff and students;
- ensure implementation of risk assessments for science experiments;
- carry out safety inspections regularly on the storage of chemicals, maintenance of fire-fighting equipment, personal protective equipment, first-aid boxes, fume cupboards, laboratory ventilation, etc., and rectify any irregularities spotted;
- formulate, implement and revise the emergency plan for dealing with emergency cases and dealing with students with special education needs, and compile of a list of students that may need greater support or supervision in the laboratory;
- conduct evacuation drills regularly;
- discuss on how to provide students with special education needs greater support or supervision in the laboratory, including the compilation of a list of these students and specifying their needs for teachers' reference; and
- formulate and implement different tailor-made plans for students with special education needs for dealing with emergency cases.

A deputy Laboratory Safety Coordinator should also be appointed and take charge of the duties of the Laboratory Safety Coordinator in the absence of the latter.

It is important that minutes of meetings of the Standing Committee on Laboratory Safety, accident records and incident records should be properly kept and made available for inspection when required.

2.2 Subject Panel Meetings

Science panel chairpersons should arrange at least one of the panel meetings each school year to discuss matters regarding laboratory safety, including review of risk assessments of science experiments, with their members. The meetings on laboratory safety should be conducted in parallel with the meetings of the Standing Committee on Laboratory Safety mentioned in Section 2.1 above, to follow up the resolutions passed and to provide feedback to the Standing Committee when necessary.

The duties of panel members related to laboratory safety should be clearly defined. Effective measures should be adopted to ensure all panel members provide adequate safety instructions and equipment to students so that learning and teaching are conducted in a safe environment. Adequate training should be provided to newly appointed teaching and laboratory staff as well as student teachers.

2.3 Laboratory Rules

To enhance laboratory safety, each school should formulate its own laboratory rules for compliance by science teachers, laboratory staff and students. When formulating such rules, schools should consider their practical situations and make reference to Chapter 4 of this handbook, and other guidelines given by the Education Bureau and other relevant government departments. The rules should be displayed conspicuously in laboratories and may be disseminated by other means, such as student handbook, parent circulars, handout, etc.

2.4 Lessons on Laboratory Safety

All science teachers should spare at least one lesson at the beginning of the school year for each class to teach the general aspects of laboratory safety to promote safety awareness and to understand safe practice as well as the general emergency measures and evacuation procedures. It should also be ensured that all students, including those with special educational needs, understand the instructions. They should also elaborate on the specific aspects of laboratory safety of individual experiments whenever appropriate during the normal delivery of science lessons.

2.5 Safety with Experiments

Teachers should ensure the safety of all practical activities and must be thorough in preparation, i.e. make certain that risk assessment has been conducted to evaluate the potential hazards in experiments and ensure appropriate control measures have been taken. Experiments should be arranged in such a way to minimise risks, for example, using the minimum amount and lowest concentration of chemicals, and replacing hazardous chemicals or dangerous procedures with safer alternatives whenever possible. Any demonstrations or student experiments that are newly conducted should be tried out before they are performed in class to avoid any unpredictable mishaps.

Before each experiment, teachers should give clear instructions to students and remind them of the potential hazards, safety precautions to take and proper ways to dispose of chemical wastes, etc. As far as possible, teachers should note the health conditions of

students so that precautions can be taken where appropriate. Teachers should also give sufficient supervision and guidance to students during experiments. A reasonably good control of class discipline should always be maintained. Reasonable accommodations for students with special educational needs should also be made for their meaningful involvment in the learning and teaching activities in laboratories.

2.6 Students' Medical History

Schools should issue a circular letter annually to parents to solicit their co-operation in reporting the medical history of their children. Details are available at the following website:
http://www.edb.gov.hk/en/sch-admin/regulations/sch-admin-guide/index.html

Schools should keep such students' health related records for reference, and ensure that such information is for internal reference only and should not be divulged to other parties without the consent of the parents concerned. Schools should observe the Personal Data (Privacy) Ordinance in handling the concerned records.

The Standing Committee of Laboratory Safety, science subject panels and teachers are recommended to scrutinise students' medical records and devise appropriate safety measures for students' participation in various science practical activities in and out of the laboratory. Please also read Section 6.6 on naphthalene and Appendix VIII on G6PD deficiency.

2.7 Laboratory Safety Inspections

Each laboratory should be regularly inspected to ensure that all safety measures are in place. If irregularities are spotted during inspection, prompt action should be taken to rectify the situation.

To facilitate regular and thorough safety inspections, it is desirable to compile a checklist detailing items which must be checked on a daily, weekly or monthly basis. A sample safety inspection checklist is provided in Appendix III. Schools may modify the checklist in light of the practical needs and conditions of their laboratories.

2.8 Using a Science Laboratory for the Purpose of Teaching Non-science Lessons

Schools should, as far as possible, avoid arranging non-science lessons to be conducted in science laboratories, especially the Chemistry laboratory. However, if a science laboratory is to be used as a classroom for teaching non-science lessons due to floating class arrangements, the teacher involved should note the following:

- clear laboratory safety rules should be given to students;
- students are not allowed to enter the laboratory unless the teacher is present; and
- students are not allowed to tamper with or remove any of the articles in the laboratory.

2.9 Laboratory Safety Information/Resources

Schools should formulate and adopt effective measures for handling information and resources on laboratory safety. All safety information and resources should be circulated among relevant teachers and laboratory technicians so that necessary safety precautions can be taken.

It is advisable to set up a "Safety Corner" for keeping all the safety information and resources, such as minutes of meetings, circulars and publications on laboratory safety issued by the Education Bureau and Material Safety Data Sheets. These materials should be kept in a specified place for easy access of science teachers and laboratory technicians. The contents should also be regularly updated.

2.10 Emergency Plan

The emergency plan should include a set of emergency measures and evacuation procedures, as well as detailed escape routes. In drawing up the emergency measures and evacuation procedures, schools should ensure that such measures and procedures can cope with different emergencies such as fire, explosion, spillage of dangerous chemicals, gas leakage and other serious laboratory accidents.

When drawing up emergency measures, schools should consider them in the following order of priority:

- firstly, how to minimise injuries;
- secondly, how to help the injured; and
- thirdly, how to cut down loss.

It is important that schools should assign one or more members of their staff to report the accident to relevant government departments (e.g. Fire Services Department, Education Bureau, etc.), to alert all school staff and students when an accident occurs, and to coordinate the evacuation when necessary.

In formulating evacuation procedures, schools should:

- set out the criteria for applying different evacuation procedures;
- devise steps involved in the evacuation; and
- look into any necessary follow-up action.

Schools should bear in mind that, in accordance with the nature of the accident, different levels of evacuation may be carried out (e.g. evacuating the staff and the students at the scene only, on the same floor or floors above the scene, or evacuating the whole school). In any event, evacuation should be carried out in a safe and orderly manner. In formulating evacuation procedures, steps should be taken to ensure that congestion will not occur in staircases and corridors.

Schools should draw maps showing in detail the escape routes from the science laboratories. Such maps should be conspicuously displayed in the laboratories, and schools should ensure that all staff and students are familiar with the escape routes.

Schools should also conduct regular evacuation drills in accordance with the evacuation procedures and escape routes.

Appropriate arrangement should be made for students with special educational needs including but not limited to those with visual impairment, hearing impairment and physical disability to cater for their specific limitations. These students should be clearly informed of emergency measures, evacuation procedures, and detailed escape routes. Barrier-free egress should also be ensured.

3 RISK ASSESSMENT

A hazard is anything with the potential to cause harm to a person or damage to property. A risk is the likelihood of a hazard causing harm in practice. Risk assessment is about the identification of the hazards involved in an activity and the preventive measures taken to control these risks. Sometimes, hazards can be identified by common sense and experience. All practical work must be carried out with safety in mind to minimise the risk of harming oneself and others—safety is everyone's responsibility.

3.1 When is a Risk Assessment Needed

A risk assessment is needed for any activity such as a student experiment, a teacher demonstration, or outdoor activity and any tasks undertaken by laboratory staff in which a hazard may be present. In science laboratories, most risks arise from the use of chemicals, electrical devices, living organisms, biological specimens, hot or sharp objects, etc. (see Section 24.2 for the common laboratory accidents reported in schools). Risk assessment should be carried out in advance by the person involved, and double-checked by a higher level of personnel.

Sometimes novel experiments may be suggested in science publications. Teachers should assess the potential risks associated with such experiments and do a trial run before performing them in class. If the risks cannot be easily controlled, teachers should neither demonstrate nor have students perform the experiments, for safety's sake.

3.2 Scientific Investigation

In recent years, there has been a marked increase in adopting an open-ended investigation and project-based learning approach in schools. Such a development is to be encouraged. Different science curricula also include a component of scientific investigation.

It is important to include safety considerations in the planning process. A risk assessment should be carried out by the students as part of the investigation plan and should be reviewed by teachers before the activities begin. Students have to know what the hazards are and how to minimise the risks. Appropriate emergency procedures must also be made known to teachers, technicians and students.

3.3 Making a Risk Assessment

The procedures of risk assessment involve:

- identifying hazards of the substances being used or made;
- assessing how likely the hazard is to actually cause harm and how serious that harm could be; and
- deciding what control measures to adopt to reduce the risk to an acceptable level, e.g. using a micro-scale apparatus, using a smaller quantity of substances, a more diluted solution, a less hazardous chemical, a lower voltage, a fume cupboard; adopting standard experimental procedures; training; using personal protective equipment, etc.

The above risk assessment should cover all preparation and experimental procedures, as well as disposal of hazardous residue from practical work. Other relevant factors such as size of the practical group, age, experience and ability of the students should also be considered.

Risk assessments are most conveniently made on a standard form. An example of the assessment form is provided in Appendix IV. The assessment procedures will become simple and straightforward when one realises that the intention is to protect oneself and others from any risks. When carrying out risk assessment, a record of findings should be kept as reference for risk assessment of similar procedures, and to help review the assessment in the future.

4 GENERAL PRECAUTIONS

The following are some general precautions concerning laboratory safety. These may serve as guidelines from which schools can work out a set of laboratory rules to be followed by every laboratory user, as well as to equip laboratories with necessary safety facilities/equipment. School should communicate safety precautions to laboratory users through effective means e.g. posters, signage where appropriate.

4.1 Students' Discipline in the Laboratory

1. Students should follow strictly the instructions given by the teacher.
2. Students should not enter the laboratory unless a teacher is present.
3. Students should not remove anything from the laboratory without permission.
4. Students should not rush around or play in the laboratory.
5. Experiments under way should not be left unattended.
6. Laboratory reagents and chemicals should be returned to the appropriate places immediately after use, with their labels facing the front.
7. Students should immediately report all accidents and breakages to their teacher.
8. Students should not suck fingers or pencils when in the laboratory since these may be contaminated with chemicals as well as germs.

4.2 Personal Precautions to be Taken by All Laboratory Users

1. Eating, drinking and smoking are strictly forbidden in the laboratory and preparation room.
2. Long hair, loose ties or other loose clothing items must be properly secured.
3. It is not recommended that students wear contact lenses in the laboratory areas.
4. Special care is needed when handling chemicals. It is important to foresee the potential hazards in each case and to take the proper precautions.
5. Wash hands after experiments, especially those involving the use of chemicals, living organisms and radioactive substances.
6. To avoid the possibility of allergy, extra care should be taken when handling pollen and fur.
7. Pipette fillers should always be used to help transfer liquid chemicals. Mouth pipetting is strictly forbidden.
8. If syringes are used for measuring or transferring liquid, needles should not be used, if possible. If needles are used, special precautions should be taken to prevent injury.
9. Heavy objects should be lifted with correct posture. Ask others for assistance whenever necessary. When carrying heavy objects, especially large bottles containing dangerous substances, an appropriate carrier or trolley should be used as far as possible.

10. Appropriate safety facilities and personal protective equipment should be used whenever necessary. Please refer to Sections 4.4 and 4.5 respectively for details.

11. During demonstrations, safety screens should be used to separate students from apparatus when hot liquids or chemicals are likely to splash.

4.3 Housekeeping

1. The laboratory and the preparation room should be kept clean and tidy at all times. Broken glass and chemical spillages must receive immediate attention. Broken glass should be placed in a separate container and clearly labelled.

2. All exits and passages should be kept clear and none of the exit doors should be locked when the laboratory is in use. Maps showing detailed escape routes should be conspicuously displayed in each laboratory.

3. The lighting in the laboratory and preparation room should be good and sufficient. Working under insufficient lighting can be dangerous.

4. Bunsen burners, rubber tubing and gas taps should be given safety checks yearly.

5. Good ventilation in the laboratory should be maintained with an annual inspection. Fume cupboards should also be given an annual safety check.

6. Every reagent bottle should be clearly labelled. All old and blurred labels should be replaced without delay.

7. Flammable and reactive chemicals must be securely stored in strong cupboards under lock and key and away from heat sources. Such chemicals should be inspected regularly. An updated chemical inventory should be kept.

8. Incompatible chemicals should be stored separately.

9. Food or drink should not be kept in the laboratory except for experimental purposes. In such cases, a label with "For Experiment Use Only" should be affixed.

10. Posters on laboratory safety and rules should be displayed in prominent positions to promote the awareness of laboratory safety.

11. Before leaving the laboratory unattended for a long period of time, all water taps, electrical switches and gas mains should be turned off, and all windows and doors should be locked.

4.4 Safety Facilities

Adequate safety facilities must be provided and kept in a state of instant readiness at all times. Science teachers and laboratory technicians should be familiar with the usage of the safety facilities.

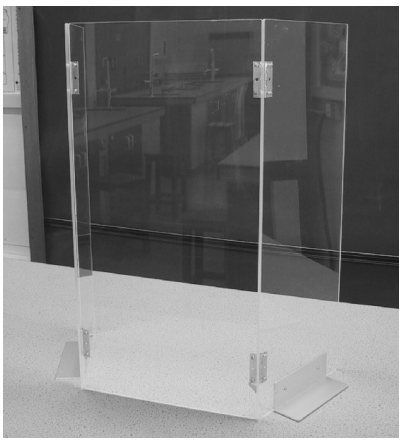
4.4.1 Fire-fighting Equipment

Every laboratory must be equipped with at least one appropriate fire extinguisher: either the carbon dioxide or dry powder type. Fire extinguishers should be inspected by a registered contractor at least once in every 12 months. In addition, there should be an approved type of fire blanket and two buckets of sand in every laboratory. These facilities should be used solely for fire fighting purposes, be easily accessible and not be obstructed.

Fire-fighting equipment should be kept in good condition and in a state of instant readiness at all times. All laboratory staff should be familiar with the operation and handling of all fire-fighting equipment.

4.4.2 Safety Screen

Each laboratory should be equipped with a safety screen. It should be used when demonstrating experiments involving potentially violent or exothermic reactions (e.g. reaction of sodium with water) and when working with glass apparatus under pressure, etc.



Safety screen

The safety screen separates the experimental set-up from observers, and guards against splashing chemicals or broken glass fragments reaching the students. The safety screen should always be kept clean. A scratched safety screen should be replaced without delay.

4.4.3 Spill Control Kit

Each laboratory should have at least one spill control kit to clean up chemical spillage. Suitable personal protective equipment should be worn when using the kit. The waste material from cleanup of chemical spills must be properly disposed of.

Spill control kit

4.4.4 First-aid Box and Eye Wash Unit

Each laboratory should be equipped with a first-aid box and an eye wash unit. Please refer to Section 23.4 for details.

4.4.5 Fume Cupboard

The fume cupboard is constantly required for carrying out laboratory work which may generate unpleasant, toxic or flammable fumes and gases. Experimental items inside a fume cupboard should be placed at least 15 cm from the front opening of the cupboard. Placing them closer to the front opening interferes with the airflow and reduces the level of protection. Keep the sash door at the lowest possible position during operation to enhance containment of chemicals and protection of users. Close the sash door when the hood is not being used. The fume cupboard working area should be kept clean and cleared when not in use. It should not be used as a storage space for glassware, apparatus and chemicals.

Please refer to Chapter 7 for details on the types of and procedures for proper use of fume cupboards.

4.5 Personal Protective Equipment

Students, teachers and laboratory staff, when working in the laboratory, should wear suitable personal protective equipment (PPE) in all circumstances wherever there is any potential risk of bodily injury. All PPE should be kept clean and properly maintained in a serviceable condition. Defective PPE should be replaced immediately. *The Guidance Notes on Personal Protective Equipment (PPE) for Use and Handling of Chemicals* (*http://www.labour.gov.hk/eng/public/os/C/equipment.pdf*) issued by the Labour Department provides a practical guide for selection of suitable PPE for use and handling of chemicals in the science laboratory.

4.5.1 Safety Spectacles and Goggles

Each laboratory should be equipped with enough safety spectacles for use by every student. Safety spectacles must be put on when conducting experiments involving heating chemicals, handling acids, alkalis and other corrosive chemicals, working with glass apparatus under pressure, carrying out potentially violent or exothermic reactions, or when there is any potential risk of eye injury. Whenever safety spectacles are required, they should be continually worn by all until everyone has finished the relevant activity.

Safety spectacles

Indirect vented goggles allow the free movement of air but prevent the direct passage of liquid. It provides more protection than safety spectacles.

Indirect Vented Goggles

Scratched or defective safety spectacles should be replaced without delay because they may affect visibility and cause strain to the eyes or fail to serve their protective purpose. Dirty safety spectacles should be cleaned with detergent or disinfectant (e.g. Savlon) as appropriate.

It is a good personal hygiene practice to clean safety spectacles with disinfectant (such as an alcohol wipe) before and after each use.

4.5.2 Face Shield

Each laboratory should be equipped with a face shield for use by teachers in demonstrations or by laboratory technicians in preparatory work. It can be used when dispensing large volumes of concentrated acids, alkalis or corrosive chemicals and opening containers which are under pressure. A face shield provides maximum protection for the eyes and face, with a very wide angle of vision.

Face shield

4.5.3 Protective Gloves and Laboratory Gown

Appropriate protective gloves should be worn for hand protection while handling corrosive chemicals, hot objects, microorganisms, etc. Chemical resistant gloves made of appropriate materials, such as nitrile, should be worn when handling chemicals. Gloves made of cotton or other heat resistant materials should be used for hot objects. Although thin surgical gloves made of latex are protective against biological materials, and provide good dexterity, some people are allergic to latex, and latex is NOT protective against many chemicals. Thin nitrile gloves are a good alternative, and nitrile also provides protection against common chemicals. Users should check the integrity of gloves by visual inspection or inflating them with air before usage; damaged gloves should be replaced immediately. Remember, gloves are consumable and must be checked regularly and replaced as necessary.

Laboratory gowns should be worn for body protection whenever necessary. However, torn or ragged gowns can be dangerous instead of protective; such damaged items should be replaced immediately.

Protective gloves

Disposable Nitrile gloves

4.5.4 Respirator

Respirator users should receive a medical examination (lung function test) prior to using a respirator and once annually thereafter. Users should also be fit-tested to select an appropriate size of respirator. Prior to using one, the user should check its fit to ensure a proper face seal.

Respirator

If it is decided a respirator is to be used, it should be equipped with suitable filter cartridges based on the hazardous chemicals to be handled. The respirator should be worn when operations involving hazardous vapours/gases have to be performed outside a fume cupboard, e.g. transfer of chemical waste. It should also be used when cleaning up spills of toxic and volatile chemicals. The filter cartridges should be regularly replaced to ensure that they are available for immediate use.

Where practical, users should be given respirators for their exclusive use. Respirators not issued on a personal basis should be cleaned and disinfected after each use.

4.6 Using Air-conditioners in Laboratories/Laboratory Preparation Rooms

If schools have installed air-conditioners in their science laboratories/laboratory preparation rooms, all users of these special rooms including students, teachers, and laboratory staff should take appropriate safety measures to ensure that there is adequate ventilation in the rooms during practical activities.

When Bunsen burners or chemicals are to be used, all air-conditioners should be switched off and exhaust fans switched on. The windows of these laboratories should be left open. Notices to this effect should be conspicuously displayed in the laboratories.

To maintain an adequate fresh air supply in the laboratory preparation room, the exhaust fan must be switched on whenever the room is in use.

Chemicals which generate hazardous vapours should not be handled or stored inside preparation rooms, whether air-conditioned or not. Preparation work which involves unpleasant or hazardous vapours/gases should not be conducted in preparation rooms but in fume cupboards of the laboratories.

Attention should be paid to regular cleansing of the air filter in the maintenance of air-conditioning facilities.

5 FIRE PRECAUTIONS

5.1 Fire-fighting Equipment

5.1.1 Fire Extinguisher

Every laboratory must be equipped with at least one appropriate fire extinguisher, either carbon dioxide or dry powder. Both carbon dioxide and dry powder fire extinguishers are suitable for ordinary combustible fires, flammable liquid fires and electrical fires. The dry powder type is also suitable for metal fires.

A fire extinguisher should normally be installed near an exit and be easily accessible, i.e. not more than 900 mm above the floor. The school is required to ensure that fire extinguishers are kept in good condition at all times, by subscribing to annual inspection services from contractors. Apart from annual inspection, each fire extinguisher shall undergo a hydraulic pressure test at least once every five years, by a registered fire services installation contractor.

Carbon dioxide fire extinguisher

5.1.2 Fire Blanket

Every laboratory must be equipped with at least one fire blanket of an approved type. The fire blanket is used for smothering clothing which has caught fire. They should be kept in the laboratory solely for fire fighting purposes and be located at readily accessible positions.

Fire blanket

5.1.3 Sand Bucket

There should be two buckets of sand in each laboratory. They are suitable for putting out small fires involving burning metals (e.g. sodium, powdered zinc, magnesium, etc.) and phosphorus. It is advisable to equip each sand bucket with a scoop.

Sand bucket

5.2 Exits

An illuminated exit sign bearing the word "EXIT" and the characters "出口" should be installed at each exit in accordance with the relevant Code of Practice issued by the Fire Services Department. For safety reasons, no exit door in the laboratory should ever be locked during lessons. Schools should also ensure that the fire-resistant doors are closed, but not locked. The passage for the laboratory exits should always be kept clear of obstacles.

Illuminated exit sign

5.3 Visual Fire Alarm

To alert those with hearing impairments, a visual fire alarm (a red flashing light) bearing the words "FIRE ALARM" and the characters "火警" should be installed in accordance with the circular letter No.4/2001 issued by the Fire Services Department.

Visual Fire Alarm

5.4 Fire Drills

Schools should conduct fire drills regularly. Maps showing detailed escape routes should be conspicuously displayed in each laboratory. All students, teachers and laboratory staff should be familiar with the escape routes from the laboratories.

5.5 Storing Flammable Substances

Every storeroom, cupboard and container used for storing flammable substances should be clearly and boldly marked with "Flammable Substances 易燃物品".

As advised by the Fire Services Department, schools should ensure that ethanol (ethyl alcohol) is not stored together with kerosene or thinner in the laboratory, workshop or in any other rooms, including the dangerous goods store within the school premises.

Storage of dangerous goods in the laboratory should not exceed the exempted quantity or the aggregated quantity specified in the *Dangerous Goods (General) Regulations*. If schools have any enquiries or difficulties in complying with the Regulations, please contact the Licensing and Certification Command, Fire Services Department at 2733 7619.

5.6 Evacuation in Case of Fire or Explosion

When there is a fire or an explosion in a science laboratory, the school should make use of all staff available to immediately evacuate students from the laboratory or the whole school building if the situation becomes serious. It is essential that any such evacuation should be carried out without using the lifts, in an orderly and controlled manner, and that every effort should be made to avoid panic amongst students.

The gas supply and electricity should be turned off at the mains, if practicable, when it is necessary to evacuate the laboratory. It is essential that all science teachers and laboratory technicians know the positions of the mains controls.

Meanwhile, the Fire Services Department should be quickly notified by dialing 999. The Education Bureau should also be notified of the incident.

6 HAZARDOUS CHEMICALS AND THEIR STORAGE AND USE

Hazardous chemicals may be defined as those which may cause injury to persons or damage to property. Chemicals may be hazardous because they are corrosive, flammable, irritant, toxic, harmful, oxidising, explosive or carcinogenic. Many hazardous chemicals may involve more than one hazard.

Good housekeeping, regular inspection as well as clear and exact labelling are essential for minimising accidents resulting from the storage of chemicals.

6.1 General Precautions in Acquiring and Storing Hazardous Chemicals

6.1.1 Acquisition and Storage

1. Before acquiring a chemical, its hazardous nature should be assessed. Safer alternatives to hazardous chemicals, if available, should be acquired for use.

2. All chemicals must be kept in a proper container clearly marked with the names and hazard warning symbols of the chemicals, preferably date-stamped on date of arrival.

3. A clear and updated inventory of chemical stocks, showing their locations, should be kept. This inventory should be regularly (e.g. annually) updated.

4. Hazardous chemicals should be stored in a locked room or cupboard except when the chemicals are being used in experiments. The key to the locked room or cupboard must be kept under control of the teacher in charge of the laboratory.

5. The bulk of hazardous chemicals should be stored in a chemical storeroom if available. Over-stocking of chemicals should be avoided. Storage of dangerous goods in the laboratory should not exceed the exempt quantity or the aggregated quantity specified in the *Dangerous Goods (General) Regulations*.

6. The preparation room and storeroom should not be accessible to students.

7. Where school laboratories have no adjacent preparation room/storeroom, there is an increased obligation on the supervisor, principal, science teachers and laboratory technicians to ensure that dangerous chemicals are properly stored in locked cupboards, to which students have no access.

8. The storage area for chemicals should be provided with sufficient fresh air ventilation.

9. Volatile liquids must be stored in a cool place, away from sunlight or heat sources. Their containers should never be completely filled.

10. It is good practice to store flammable chemicals in fireproof cabinets. Flammable liquids should never be kept on open shelves, nor should they be readily accessible to students. They should be stored away from any heat source.

11. In general, chemicals, especially hazardous ones, should not be stored on high shelves where there would be a risk of dropping when taking them down for use. The main stock of concentrated sulphuric, nitric and hydrochloric acids, 0.88 ammonia, and flammable liquids should be stored as near to floor level as possible.

12. Spillage trays should be placed under hazardous liquids.

13. It is good practice to check compatibilities of chemicals in chemical cabinets. Incompatible chemicals should be stored separately.

6.1.2 Information on Chemical Hazards

All containers of hazardous chemicals, including bench reagent bottles, should bear appropriate hazard warning symbols which depict the nature of the chemicals and hence serve to alert laboratory users. More than one symbol should be used for chemicals with more than one hazard. Some hazard warning symbols in common use are shown in Appendix V.

The Material Safety Data Sheets (MSDSs) for all hazardous chemicals used should be readily available in each science laboratory. They provide important hazardous information about the chemicals, including the nature of the hazard, safe handling procedures, first-aid measures and emergency procedures, for reference of laboratory users at any instance. MSDSs also form an important basis for risk assessment of experimental procedures involving such chemicals.

MSDSs are usually available from suppliers of chemicals or on the Internet. A set of MSDSs covering 450 chemicals commonly used in school laboratories has been prepared by the City University of Hong Kong. It is available on the web pages of the City University of Hong Kong and the Science Education Section, Education Bureau.

6.1.3 Storage of Special Reactive Chemicals

Chemicals which have to be kept in suitable immersion liquids (e.g. sodium in paraffin oil) should not be kept on the same shelf where they could be confused. An additional label showing the name of the immersion liquid should be stuck on each container. The adequacy of immersion liquid should be regularly inspected.

Water-reactive chemicals such as silicon tetrachloride, when in contact with water or moist air, can give out flammable or harmful gases. This may also result in a build-up of pressure inside the container and cause cracking of the bottle if the stopper is jammed. These chemicals should be kept dry by storing them in tightly sealed containers or desiccators, away from heat and moisture. It is always advisable to keep only the minimum quantity sufficient for current use.

6.1.4 Regular Inspections

Chemicals in containers should be regularly checked to spot any signs of change, leakage or spillage. Once detected, appropriate corrective actions should be taken. Adequate and suitable equipment (e.g. spill control kit and personal protective equipment, etc.) should be readily available for trained laboratory staff to handle chemical spillages/leakages according to proper emergency procedures. Blurred or detached labels should also be replaced immediately.

6.2 Corrosive Chemicals

Corrosive chemicals refer to those chemicals which may cause serious injuries on prolonged contact with skin. Special care is called for when storing or using the following corrosive substances:

ammonia, bromine, ethanoic acid, hydrochloric acid, hydrogen peroxide, methanoic acid, nitric acid, potassium hydroxide, sodium hydroxide and sulphuric acid

Corrosive chemicals should always be handled with suitable chemical resistant gloves on. Clothing contaminated with corrosive chemicals should be carefully removed for cleaning or disposal of. Chemical splashes on skin should be immediately washed with plenty of water. However, it should be noted that some chemicals, such as concentrated sulphuric acid, have highly exothermic reactions with water. Splashes of these chemicals on skin should be quickly soaked up as far as possible with a dry cloth before drenching the area with a large amount of water.

The following are safety precautions in storing selected corrosive chemicals:

Chemicals	Storage
Ammonia (25%)	Cool, dry, well-ventilated and at floor level. Isolate from halogens and acids. Ammonia is corrosive and very volatile; wear nitrile gloves and open stock bottles in fume cupboard.
Bromine	Store apart from incompatible materials in a cool place. Stopper the bottle tightly after use, and handle only in a fume cupboard. Keep bottle of bromine in a desiccator with soda lime at the bottom. Fresh purchases should be in the form of ampoules which are more convenient to store.
Hydrochloric acid, concentrated	Store at floor level in a well-ventilated room. Isolate from strong bases and oxidising agents, particularly nitric acid, chlorates and methanal (formalin or formaldehyde).
Hydrogen peroxide (30%)	Keep in brown bottles, away from heat and sunlight. Hydrogen peroxide is fairly stable when pure but may decompose explosively, particularly in contact with dust particles or finely divided metals.

Chemicals	Storage
Nitric acid, concentrated	Store at floor level in a well-ventilated room. Isolate from reducing agents, metals, strong alkalis, organic chemicals and sulphides.
Potassium hydroxide (solid) and sodium hydroxide (solid)	Store dry in well-sealed containers. Keep away from acids.
Sulphuric acid, concentrated	Store at floor level in a cool, dry, well-ventilated place, away from strong alkalis, chlorates, perchlorates, permanganates, cyanides, sulphides and metals.

6.3 Flammable Chemicals

Flammable chemicals may be gases, liquids or solids. The use of such chemicals in science laboratories poses a fire and sometimes an explosive hazard. The following precautions should be taken:

- no smoking, no flames and no electric hot-plates
- fire-fighting equipment must be at hand
- flammable chemicals must not be poured down the drain

6.3.1 Flammable Gases

These include hydrogen, hydrogen sulphide, carbon monoxide, town gas, LP gas, and hydrocarbon gases. Most of them form explosive mixtures with air or oxygen.

6.3.2 Flammable Liquids

Flammable liquids not only burn in air but their vapours also form explosive mixtures with air. They include ethoxyethane (diethyl ether), ethanol, ethyl ethanoate, methanol, propanone (acetone) and petroleum ether.

In general, all organic liquids should be treated as flammable and appropriate safety measures should be taken when working with them. Volatile flammable liquids must be stored in a cool place (not in a refrigerator) at floor level, away from heat sources and direct sunlight. Their containers should never be completely filled.

Volatile flammable liquids should never be placed in domestic refrigerators. If placed in refrigerators with thermostat controls and a door-switch which may spark in operation, these liquids can give out vapours which may be ignited by the sparks, thus causing an explosion.

The following are safety precautions in storing ethoxyethane:

Chemical	Storage
Ethoxyethane (diethyl ether)	Ethoxyethane (diethyl ether) can ignite when the vapour or liquid comes into contact with a hot surface. Ether peroxide can be formed by air oxidation of diethyl ether. Ether peroxide is highly explosive. Explosion may result when "old" samples of diethyl ether are distilled or evaporated to a small volume, due to formation of ether peroxide. If in doubt, test with potassium iodide solution. A yellow or brown colour indicates the presence of the peroxide. Diethyl ether should not be kept for more than one year and should be stored in half-empty bottles.

6.3.3 Flammable Solids

Some solids burn upon exposure to air, water or heat. Some ignite spontaneously when subject to friction, or give off flammable gases upon contact with water and moisture. Flammable solids in this category include aluminium and magnesium powder, sodium and sulphur.

The following are safety precautions in storing selected flammable solids:

Chemicals	Storage
Alkali metals: e.g. sodium	Cover with paraffin oil in well-sealed glass bottles. Keep bottles in metal containers and store dry. Old stocks of sodium which appear yellow due to the formation of superoxides are liable to explode upon friction or shock. It is therefore strictly forbidden to use these old samples for practical work or to cut them into small pieces with a knife as it would entail an explosion. As a general guide, it is advisable ♦ to purchase these metals only in small quantities (i.e. to keep not more than 100 g of each metal in the laboratory); ♦ to date-stamp the these metals upon arrival; ♦ to check the stock of these metals in the laboratory regularly, making sure that there is enough immersion liquid; and ♦ never store these metals in the refrigerator.
Metal powders: aluminium powder and magnesium powder	Keep dry. Isolate from strong oxidising agents.

6.4 Irritant Chemicals

Irritant chemicals usually refer to those chemicals which can cause, by themselves or their vapours, inflammation through immediate, prolonged or repeated contact with the eyes, skin or respiratory system. Though some chemicals are not classified as irritant, their vapours may still have certain irritant effects. Protective gloves should be worn and good ventilation should be ensured when handling these chemicals. **Do not allow people with asthma to smell irritating gases.** Containers of these chemicals should be opened with particular care in a fume cupboard.

Irritant chemicals should be stored inside a cool and well-ventilated room.

Students should also be made aware of the hazards associated with the use of the following substances:

1. Halogens are strong irritants to the eyes and skin. Experiments involving halogens should be carried out inside a fume cupboard.
2. The vapour of ethanoic acid irritates the respiratory system, skin and eyes.
3. Methanal (formaldehyde) vapour irritates the respiratory system and eyes. Its solution (formalin) irritates the skin and eyes.
4. The vapour of trichloromethane (chloroform) irritates the eyes.

6.5 Toxic Chemicals

Toxic chemicals are substances which if inhaled, ingested or absorbed through the skin, may involve serious, acute or chronic health risks and even death. No chemical should be tasted. Teachers should impress upon students the dangers of eating food in the laboratory, or using laboratory glassware as drinking utensils. Students should be instructed to wash their hands before leaving the laboratory.

Toxic chemicals must be stored in proper containers (highly toxic chemicals should preferably be stored in double containment) and kept in a locked cupboard.

Students should also be made aware of the hazards associated with the use of the following substances:

1. Mercury, a cumulative poison, also yields a vapour which is toxic in as low a concentration as one in a hundred million. In this context, the preparation of oxygen by heating mercury(II) oxide is not recommended. Since mercury does produce a vapour, every precaution should be taken to avoid spilling, thereby minimising the risk of mercury poisoning. Any spills should be picked up at once (please refer to Section 8.1 for details of the treatment of mercury spill). Mercury thermometers should not be used. Mercury salts are also highly toxic.
2. Lead compounds are in general toxic. There is now clear evidence of the many harmful effects resulting from ingestion or inhalation of small quantities. It should be noted that lead poisoning is long term and cumulative. Science students, in

common with the rest of the population, are exposed to lead in the atmosphere and from many other sources. Every care should be taken not to add appreciably to the body's accumulation of lead as a result of experimentation in the laboratory.

3. Halogens such as chlorine and bromine are highly toxic by ingestion and inhalation. Experiments involving halogens should be performed in a fume cupboard.

4. Methanal (formaldehyde) is a strong irritant to mucous membranes of eyes and nose, and is a confirmed carcinogen. Although aqueous solution of methanol (formalin) has been widely used as a preservative of biological materials and specimens, every practicable measure should be taken to minimise exposure to methanal.

5. Common toxic gases, such as ammonia, bromine, carbon monoxide, chlorine, hydrogen sulphide, nitrogen dioxide, and sulphur dioxide, should never be directly smelled in the course of experiments. To smell the contents of a container (e.g. test tube), hold the container about 10 cm away from the nose and gently fan any odour from the hand towards the nose. **Do not allow people with asthma to smell toxic gases.**

6.6 Harmful Chemicals

Harmful chemicals are those substances which if inhaled, ingested or absorbed through the skin, may involve limited health risk. Although the level of harmfulness seems to be lower than that of toxic chemicals, similar safety precautions to those of toxic chemicals should also be taken when handling harmful chemicals.

Harmful chemicals should be stored under lock and key.

Students should also be made aware of the hazards associated with the use of the following substances:

1. Ethanedioic acid (oxalic acid) and ethanedioates (oxalates) are harmful in contact with skin and if swallowed. Pipette filler should always be used if aliquots of these are to be used volumetrically.

2. **Trichloromethane (chloroform)** vapour is a strong anaesthetic which may cause drowsiness, vomiting or unconsciousness. It is a suspected carcinogen. Short-term exposure to high concentrations can cause serious or even fatal poisoning.

3. Naphthalene is harmful by inhalation, ingestion and skin absorption. In addition, people with G6PD (glucose-6-phosphate dehydrogenase) deficiency when exposed to naphthalene (e.g. in mothball) may suffer from haemolysis (destruction of blood cells). **Teachers are advised not to use naphthalene in any science experiments.** The use of naphthalene in the experiments such as melting point determination and the study of cooling curves should be replaced by wax or octadecan-1-ol, which are safer alternatives. Please also read Section 2.6 and Appendix VIII.

6.7 Oxidising Chemicals

Oxidising chemicals are those chemicals which may give rise to highly exothermic reactions when in contact with other substances, particularly flammable substances.

Oxidising chemicals should be stored cool and away from flammable substances.

Students should also be made aware of the hazards associated with the use of the following substances:

1. Concentrated nitric acid will induce violent reaction when in contact with ethanoic acid, ethanol or propanone. It will also ignite when mixed with aluminium, lithium, magnesium, sodium or potassium. This acid should be stored at low level, preferably in a tray to contain spillages, and it should be kept away from metals and combustible materials including organic substances.

2. Potassium manganate(VII) (potassium permanganate) will form vigorously burning mixtures upon mixing with metal powders or combustible materials. Mixing potassium manganate(VII) with concentrated sulphuric acid will produce manganese(VII) oxide which can be explosive. This chemical should be kept away from other flammable chemicals in the laboratory.

6.8 Explosive Chemicals

Explosive chemicals are those chemicals which may start reactions spontaneously upon sudden change in temperature and pressure or under mechanical friction and vibration. The reactions are usually violent and explosion often results.

Explosive chemicals should be stored in a strong locked cupboard, away from heat and moisture and be regularly inspected. Containers of these chemicals should be marked with the date of receipt. It is always advisable to keep the minimum quantity sufficient for current use.

The following substances should not be stored in schools:

- 2,4,6-Trinitrophenol (picric acid) is potentially explosive when subjected to heating, scratching or abrasion.
- Azides may result from prolonged standing of Tollens' reagent, and are liable to explode without any apparent provocation.

6.9 Carcinogenic Substances

Carcinogens are substances capable of causing cancer.

In general, the effects of chemical carcinogens are long-term and insidious, rather than immediate and obvious. These substances can enter the body not only by ingestion, but also by inhalation and skin absorption.

The known cases of carcinoma in humans attributable to certain substances have normally been due to prolonged exposure in industrial conditions, either of manufacture or use. It is unlikely that students are at great risk while exposed to these compounds for the much shorter periods involved in educational experimentation. It should be made clear that no threshold dosage has yet been established nor has a safe maximum time of exposure. For as long as this information remains undetermined, it is advisable to take careful precautions. Safer alternatives should be used.

It is recommended that each school should prepare a list of the names and quantities of known or suspected carcinogens held under its control. This list should be kept up-to-date and should be retained by a senior staff member.

All carcinogenic substances should be stored in tightly sealed containers, preferably in double containment, labelled "CARCINOGEN", and kept in a locked cupboard.

6.9.1 Carcinogens

The following carcinogens should not be used in schools:

> asbestos, 4-aminobiphenyl, benzene, benzidine and its salts, chloroethene (vinyl chloride), coal tar, cyclophosphamide, 4-nitrobiphenyl, 4,4-dinitrobiphenyl, 1-naphthylamine and its salts, 2-naphthylamine and its salts

The use of asbestos wool and powder, which will create airborne asbestos fibres, is strictly forbidden in school laboratories. Glass wool and mineral wool (e.g. rocksil) are possible alternatives. Wire gauzes with asbestos centres should be replaced by wire gauze with ceramic centres. Asbestos boards should be replaced by suitable non-asbestos substitutes, e.g. bench mats made of glass-reinforced cement. Schools are strongly advised to replace asbestos fire blankets by fibreglass or other substitutes approved by the Fire Services Department. If schools wish to retain the asbestos specimen in the mineral specimen set used for teaching, they should ensure that the asbestos specimen be securely sealed inside a transparent plastic box.

Bis(chloromethyl) ether (BCME) can be formed spontaneously from the vapours of methanal (formaldehyde) and concentrated hydrochloric acid under normal laboratory conditions. It is a powerful carcinogen at very low concentration if inhaled continuously. Every precaution should be taken to reduce the chances of the two vapours mixing in the laboratory.

A complete list of known human carcinogens and relevant information can be found on the web pages of the International Agency for Research on Cancer (IARC) at *http://www.iarc.fr*.

6.9.2 Suspected Carcinogens

A large number of other substances, listed below, have been shown to cause cancer in animals. It is possible that they could have similar effects on humans.

- Polycyclic aromatics and their derivatives
- Aromatic amines, nitro compounds and related compounds
- *N*-nitroso compounds of the general formula RN(NO)R' and the related *N*-nitrosamides, RN(NO)COR'
- Complex mixtures such as crude oil
- Trichloromethane (chloroform) and tetrachloromethane (carbon tetrachloride)
- Other specific substances such as azoxyethane, 1,2-diethylhydrazine, urethane, thiourea, nitrogen mustard, tetramine and β-propiolactone, etc.

The above list is by no means exhaustive. The compounds named serve to indicate the wide range of substances which may have carcinogenic effects.

7 FUME CUPBOARDS

The fume cupboard is required for carrying out laboratory work which may generate unpleasant, toxic or flammable fumes and gases. The three main types of fume cupboards are conventional, by-pass and ductless.

School should always rely on ducted fume cupboards for containing and exhausting fugitive chemicals from laboratories. Ducted fume cupboards (i.e. conventional and by-pass) discharge chemicals to the outside, if probably installed, maintained, and used, they can provide necessary protection from chemicals for laboratory users. If additional fume cupboards are needed in particular laboratories, the school should install additional ducted fume cupboards if possible. In some instances, ductless fume cupboards may be an option to supplement existing ducted fume cupboards, due to their mobility and adaptability to laboratories where, for any reason, additional ducted fume cupboards cannot be installed. However, the school must have a full understanding of the limitations of ductless fume cupboards due to their design principles, and the different maintenance and use requirements.

7.1 Types of Fume Cupboards

7.1.1 Conventional Fume Cupboard

The conventional fume cupboard is a basic enclosure with an interior baffle and a movable sash. The face velocity is inversely related to the open face area, allowing a constant volume of air to be exhausted. If the sash is lowered, the inflow air velocity increases. With the sash in the near closed position, high face velocity may disturb equipment and apparatus in the hood, for example, extinguishing Bunsen burners or creating excessive turbulence.

7.1.2 By-pass Fume Cupboard

The by-pass fume cupboard generally operates at a constant volume and is designed so that as the sash is closed, a proportional fraction of the exhaust is drawn through an opening in the hood structure (usually above the sash and below the air foil) instead of through the remaining open face. The bypass limits the increase in face velocity as the sash nears the fully closed position, maintaining a relatively constant volume of exhaust air regardless of sash position.

7.1.3 Ductless Fume Cupboard

The ductless fume cupboard has a design similar to the conventional by-pass fume hood but is not ducted to the outside. The air is passed through a high-efficiency particulate air filter (HEPA), activated charcoal or impregnated activated charcoal for particulates, organic and inorganic compounds and the "clean air" is returned to the laboratory. It should be equipped with a breakthrough alarm or detection system to alert a breakthrough of the filter. Life times and absorption efficiencies of activated charcoal and impregnated activated charcoal filters are extremely variable and should only be used with very low hazard chemicals. The filters of ductless fume cupboards must be appropriate to the types of chemicals used or produced and replaced prior to failure.

Suppliers should provide written documentation (e.g. official test report and certificate) of filters proving the filtration efficiency and confirming the quantities of chemicals that the manufacturer certifies may be possibly retained on the appropriate filter. The ductless fume cupboard should be equipped with a filter breakthrough alarm or detection system to signify breakthrough of air contaminants and alert to saturation of sorbent materials. The outlet concentrations of air contaminants must be less than their corresponding Occupational Exposure Limits. Suppliers shall provide a suggested method(s) for filter breakthrough and/or saturation checks.

7.2 Selection, Test and Maintenance of Fume Cupboards

The fume cupboard should be properly maintained and tested annually. The annual test should include face velocity and smoke visualization tests. The exhaust ventilation system should also be checked regularly to ensure proper functioning.

7.3 Procedures for the Proper Use of Fume Cupboards

1. Wear proper personal protective equipment such as a laboratory coat, goggles and protective gloves.

2. Be aware that drafts from open windows, open doors, fans, air conditioners, or high traffic walkways may interfere with normal hood exhaust.

3. Before using the chemical fume cupboard, make sure air is entering the hood and hood is functioning properly:

   - Check the air flow indicator or
   - Try holding a small piece of paper near the bottom of the sash to see if air is flowing into the hood in a normal fashion.

4. Verify operation of the fume cupboard alarm (sash alarm or low flow alarm) before each use.

5. Hoods equipped with a combination vertical and horizontal sash are intended to be used primarily with the vertical frame down and the horizontal moving panels open. Never raise the sash vertically without closing the horizontal panels first.

6. Do not block baffle openings or place bulky items in the hood that will prevent air from entering the baffle opening.

7. Never store large quantities of chemicals in the hood. Chemical containers block airflow and create unnecessary hazards.

8. Set up apparatus as close to the back as possible.

9. Conduct work at least 15 cm from the edge of the hood.

10. Lower the sash to a reasonable height to protect yourself from dangerous reactions (use the glass as a face shield).

11. Avoid rapid movements in front of and inside the hood. This can cause air currents to draw contaminants out of the hood.

12. Do not let organic chemicals evaporate in the hood.

13. Do not leave uncapped bottles of chemicals or waste in a hood.

14. Keep hood clean and uncluttered. Wipe up spills immediately.

15. Close the sash completely when not working at the hood.

8 CHEMICAL SPILLS

Schools should have effective emergency measures to deal with spillage of chemicals. Laboratory staff should be well prepared to handle small-scale spillages that are likely to occur in school laboratories. Methods of safe handling of chemicals and dealing with spillages are usually provided in Material Safety Data Sheets. Adequate safety equipment (e.g. spill control kits, barrier tape, etc.) and personal protective equipment (e.g. protective gloves, respirators, safety goggles, etc.) should be readily available and accessible for use in handling chemical spills.

8.1 Handling Spills

All students and untrained personnel should be kept away from the immediate area of a spill. Before attempting cleanup, the degree of hazard should be assessed, proper procedures should be followed and necessary safety precautions should be taken. Appropriate personal protective equipment should be put on when dealing with spillages of hazardous chemicals. Spillage of solid materials that are non-hazardous can be treated with brooms, brushes and shovels. Liquid chemicals that are harmless can be mopped up with paper towels or absorbents.

Guidelines on cleanup of some chemical spills are as follows:

Nature of Spillage	**Cleanup**
Acids	Cover with solid sodium carbonate to completely neutralise the acids. Mop up with water.
Alkalis	Cover with solid sodium hydrogen sulphate or citric acid to completely neutralise the alkalis. Mop up with water.
Organic liquids	
♦ Non-flammable	Emulsify with detergent. Mix with water. Mop up.
♦ Flammable	Absorb in sand or mineral absorbent. Shovel into a metal bucket and dispose of as chemical wastes.
Mercury	As far as possible any drops spilt on the floor or the bench should be collected by means of a glass capillary tube attached to a vacuum pump (or water pump) via a suitable trap (e.g. a filter flask). Any remaining small drops (especially those in the crevices) should then be immediately covered with a paste of sulphur and lime. Leave for a few hours, then sweep into receptacles. Wrap in plastic bags and dispose of as chemical wastes.

8.2 Serious Chemical Spills

Teachers and laboratory technicians should not attempt to clean up chemical spills which involve a high degree of hazard. For these serious spills, students should be immediately evacuated from the laboratory. The area should be cordoned off and warning signs should be posted. The principal should be notified immediately to initiate other necessary emergency procedures.

In incidents where the spillage may result in significant contamination of an area or there is risk of pollution, dial 999 or contact the Fire Services Department for help. The Environmental Protection Department should also be informed immediately in case services from the CWTC Emergency Response Team are required.

9 PROCUREMENT OF CONTROLLED CHEMICALS BY SCHOOLS

To fulfil the international obligation under the *United Nations Convention Against Illicit Traffic in Narcotic Drugs and Psychotropic Substances, 1988*, controls have been introduced on 26 chemicals which can be used for manufacture of dangerous drugs. These controls are prescribed in the *Control of Chemicals Ordinance* (CAP. 145).

9.1 Controlled Chemicals in School Experiments

The following requirements of the Ordinance must be closely observed when procuring controlled chemicals.

9.1.1 **Acetylating Substances** (Schedule 1 chemicals under the Ordinance)

Schools wishing to acquire acetylating substances i.e. ethanoyl chloride (acetyl chloride) and ethanoic anhydride (acetic anhydride) for experimental purposes must apply for a Controlled Chemicals Licence from the Commissioner of Customs and Excise. The application for the licence should be made on Form CED 359. An inspection to ascertain the suitability of the prospective licensed premises will be arranged.

Schools possessing acetylating substances should store them in a locked cupboard in the laboratory and keep an up-to-date record of usage of these substances.

9.1.2 **Potassium Permanganate** (Schedule 2 chemical under the Ordinance)

Schools wishing to acquire potassium permanganate for experimental purposes must apply for Storage Approval from the Commissioner of Customs and Excise. The application for Storage Approval should be made on Form CED 360.

Schools should keep potassium permanganate in no more quantity than approved in a locked cupboard in the laboratory within the validity of the storage approval. They should also remember to renew their storage approval before its expiry date.

9.2 Submission of Application

Application for a licence or an approval for controlled chemicals should be forwarded to the Controlled Chemicals Group, Customs and Excise Department, 3/F, Customs Headquarters Building, 222 Java Road, North Point, Hong Kong.

As the Ordinance may be reviewed regularly to include more chemicals under its control, schools are advised to contact the Controlled Chemicals Group, Customs and Excise Department at 2541 4383 or refer to their web pages at *http://www.customs.gov.hk* for the latest list of controlled chemicals.

10 DISPOSAL OF CHEMICAL WASTES

All schools with science laboratories and/or technological subject workshops are required to comply with the *Waste Disposal (Chemical Waste) (General) Regulation* under the *Waste Disposal Ordinance* (CAP. 354) in respect of the registration with the Environmental Protection Department (EPD) as chemical waste producers and the storage and disposal of chemical wastes.

New schools not yet registered with EPD as chemical waste producers should do so as soon as possible by submitting a completed registration form (EPD 129) to EPD. EPD 129 is available at EPD offices and the EPD website. The general requirements for segregation, packaging, labelling, storage, collection and disposal of chemical wastes generated in schools are detailed in EDB Circular on Control of Chemical Wastes in Secondary Schools.

10.1 Chemical Wastes

Schools are required to store up, prior to collection for disposal by licensed collectors, the following main types of chemical wastes which arise as a result of practical work in science laboratories and technological subjects workshops:

- Spent acids with concentrations as defined in Schedule 1 of the Regulation (an abstract of Schedule 1 is in Appendix VI)
- Spent alkalis with concentrations as defined in Schedule 1 of the Regulation
- Spent non-halogenated organic solvents*
- Spent halogenated organic solvents*
- Surplus or expired chemicals.**

* If quantities of halogenated and non-halogenated solvents are not large, schools may use a single container to store both, and submit to waste collectors as halogenated solvents.

** Surplus, expired or old samples of sodium, potassium, phosphorus and other dangerous chemicals should be regarded as chemical wastes and properly disposed of.

If these chemicals are specified in Part A of Schedule 1 of the Regulation, schools should comply with the Part A Chemical Waste Notification requirements stipulated under section 17 of the Ordinance.

10.2 Chemical Waste Disposal Alerts

In order to prevent the mixing of incompatible chemicals, the following should be observed:

- A compatibility test should be done before adding new chemical waste to an existing waste pail.
- Never store chemical waste in a container which has been previously used for storage of other chemicals, even if it is now empty.
- Separate containers for different waste categories.

10.3 Storage Facilities

Schools should acquire adequate storage facilities for chemical wastes, viz. steel cupboards or steel and plastic trays, according to the specifications given in the latest Chemistry or Integrated Science Standard Equipment and Furniture Lists. The schools registered as chemical waste producers should receive 20-L pails, free of charge, from the Contractor of the Chemical Waste Treatment Centre (CWTC), if their wastes are to be collected by the Contractor.

10.4 Collection Services and Disposal Charges

Only licensed collector may collect and transport chemical waste from school laboratories to licensed disposal facilities. Where the wastes will be disposed of at CWTC, the Contractor will carry out regular collections from schools. For enquiries concerning the collection services, schools should contact CWTC direct (Tel: 2434 6450).

The schools registered as chemical waste producers are required to pay for the collection and disposal services offered by the CWTC. Non-profit making schools can apply in writing to EPD for a reduction or waiver of charges for disposal of chemical waste at CWTC.

11 GLASSWARE

All glass items should be handled and stored with care. Heat-resistant glassware should be used when contents are to be heated.

11.1 Handling Glassware

1. Large glass bottles should not be lifted or carried by the neck, nor cradled in the arms. The main body of the bottle should be grasped firmly, and trolleys or special carriers should be used.

2. When a tight glass-stoppered bottle is opened, the bottle should be placed in a trough large enough to hold the contents in case of accidental spillage and the stopper gently tapped. Brief gentle warming of the neck of the bottle can help if appropriate.

3. The fitting of a pipette filler to a pipette should be done gently. During the process, the pipette should be held at the upper stem to avoid accidental breakage.

4. When glass tubing and rods are being cut, hands should be protected with a piece of cloth when "snapping" the cut. The sharp ends of glass tubing should always be polished in a flame.

5. When inserting glass tubing into a cork or rubber bung,

   - the tubing should not be pointed towards the palm of the hand;
   - the size of the hole should be compatible with the size of the tubing and a lubricant should be used; and
   - a cork borer can be used to assist the threading of tubing through the hole of a rubber bung.

   It is always better to sacrifice a cork by cutting it than to struggle to remove stuck glass tubing.

6. Glass tubing should be stored vertically, whenever possible. If a horizontal rack is used, the tubing should not protrude beyond the end of the rack.

11.2 Cracked and Broken Glassware

1. Glassware showing signs of cracking or those items with broken edges should not be used for experiments.

2. Broken pieces of glass should be disposed of properly in a metal or plastic container assigned for such purposes and never into a general rubbish container. If glass is broken in a sink, the pieces should be removed from the sink with tongs.

3. Do not use bare hands to pick up broken glass.

12 USE OF FUEL GAS

12.1 Gas Supply

Schools should never attempt to carry out installation or repair work on gas pipework or appliances. By law, such work must only be undertaken by registered gas installers (RGIs) employed by registered gas contractors (RGCs).

If liquefied petroleum gas (LPG) is used in the laboratory, formal approval must be obtained from the Director of Fire Services and all fire services requirements formulated for such purposes must be observed at all times.

According to Regulation 8(2) of the Gas Safety (Gas Supply) Regulations (CAP. 51B), the owner of an LPG cylinder shall not use the cylinder to contain LPG unless the cylinder has been tested and examined not less than once in the 5 years period immediately preceding such use to ascertain whether the cylinder is safe to be so used. Expired LPG cylinders must be returned to the supplier.

The Gas Authority strongly recommends on safety grounds that LPG cylinders should not be stored inside school science laboratories. For schools in locations where a piped gas supply is not available, LPG cylinders should be housed in an approved chamber external to the school building with the gas supply piped into the laboratories. Unless specifically approved in accordance with the Gas Safety Ordinance, storing LPG cylinders (including empty cylinders) with a total nominal water capacity of over 130 litres (approximately 50 kg nominal weight) at any time is an offence. If schools have any enquiries about these recommendations, please contact the Electrical and Mechanical Services Department at 1823.

LPG cylinders must not be used in any locations below ground level where natural ventilation is not possible.

12.2 Ventilation

Make sure that ventilation in the room is adequate when Bunsen burners or gas appliances are to be used.

In laboratories and preparation rooms where air-conditioners are installed, all air-conditioners should be switched off and exhaust fans switched on when doing experiments. All windows of these rooms should also be left open.

12.3 Gas Burners

The main gas supply valve of the laboratory should only be turned on when gas supply is required, and all downstream gas taps inside the laboratory must be in the OFF position before the main valve is turned on.

Gas taps with safety locks are recommended. Older types of gas taps without safety locks tend to loosen with constant use, and should be checked from time to time and replaced when necessary.

Use the low pressure flexible tubing that is approved by the Electrical and Mechanical Services Department and bears the EMSD APPROVAL mark.

The rubber tubing connecting gas taps to Bunsen burners should be of a type suitable for use with the gas supplied and should be obtained from the gas supplier. Both ends of the tubing should be held in position by hose clips to prevent loosening. They should be inspected by an RGC at least once every 12 months for defects and replaced at least every three years or before the expiry date, whichever comes first.

Both ends of a rubber tubing should be held in position by hose clips

All unused gas taps should be properly secured to prevent them from being mistakenly turned on by students. All gas taps should be turned off after experiments have been completed.

12.4 Contingency Measures in Case of Gas Leakage

The location of the main gas supply valve to each laboratory (with ON/OFF positions clearly marked) should be made known to all concerned personnel so that it can be turned off when the laboratory is to be unattended for an extended period of time or in an emergency.

If a gas leak is discovered or suspected,

- all gas supply taps including the main valve to the laboratory should be turned off;
- all windows/doors should be opened wide;
- students should be evacuated from the laboratory area;
- electrical switches must not be operated; and
- all naked flames should be extinguished.

The gas leak should be reported urgently in accordance with the established procedures.

The main gas supply valve must not be turned on again until the gas leak inside the laboratory has been located and repaired by an RGC. However, when gas continues to escape into the laboratory after the main supply has been turned off, or when a smell of gas persists, then the Fire Services Department and the gas supply company must be contacted immediately in accordance with school emergency procedures.

As LPG is heavier than air, leaked LPG tends to accumulate at low levels. It will not dissipate easily unless there is plenty of ventilation at low levels. Town gas is lighter than air and can be diluted by opening windows wide.

13 COMPRESSED GAS CYLINDERS

The Fire Services Department grants exemption from licensing if the following maximum quantity of cylinders stored in each school is not exceeded:

Type of Compressed Gas Cylinder	Maximum Quantity
Oxygen	2
Nitrogen	1
Carbon dioxide	1
Hydrogen	1

Compressed gas cylinders should be handled with extreme care as a number of possible dangers are associated with the storage and use of compressed gas cylinders.

According to Regulation 66 of the Dangerous Goods (General) Regulations (CAP. 295B), the owner of a permanent or liquefied gas cylinder shall not use the cylinder to contain permanent or liquefied gas unless the cylinder has been tested and examined not less than once in the 5 years period immediately preceding such use to ascertain whether the cylinder is safe to be so used. Expired gas cylinders must be returned to the supplier.

13.1 Storage

1. Always secure cylinders to a wall or bench in an upright position.
2. Store cylinders in a cool and well-ventilated place, away from direct sunlight, heat or ignition sources.
3. Cylinders should be stored well clear of all corrosive substances.
4. Dirt, oil or water should be prevented from entering cylinder valves.
5. When not in use they should not be kept in the laboratory and should be removed to a well-ventilated storage or preparation room.
6. Keep the storage quantity of gas cylinders to a practical minimum and in compliance with the requirements under the *Dangerous Goods Ordinance.*
7. Empty cylinders should be immediately returned to the supplier.

13.2 Use

1. Always handle cylinders with great care and do not throw or bump them heavily. Inform the supplier immediately if the gas cylinder is found to be physically damaged.
2. Before use, the cylinder valve should be inspected. It is most important that the valve can be opened smoothly.
3. When in use, gas cylinders should be fixed in stands, wall brackets, or trolleys in an upright position.
4. Stiff valves should be treated cautiously. If possible, try to open the valve slowly by hand pressure using the standard key. Do not use hammers or excessive leverage and do not lubricate any valve or fitting. (This should be strictly observed, especially for oxygen cylinders).

5. Cylinders with stiff valves should be returned to the supplier immediately.

6. Do not handle oxygen cylinders, valves or any fittings with greasy hands, gloves or rags, to prevent oxidation of the grease under pressure, in which case an explosion may result.

7. Always use gas cylinders in a well-ventilated area to prevent asphyxia.

14 HANDLING PLANTS

14.1 General

Students should be warned not to ingest any plant materials used in experiments because some of them are poisonous (e.g. castor oil seeds), or contaminated with fungicides, pesticides, pollutants or spoilage microorganisms. Plant materials may also be contaminated during an experiment. Thus, remind students to wash hands after handling plants.

Keep plants known to contain irritants inaccessible to students, as the substances may cause allergic reactions. (Refer to Appendix VII for some common plants known to contain irritants.)

Students who are known to be hyper-sensitive to pollen should not be encouraged to handle flowers. Proper precautions should be taken when working with flowers. When dealing with plant specimens which bear spines or thorns, care must be taken. Suitable protective gloves should be worn.

14.2 Extraction of Chlorophyll

In the extraction of chlorophyll from leaves, using hot alcohol, care must be taken to minimise fire risk. Use alcohol only in the absence of naked flame. To prepare hot alcohol, heat the tube of alcohol by immersing it in a beaker of very hot water. When using other flammable solvents, such as propanone, for extracting chlorophyll for chromatography, the same precautions should be taken.

14.3 Free-hand Sectioning

In free-hand sectioning of plant specimens, care should be taken when holding a razor to prevent cutting the fingers. Do not use rusted or blunt razors. Handle double-bladed razors with special care.

14.4 Macerating, Fixing, Mounting and Staining

Macerating fluids can be harmful, corrosive or flammable. Appropriate care should be taken. Caution should also be used when handling fixatives, mountants and stains. Some chemicals can only be handled in a fume cupboard and not in open areas. It is recommended to wear chemical resistant gloves.

15 HANDLING MICROORGANISMS

15.1 General

Cultures of microorganisms should be treated as potentially hazardous due to the possibility of being contaminated by pathogens or becoming virulent as a result of mutation. Pathogenic microorganisms may gain access into the human body if a body surface with wounds or cuts is in direct contact with the culture, if aerosols above the culture are inhaled, or if contaminated food/drink is ingested. All microorganisms and their cultures should therefore be handled with caution.

Hygienic measures should be emphasized when working with microorganisms. Protective gloves should be worn. Laboratory gowns are recommended to prevent contamination of personal clothing. All wounds and cuts on body surfaces should be covered with sterile dressings before starting microbiological experiments.

Always employ aseptic technique when working with microbial cultures. Before and after work, clean the bench surface with disinfectant as well as wash hands. All unwanted cultures should be sterilized and disposed of after experiment.

Pipette fillers should be used to help transfer liquid cultures. **Mouth pipetting should be strictly forbidden during microbiological experiments.**

15.2 Microbial Culture

15.2.1 Microbial Source

Never culture microorganisms from potentially dangerous sources such as sewage, human mucus, pus or faeces. Use non-pathogenic microorganisms only.

Microorganisms can be cultured on agar medium or on substances on which they grow naturally, for example bread or fruit.

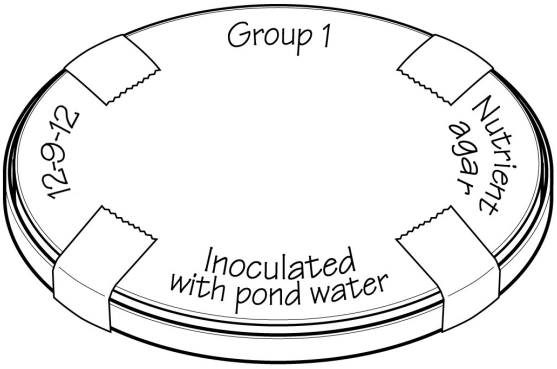
15.2.2 Inoculation of Culture

Always practise aseptic technique in inoculation. Immerse an inoculating tool, such as an inoculating loop and knife, in 70% alcohol before flaming, (but not in the reverse order, to prevent ignition of fire). Be cautious in handling the flamed loop. Cool down the inoculating tool so as to avoid killing the target microorganism and to reduce the risk of generating aerosols. Sterilise the inoculating tool immediately after use to avoid spread of the microorganism and contamination of the workplace.

15.2.3 Taping and Labelling

Using permanent felt pen or wax pencil, label the base of the petri dish rather than the lid, to avoid mix-up in case the base gets separated from the lid.

Always hold the whole petri dish set (the base and the lid together). Seal the dish with adhesive tape if necessary to avoid contamination or accidental separation of the base from the lid. Sealing can be made in a manner so as to allow gaseous exchange.



Taped and labelled sample of microorganism

15.2.4 Incubation of Microbial Culture

Cultures of microorganisms should be incubated in an enclosed environment, e.g. incubator. During incubation, the covered dishes should be placed upside down.

Most microorganisms used in school microbiological experiments grow well at room temperature. Raising the temperature to 37°C favours the growth of microorganisms pathogenic to humans and thus is not encouraged.

15.2.5 Examination of Microbial Culture

Transfer of microbial culture by students should not be encouraged.

Examine the specimens in a sealed state, e.g. in taped petri dishes or sealed transparent plastic bags. Opening the petri dishes containing cultures of microorganisms for inspection is not recommended. If the petri dishes containing cultures of microorganisms must be opened for inspection, the teacher or laboratory technician should kill the microorganisms by exposing the culture to methanal vapour (a filter paper soaked in 40% methanal solution (formalin) in a petri dish for 24 hours) in a ventilated fume cupboard prior to class inspection.

15.3 Handling Microbial Spillage

Microbial spillage should be dealt with by teachers or laboratory technicians. When clearing up the mess, protective gloves and laboratory gowns should be worn. Wear masks when appropriate. It is important not to inhale the aerosol cloud formed above the spill.

The spillage should be covered with a towel soaked in disinfectant (e.g. hypochlorite). The towel should be left in place for 15 minutes and then swept into a suitable container. The contaminated area should also be disinfected as appropriate. In case the skin comes into contact with the spillage, wash with liquid soap and water immediately and thoroughly. Seek medical help if necessary.

15.4 Disposal of Unwanted Cultures and Contaminated Materials

Unwanted cultures should be destroyed by steam under pressure (autoclave) or immersing in disinfectant for several hours before disposal. All apparatus contaminated with microorganisms or waste materials should also be treated in the same way before disposal.

The use of autoclaves in schools is governed by the Code of Practice for Owners of Boilers and Pressure Vessels, issued by the Labour Department. The autoclave has to be registered with the Labour Department, and examined and inspected regularly by Appointed Examiners. Autoclaves should be operated by competent persons unless the autoclaves are granted exemption in accordance with Section 9 of the Boilers and Pressure Vessels Ordinance.

15.5 Sterilisation after Microbial Work

After each microbiology practical, the bench surface should be wiped with disinfectant (e.g. 70% alcohol, 1:10 bleach solution) immediately.

Wash hands thoroughly with liquid soap and water after microbiological work. For drying purposes, paper towels are preferred and used ones have to be disposed of in a waste container with lid.

16 EXPERIMENTS IN BIOTECHNOLOGY

16.1 General

Precautionary measures should be taken when working with experiments in biotechnology, especially when handling deoxyribonucleic acid (DNA), cells and tissue culture, for the sake of laboratory safety as well as to avoid contamination. Aseptic technique should be employed if appropriate.

All cuts and wounds should be covered with sterile dressings. Protective gloves should be worn. Laboratory gowns are recommended to prevent contamination of personal clothing. Wash hands before and after experiments.

Manipulation of bacterial cells may be involved in biotechnology experiments . Take the necessary precautions as mentioned in Chapter 15 whenever appropriate.

Before handling experimental kits and delicate equipment, first read the operating manuals and become familiar with the operation procedures. Handle all pipetting devices with special care to avoid formation of aerosols during transfer. **Mouth pipetting is prohibited.**

16.2 Working with Deoxyribonucleic Acid (DNA) and Other Biomolecules

Isolation, analysis and manipulation of both DNA and other biomolecules are always involved in the study of biotechnology/molecular biology. Schools should ensure that all the samples used are biologically safe. The use of those potentially hazardous DNA fragments should be prohibited.

16.2.1 Electrophoresis

Electrophoresis of DNA fragments or other biomolecules should be operated at low voltages. Make sure the wire connection is correct and secured before switching on the power supply. Switch off the power supply before transferring the gel for staining. If home-made electrophoresis equipment is used, make sure it is carefully constructed for safe handling.

16.2.2 Handling Reagents

Toxicity or harmfulness of reagents, such as restriction enzymes and stains, should be checked and proper precautions should be taken.

Care should be taken when staining DNA with dye. A common non-specific dye, methylene blue may be used. **Ethidium bromide** and **propidium iodide**, which are specific to nucleic acids, are mutagens and should not be used in schools. Non-mutagenic DNA stain or equivalence should be used.

16.3 Tissue Culture

In tissue culture, plant materials are commonly used. If animal cells are cultured, ensure that they do not harbour any pathogens. Refer to the safety precautions mentioned in Chapter 17 whenever appropriate.

Reagents involved in the preparation of tissue culture may be harmful and should therefore be handled with care to prevent exposure to personnel and contamination of the laboratory area.

16.4 Disinfection after Practical Work

All used glassware and plasticware that have been in contact with DNA, biomolecules, bacterial cells and tissue culture should be considered as contaminated. They should be soaked in disinfectant (e.g. hypochlorite) for at least one hour or sterilised using steam under pressure (autoclave) before cleaning or disposal.

After each practical on biotechnology, the bench surface should be wiped with disinfectant (e.g. 70% alcohol, 1:10 bleach solution) immediately. Wash hands thoroughly with liquid soap and water.

17 HANDLING ANIMALS AND ANIMAL PRODUCTS

17.1 General

It is common for schools to use live animals, taxidermic specimens, specimens from abattoirs (e.g. ox eyes and pig hearts), and other animal products for laboratory use. As the animals and animal products may carry germs or parasites, hygienic measures should therefore be emphasized. Protective gloves and laboratory gowns should be worn. Any wounds on body surfaces should be covered with sterile dressings.

After practical work, all bench surface and instruments should be cleaned with disinfectant. Hands should be washed thoroughly with liquid soap and water.

17.2 Live Animals

It is not recommended to rear wild animals in school laboratories. Animals purchased for laboratory use must be obtained from licensed dealers.

Animals have to be treated humanely. Persons involved in handling animals should note that it is an offence under the *Prevention of Cruelty to Animals Ordinance* (CAP. 169) to treat animals cruelly and cause unnecessary pain and suffering to them. CAP. 340 Animals (Control of Experiments) Ordinance should also be referred to and followed where necessary for procedures involving the use of animals.

17.2.1 Protective Measures

Animals may attack, bite or scratch people when under stress or disturbance. They may harbour germs or parasites which can be transmitted to humans. Suitable protective gloves (e.g. leather gloves for animal handling) and laboratory gowns should therefore be worn when working with live animals. Dirty or soiled gowns should be disposed of or washed before next use.

17.2.2 Animal Cage/Wormery/Aquarium

Animals for laboratory use must be kept in hygienic cages, wormeries or aquaria of suitable sizes. The cages/wormeries/aquaria should be cleaned and disinfected regularly. Cages made of galvanised wire or plastic are recommended because they can be easily sterilised or disinfected.

If an electrical device installed in an aquarium (e.g. air pump or heater) shows signs of abnormal operation (e.g. is difficult to switch on, produces excess noise or overheats), it should not be used and should be checked by registered electrical workers.

17.2.3 Animal Bites

In cases of bites or other injuries, apply first aid immediately. (Wear disposable plastic/vinyl gloves before handling the wounds.) The injured person should be sent to hospital for medical treatment. The animal in question should be isolated as it may be required for subsequent diagnosis.

17.3 Animal Dissection

Do not allow students to perform dissections outside school laboratories. Before starting the dissection, ensure that students have covered any wounds on exposed parts of their bodies with sterile dressings. Instruct students to wear laboratory gowns and surgical/disposable gloves, and advise them to wear masks. Remind them to wash hands thoroughly with liquid soap and water after performing dissections. Seek medical treatment promptly in case of accidental injury during dissection.

17.3.1 Handling Dissecting Instruments

Teachers should instruct students to handle all dissecting instruments with great care and not to play with them. Do not use rusted or blunt dissecting instruments.

Soak all dissecting instruments and boards in disinfectant after use. Dispose of unwanted dissecting instruments or sharp parts such as used scalpel blades with great care. A puncture-resistant container should be used for disposal to avoid injuries.

17.3.2 Killing of Animals for Dissection

Rat dissection is commonly carried out in schools. Under no circumstances should students be allowed to handle live rats. Killing of rats should only be carried out by teachers or laboratory technicians. It should be done in a swift and humane way with carbon dioxide or chloroform (trichloromethane) in the absence of students. As chloroform is harmful, the killing chamber should be exposed after use either in a fume cupboard or in the open air. After killing, check that the animals are dead and immerse them in dilute disinfectant before handing them over to students for dissection.

17.3.3 Disposal of Dissected Animals

Dispose of the dissected animals quickly and properly after dissection. Place the animal carcasses in double sealed plastic bags, label the bags, and dispose of them at a designated refuse collection point.

If it is suspected during dissection that the animal is diseased, stop the dissection and dispose of the animal in the proper way. Promptly wash hands and clean up bench area afterwards.

17.3.4 Measures for Keeping Animals

Do not rear animals in school for use in dissections, and inform students not to do so at home. If necessary, the school may keep the animals for a short period of time. In such circumstances, teachers and laboratory technicians are reminded of the following:

1. Students should not be allowed to handle live animals.
2. Persons who are ill should not come in contact with animals, as some human infections may also be transmitted to animals.
3. Keep the laboratory in a generally clean and hygienic state. Place animals in a suitable area of the laboratory which is well-ventilated and where wild rodents and insects cannot gain access.
4. Use cages which are escape-proof, can be cleaned easily, and have adequate facilities for feeding and watering. It is important that animals are separated from their excreta. Clean and sterilise the cages regularly.
5. Provide the animals with sufficient food on a regular basis and fresh drinking water at all times.
6. Use clean and dry sawdust, or absorbent paper (preferably shredded) for bedding materials. Change the bedding materials daily and dispose of them in double sealed plastic bags.
7. Kill any sick animals and dispose of them properly. Isolate other animals that have been in contact with the sick ones, and watch carefully for any possible development of signs of disease. Kill all the kept animals if an epidemic has broken out. Disinfect the cages and dispose of the carcasses properly.
8. Seek medical treatment promptly in case of accidental injury while handling rats, cages, soiled bedding, etc.

17.4 Taxidermic Specimens

When handling taxidermic specimens, carry out protective measures as far as possible. As some students may be allergic to fur or feathers, teachers are advised not to allow these students to handle mammal and bird specimens. Students in doubt of their allergies should also refrain from touching the specimens.

17.4.1 Formalin-fixed Specimens

Animal specimens which have been preserved in formalin (methanal solution) may irritate the respiratory system, skin and eyes. Methanal (formaldehyde) is also a confirmed human carcinogen. Examine these formalin-fixed specimens in sealed containers only. Do not allow students to handle unsealed formalin-fixed specimens. If unsealed formalin-fixed specimens need to be handled by teachers or technicians, the handling must be conducted within a fume cupboard, and the person must wear chemical resistant gloves.

17.4.2 Specimens Treated with Other Chemicals

Arsenic compounds and mercury (II) chloride, which are commonly added to the fur or feathers of taxidermic specimens for preservative purposes, are toxic. **Students should be warned not to touch these specimens.**

Ethyl ethanoate (ethyl acetate) is recommended to replace cyanides in the killing bottle used for insects. However, it should be noted that ethyl ethanoate is highly flammable and its vapour may irritate the eyes and respiratory system. Practise proper and safe procedure.

17.5 Animal Cells / Blood

For experiments that involve animal cells, such as the preparation and examination of animal cells, the following can be used: ox corneal cells or frog skin cells. Whenever appropriate, commercially prepared slides of animal cells can be used for microscopic observation. For infection control, it is not recommended that students handle animal blood.

17.5.1 Hygienic Measures

Teachers should instruct students to avoid direct contact with animal cells, as many animal pathogens may infect humans. Under no circumstances should these samples be in contact with wounds or mucosal membranes. Wounds and cuts should be covered with sterile dressings. Laboratory gowns and disposable gloves should be worn.

Care should also be taken to prevent spillage. Whenever appropriate, masks and safety spectacles should be worn when splashing of animal blood is anticipated.

17.5.2 Handling Animal Blood Spillage

Any spillage of animal blood should be cleaned up with disposable absorbent materials immediately. The spill site should then be wiped off with cloth or paper towels soaked in disinfectant (e.g. hypochlorite) and then the blood-soiled gloves, cloth and absorbent materials should be placed in double sealed plastic bags for disposal. In case the skin comes in contact with the spillage, wash with liquid soap and water immediately and thoroughly.

17.5.3 Disinfection after Practical Work

After practical work, all used plasticware and glassware should be immersed in disinfectant for an appropriate period of time. If they can tolerate heat, they can be boiled for 5 minutes for disinfection, or sterilised by using steam under pressure (autoclave). The bench surface should be wiped with disinfectant (e.g. 70% alcohol, 1:10 bleach solution). Those involved in the experiments should wash hands thoroughly with liquid soap and water. For proper hand washing procedures, please refer to Centre for Health Protection website at *http://www.chp.gov.hk/files/media/hand_washing.wmv*.

18 INVOLVING STUDENTS AS SUBJECTS IN EXPERIMENTS

18.1 Avoid Use of Human Blood Samples in Experiments

Schools are reminded that taking human blood for practical work should not be performed, as this may carry a risk of transmitting blood-borne diseases such as AIDS (Acquired Immune Deficiency Syndrome) and viral hepatitis types B, C and D.

Teachers should be familiar with the precautionary measures for prevention of blood-borne diseases in schools. Please refer to *Guidelines on the Prevention of Blood-borne Diseases in Schools* issued by the Department of Health and Education Bureau for details at *http://www.chp.gov.hk/files/pdf/g103.pdf*.

The use in experiments of other human body fluids, for example urine and other mucosal secretions, should also be avoided, as these are potentially infectious.

18.2 Avoid Use of Human Saliva and Cheek-cell Samples in Experiments

For hygienic purposes, it is highly desirable to replace saliva by diastase solution when studying the action of human saliva on starch. It is also advisable to use animal cell samples to replace taking human cheek cells for experiments. (Please refer to Section 17.5 for the types of animal cells used.) If human cheek-cells are to be used inevitability, teachers should instruct students to work only with their own cheek-cells samples. Treat the used apparatus as contaminated materials. Practise safe and proper procedure for cleaning or disposal after experiment.

18.3 Experiments that can Cause Physical Stress or Emotional Disturbance

18.3.1 Health Status of Students

When students are asked to serve as the subjects of experiments, teachers should ensure that the students are physically and psychologically fit for the experiments. Students who have health problems should refrain from participating in the experiments. Teachers may refer to the Schools Miscellaneous Circular on Health Problems of Pupils issued by the Education Bureau, for details.

18.3.2 Experiments that can Cause Physical Stress

Some physiological experiments (such as the estimation of the vital capacity of the lungs and the investigation of the effects of exercise on the pulse rate or breathing rate), in which students may be used as subjects, may exert excessive physical stress on some of the participating students. There must be no compulsion for students to perform these experiments. The purpose of the above experiments is to illustrate natural variations among individuals. Finding out who can blow hardest or who can achieve the fastest pulse rate is not the purpose of the experiments and such competition should be discouraged.

Before conducting any experiments involving activities that are outside the range of normal daily experience, teachers should ensure that students

understand and comply with the appropriate precautions. Students need to be reminded to stop doing the experiments immediately if they feel uncomfortable or unfit.

Students who are exempted from taking Physical Education lessons for medical reasons should not be allowed to take part in any physiological experiments involving strenuous exercise.

18.3.3 Experiments that can Cause Emotional Disturbance

Teachers are reminded that experiments involving identification of certain hereditary characters, such as colour-blindness, among individuals, or pedigree analysis of their families may cause embarrassment and thus be distressing to certain students.

Some students are afraid of doing animal dissection or handling animal blood. They may even be shocked at the sight of a dissected animal or a blood sample. Emotional disturbance may also arise from the use of visual materials such as photographs or videos showing dissection and surgical operation. Teachers have to consider these students' perception of the animal specimens or experimental procedures. There should be no compulsion for the students to be involved in the experiments/activities.

18.3.4 Use of Spirometer, Stethoscope and Sphygmomanometer

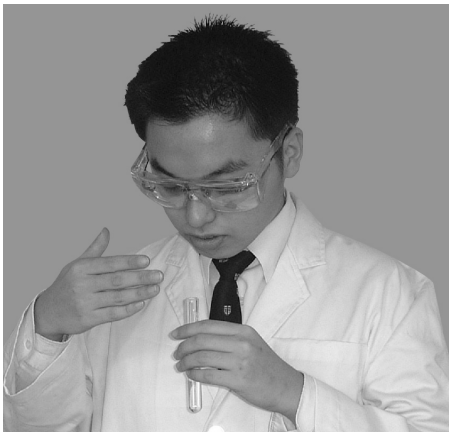
Measurements obtained by spirometer, stethoscope and sphygmomanometer from physiological experiments are approximate only and should not be taken as medically relevant.

The mouthpieces/earpieces of spirometers and stethoscopes should be disinfected before and after use. Whenever appropriate, disposable mouthpieces or earpieces should be used.

18.4 Smelling and Tasting Substances

In experiments involving the smelling of chemicals, students should be reminded to smell only very small quantities of the chemicals by fanning gently towards the nose. Experiments have to be performed in well-ventilated areas.

Tasting should not be carried out in laboratories. For experiments involving smelling items other than chemicals, substances known to be harmless and free from contamination should be used. Substances containing irritants or having allergic effects should not be used.



Smelling of chemicals

19 OUTDOOR/FIELDWORK ACTIVITES IN SCIENCE

As life-wide learning is now emphasized in schools, arranging science learning and teaching activities outside school settings has become more popular. When organising outdoor/fieldwork activities, like planning for practical work in laboratories, the concept of risk assessment is also applicable to ensure safety. Risk assessment should be carried out as part of the planning for field activities. All participants have to be conscious of the associated hazards when working outdoors. Necessary precautions need to be taken so as to minimise all possible risks.

The general safety measures as listed in Section 19.1 below aim to provide teachers and other responsible staff with the principles of organising outdoor/fieldwork activities in science as a whole, and the remaining parts of this chapter highlight the relevant safety precautions for working in specific habitats.

19.1 General

Schools should note that outdoor/fieldwork activities must be under the supervision of responsible school staff. For fieldwork, a ratio of one teacher/instructor to a group of 30 (or fewer) students is recommended.

The school should inform the police and students' parents/guardians of the route of the trip and the expected time of return. Prior written consent from parents/guardians for students taking part in outdoor/fieldwork activities must be obtained. (Please refer to the latest Guidelines on Outdoor Activities issued by the Education Bureau for details.)

19.1.1 Considerations in Planning for Activities

When planning field activities, it is important to ensure that the activities are appropriate for the age, ability, experience and special educational needs, if any, of the students. Students should be adequately trained, prepared and properly equipped for the fieldwork activities.

Plan the time required, including rest stops, to walk to the field site and return according to the pace of the slowest member. Do not make the walk too long. Give consideration to the gradient of the route. Slopes or footpaths steeper than 30° are difficult to walk or work on. Avoid working in gullies. If the route involves walking along the valley, make sure no part is impassable.

Check for the time and height of tides when it is necessary to work at or walk along the coast. Make sure to retreat before high tide.

Check whether a permit is needed if the field site is a Site of Special Scientific Interest (SSSI).

When planning visits to countryside or historic monuments, teachers/instructors may refer to the Schools Miscellaneous Circulars on Protecting Hong Kong Countryside from Fire and Litter Damages and on Guidance Notes for the Arrangement of School Visits to Historic Monuments and Archaeological Sites in Hong Kong, issued by the Education Bureau, for information.

19.1.2 Pre-trip

Teachers/instructors should visit the field site before taking any students there. The potential hazards of the field site and possible risks involved in the outdoor/fieldwork activities should be recognised. The location of the nearest telephone to call for assistance and the nearest shelter should also be identified. A mobile phone and first-aid kit should be brought along. For the mobile phone, it is important to note the range of signal coverage and any blind spots in the area.

Details of the field trip with a route map should be worked out before the trip and left with a responsible person not participating in the field activities. Contingency plans should be arranged in advance.

19.1.3 Briefings on Activities

During briefings on the activities, students should be made aware of the terrain and other potential hazards, as well as the necessary safety precautions. All participants, including staff, must understand their responsibilities and what action to take in the event of an emergency. The need for regard for the safety of oneself and others, as well as the need for calm behaviour and common sense when encountering dangers, should be emphasized.

Students have to be reminded to follow the Country Code. They should also be advised not to collect specimens more than necessary. Protected or endangered species should not be collected.

Students have to be assigned to work in groups and the group size should be at least three, but room should be allowed for individual work/projects. A leader should be appointed for each group and each participant should be made aware of appropriate actions to take in times of emergency. Students should also be reminded not to work alone at the field site.

19.1.4 Exempting Students from Outdoor/Fieldwork Activities

Students who are not physically fit enough or who are exempted from Physical Education lessons could also be exempted from outdoor investigation or field trips. Students with heart or respiratory illness should be advised to refrain from participating in outdoor activities if the air quality is unfavourable. (Please refer to the latest Guidelines on Outdoor Activities issued by the Education Bureau for details.)

19.1.5 Weather Conditions

Teachers/instructors should refer to the Circular on Tropical Cyclones and Heavy Persistent Rain Arrangements for Kindergartens and Day Schools, issued by the Education Bureau, for details of arrangements under inclement weather conditions. Teachers/instructors should pay attention to weather forecasts before and during the fieldwork activities. Weather forecasts are readily available through television, radio, news media, Internet (Hong Kong

Observatory's website: *http://www.hko.gov.hk,* Enivornmental Protection Department's website: *http://www.epd.gov.hk*) or over the telephone (Hong Kong Observatory's Enquiry Hotline, "Dial-a-Weather": 187 8200. A pocket radio should be carried by the group for the same purpose. In interpreting weather forecasts/conditions, teachers/instructors should err on the side of caution.

When the weather conditions are considered unfavourable or unstable, teachers/instructors should exercise judgement on the suitability of conducting field trips. Cancellation of field trip is also required, if necessary, for the sake of safety. When considering whether an activity to be cancelled or not, schools are recommended to read the latest Guidelines on Outdoor Activities issued by the Education Bureau for details.

Under high ambient temperature, prolonged outdoor work may lead to heat exhaustion or even heatstroke. Avoid prolonged exposure to direct sunlight and do not overwork. Wear light airy clothing and remember to drink lots of water and replenish electrolytes.

Working outdoors in very cold weather may lead to hypothermia. Avoid overstrain so as to conserve energy. Bring spare warm clothing.

19.1.6 Items to Bring Along

The group should carry an updated map of suitable scale showing clearly the area where the participants conduct their fieldwork and the route leading to the field site. The group should also carry a compass, a whistle, a torch, a pocket radio, a mobile phone, a first aid kit, adequate food and water as well as emergency rations.

A first-aid kit which should include the following standard items:

- Bandages (of different sizes), triangular bandages
- Elastic tensor bandages (2" & 3")
- Sterile gauze
- Sterile adhesive dressings (of different sizes)
- Sterile eye pad
- Adhesive tapes
- Cold pack
- Sterile cotton wool, cotton buds, towel
- Antiseptics
- Alcohol 70%

The first-aid kit should also include the following additional items:

- Disposable plastic/vinyl gloves
- Forceps
- Safety pins
- Scissors
- CPR masks
- Turpentine liniment

- Thermometer
- Fan
- Casualty report card/sheet
- Marker Pen

The first-aid kit should be checked before the field trip. All participants should be made aware of where the first-aid kit is kept. It is highly desirable to have someone with first-aid training accompanying the group.

Plastic-ware should be used as far as possible. If items of glassware, such as test tubes and beakers, are to be carried, they should be protected from accidental breakage. Care should be taken not to leave them on the ground, otherwise they may pose a potential hazard. Take care of all electronic items such as data loggers, digital cameras, notebook computers, etc., and keep them away from water.

Clothing and footwear should be suitable for the fieldwork and the time of year. Participants should also bring along windbreakers, raincoats, wide-brim hats and some spare clothing. Bring along protective gloves and suntan lotion if necessary.

Suitable amounts of food and drinking water should be carried individually by all participants when on a whole day trip, unless these are easily available elsewhere.

All participants should bring along identity documents, such as Hong Kong ID cards.

19.1.7 During Fieldwork Activities

Observe the Country Code when working in the countryside. Beware of snakes and venomous insects which may hide among bushes and grasses. Keep to the established footpaths and avoid making new short-cuts.

Vigilant and effective supervision is required at all times at field sites. Teachers/instructors should be aware of the whereabouts of all their students at all times. Regular head counts should be carried out before, during and after a field trip, and if necessary, before moving from one site to another.

Irresponsible behaviour can be a threat to safety, and a vigilant approach is required to ensure that responsible and appropriate standards of behaviour are maintained at all times.

Before students proceed to work, teachers/instructors have to:

- remind them where the first-aid kit is kept;
- remind them to work in groups; and
- alert them to the potential hazards at the field site.

19.1.8 Other Points to Note

Guard against all risks of fire during fieldwork.

Fieldwork must be finished before sunset.

When fieldwork activities in polluted areas have to be undertaken, the following practical precautions should be taken to prevent infection:

- Rubber gloves should be worn when sampling or measuring.
- Cuts and abrasions should be covered with waterproof dressings.
- It is advisable for individuals with recent cuts and abrasions to take up the duty of recording data instead of collecting samples or taking measurements.
- Wellington boots should be worn in polluted water.
- Never touch food or drinks with contaminated hands.
- Wash hands upon leaving the field when there is a clean water supply.

Beware of symptoms of heat exhaustion such as headache, nausea, dizziness and muscle spasm. If allowed to worsen, the patient can develop heatstroke and he/she may become unconscious. To treat heat exhaustion, rest the patient in a cool and shady place, loosen his/her clothing, and administer water to re-hydrate him/her.

Beware of symptoms of hypothermia, such as fatigue, exhaustion, clammy skin and shivering, due to a sudden rainstorm or lack of sufficient clothing in cold weather. To treat hypothermia, seek refuge from the rain and change wet clothing if appropriate. Cover the body with clothing to keep warm and take high calorific food or drinks to maintain body temperature.

If a thunderstorm is imminent, take shelter and wait for conditions to improve. Put on raingear before becoming wet. Lightning usually strikes high projections. Bear this in mind when seeking shelter.

The group should take appropriate measures in dealing with emergency situations. For the measures to be taken in case of becoming lost, a hill fire or heavy rain, details are attached in Appendix IX.

19.2 Precautions for Specific Habitats

19.2.1 Terrestrial Habitats

1. To avoid insect bites or being scratched by spines and thorns of plants, participants should wear long-sleeved shirts and jeans/trousers.

2. Slippers, sandals or flip-flops are not allowed in the field.

3. Quite a number of plants in the wild are poisonous. Teachers/Instructors should warn students not to taste fruits, seeds or leaves of wild plants. Students should be reminded not to touch those plants which are known to contain irritants that induce allergy or dermatitis on skin contact. (Please refer to Appendix VII for some common plants known to contain irritants.)

4. Beware of swarms of wasps/bees, and watch for snakes, stray dogs and cattle. Students should be warned not to irritate hives of wasps/bees or other wild animals, since quite a number of them are venomous or are vectors of diseases.

5. Keep to cleared and marked footpaths where possible.

6. Examine the surrounding area carefully before crawling under bushes to observe and collect specimens.

7. Examine rocks or logs before sitting on them. Do not lift stones or other objects with bare hands. Always use a stick to turn them over.

8. Dead specimens of vertebrates in the field should not be collected or closely examined due to the risk of transmitting infectious diseases.

9. When collecting animals and plants that bear spines or thorns, one should take extreme care to prevent injuring oneself. Protective gloves should be worn.

10. Plants collected from the field should be free from pests or diseases to minimise the chance of infection to other plants.

11. Avoid collecting plants known to contain poisonous or irritating sap.

12. When doing experiments on soil analysis, extreme care should be taken to prevent bites from soil organisms such as centipedes or millipedes.

19.2.2 Shore Habitats

1. Teachers/Instructors should always bear in mind the time of high and low tides, and make sure to leave the site before high tide.

2. Each participant should be properly dressed in shoes with adequate treads.

3. Avoid working on exposed shores with strong wave action.

4. On rocky shores, the surface is uneven and often covered with slippery algae. Test footing before putting one's weight down. Jumping from rock to rock may be dangerous.

5. On mangrove and sandy beaches, the surface may be slippery and the substratum unstable. Test footing before putting one's weight down. Do not tread on the protruding plant roots/pnematophores and avoid tripping over them.

6. Beware of dangerous plants that can cause skin allergy, such as *Strophanthus divaricatus* (Goat Horn), *Cerbera manghas* (Cerbera) and *Excoecaria agallocha* (Milky Mangrove), or those plants with prickly leaves such as *Acanthus ilicifolius* (Spiny Bears Breech).

7. Do not turn stones over or scrape any organisms from rocks with bare hands.

8. A throw line must be carried at all times.

9. Never attempt rock climbing, caving, swimming or diving.

19.2.3 Freshwater Habitats

1. Flash floods may occur suddenly during and after heavy rainfall. Leave the stream channel quickly when it rains and never work in streams after heavy rainfall. A sudden rise of water level or an increase in the turbulence and turbidity of the streamflow may be a sign of an approaching flood.

2. Except for very shallow ponds and ditches, working in freshwater habitats should be regarded as potentially dangerous. This is because water current, submerged objects and slippery rock surfaces all pose hazards. Do not jump from rock to rock.

3. Students should work in stream areas where the nature of the substratum is known with certainty and the water is no more than knee-deep.

4. Each participant should be properly dressed in shoes with adequate treads. Rubber boots, slippers or sandals should not be worn.

5. Extreme care should be taken when placing the feet into streams. Always beware of potholes, underwater obstacles, and sharp objects such as protruding stones or broken glass, and harmful animals, e.g. snakes or leeches.

6. A throw line must be carried at all times.

7. Never attempt wading, swimming or diving in streams or ponds.

20 USE OF ELECTRICAL EQUIPMENT

It is essential that electrical installations for laboratories should be done in such a manner to comply with the safety requirements as stipulated in the *Electricity Ordinance* (CAP. 406) and its subsidiary Regulations, in particular the *Electricity (Wiring) Regulations* and the *Electrical Products (Safety) Regulations.*

20.1 Electrical Installations

All electrical work (including new installation, addition, alteration, inspection, testing and repair) should be carried out by electrical contractors registered with the Electrical and Mechanical Services Department, except for those electrical installations which are installed or maintained by the Government. Lists of registered electrical contractors/workers are available for reference at the Customer Services Office of the Electrical and Mechanical Services Department (EMSD), EMSD website at *http://www.emsd.gov.hk/emsd/eng/pps/electricity_reg.shtml* or in all District Offices.

Electrical installations should have an effective earthing arrangement. To prevent leakage of current, socket outlets should be protected by a residual current device having a rated residual operating current not exceeding 0.03 A.

A main switch which can isolate the supply to all outlets in the laboratory should be installed. Switched socket outlets, preferably with pilot lights, should be installed to facilitate local isolations. They should be placed away from any water tap so that they cannot be splashed by water as far as is reasonably practicable.

All electrical products and accessories should be obtained from reputable agents/suppliers and the products should be properly marked (e.g. voltage rating, current rating/power consumption).

20.2 Regular Inspection

According to the *Electricity (Wiring) Regulations*, low voltage fixed electrical installations located in schools should be inspected, tested and certified at least once every five years. A certificate prepared under this regulation shall be delivered to the Director of EMSD for endorsement within 2 weeks after the date of the certificate. Schools are advised to pay attention to the fulfilment of this requirement in science laboratories.

If schools have any enquiries or difficulties in complying with the regulations, please contact the Electricity Legislation Division of the Electrical and Mechanical Services Department at 1823.

20.3 Electric Shock

It should be stressed strongly that the passage of even small electric currents through the body may cause death by heart failure. It is the amount of current flowing through the body that determines the effect on the body. Any amount of current over 0.01 A or so is capable of producing a severe shock, and current exceeding 0.03 A is lethal.

Since the voltage at the outlets in the laboratory is usually fixed, such as 220 V, the current that passes through the body is basically determined by the resistance of the human body. The actual resistance varies according to circumstances, e.g. the points of contact, the moisture content of the skin and the voltage of the live parts. When wet, skin resistance can be reduced considerably. This greatly increases the chance of a severe electric shock.

20.4 Safety Measures

The use of electricity in science laboratories is very common and the potential danger of electric shock is always present. It is important that appropriate safety measures be taken.

20.4.1 Plugs/Adaptors/Extension Units

1. Three-pin plugs which comply with the safety standard (BS 546 or BS 1363) should be used. The connections between electrical appliances and three-pin plugs should be made with three-core flexible cables of adequate current rating.

2. Keep the use of adaptors and extension units to a minimum. No adaptor should be inserted into an extension unit and vice versa. Do not connect one extension unit to another. If necessary, use acceptable three-pin adaptors and extension units (BS 546 or BS 1363) with shutters and pin holes which are either rectangular or round in shape. Do not use more than one adaptor or extension unit at one socket outlet as this may cause overloading.

3. Do not use plugs, adaptors or extension units with cracks, signs of loose parts or signs of overheating (e.g. discolouration, charring or deformation).

4. Cables and wires should be appropriately installed or fixed to prevent tripping hazards.

20.4.2 Electrical Appliances

1. Students must be made aware of the great danger resulting from bodily contact with a "live" electrical outlet. **They should not handle electrical appliances when their hands, feet or bodies are wet or when they are standing on a wet floor.**

2. Electrical appliances should not be used in wet places such as areas in close proximity to sinks.

3. Ensure that the voltage rating of an electrical appliance matches with the voltage of the power supply before use.

4. Switch off the appliance and/or the power supply before the plug is withdrawn/inserted.

5. An electrical appliance which gives even the slightest shock should be repaired immediately. A faulty appliance should never be used until the fault is satisfactorily rectified.

6. In general, electrical appliances should not be left switched on unattended.

7. Flammable liquids should not be stored near electrical equipment because their vapours can be ignited by an electric arc or a spark.

8. Charging of secondary cells such as lead-acid batteries should be carried out in a well-ventilated area.

20.4.3 High Voltage Equipment

1. Any experimentation requiring the use of high voltage is safer if the floor is covered with effective insulating materials.

2. Nobody should be allowed to work alone in a room when using high voltage equipment.

3. A suitable screen or barrier for protection against electric shock should be provided whenever necessary.

4. All high voltage equipment should always be kept clean.

5. It is essential to ensure that there is a large current-limiting-resistor in series with the positive terminal, fitted into the extra high tension (EHT) power supply.

6. Ensure that there are no protruding or exposed metal parts on the plugs when connecting to the EHT power supply.

7. Always connect the negative terminal to the earth terminal of an EHT power supply unless otherwise instructed.

8. Users should always switch off the EHT power supply before making adjustments to the circuit.

9. The Van de Graaff generator can produce extremely high voltage. Generally the equipment is reasonably safe as the current is at the microampere level, but some people (e.g. those with weak hearts) are susceptible to health risk. The generator should be discharged before making any alteration and the chassis of the generator should be properly earthed.

20.4.4 Safety Check

1. Danger from electricity can arise in the laboratory through ageing and the resulting breakdown of insulation. Electrical appliances in which heat is generated (e.g. hotplates, ovens, furnaces or motors) are particularly susceptible to damaged insulation. Frequent inspection of the state of the insulation should be carried out. Stop using the appliance when an unusual symptom or hazard is identified.

2. Flexible cables should be replaced as soon as wear becomes noticeable; damaged cables should be wholly replaced, never patched.

21 USE OF RADIOACTIVE SUBSTANCES

The use of radioactive sources for teaching purposes in schools is governed by the *Code of Practice on the Use of Radioactive Sources for Teaching Purposes in Schools* which was issued by the Radiation Board. The Code of Practice is reproduced below for reference.

21.1 General Rules

1. Students shall not be exposed to ionizing radiation unless there is a valid reason for doing so: demonstrations and experiments that result in exposure shall be relevant to the course of instruction. Any such exposure shall be kept to as low as reasonably achievable.

2. The use of sealed radioactive sources ("sources") in schools shall be solely for the performance of simple experiments to demonstrate fundamental principles, and the sources used and the methods of using such sources shall be such as to ensure that degree of hazard is very small.

3. No demonstrations of experiments involving the deliberate exposure of students, staff or any other persons to ionizing radiation shall be performed.

4. Experiments shall be carefully planned to minimize the exposure time, and preliminary rehearsals of the experiment procedure using simulated sources should be encouraged.

21.2 Control of Sources

1. The Radiation Board is the statutory body which controls the use and/or possession of radioactive substance and irradiating apparatus in Hong Kong. Schools deciding to avail themselves of the opportunities to possess and use sources for teaching shall apply to the Secretary, Radiation Board, 3/F., Sai Wan Ho Health Centre, 28 Tai Hong Street, Sai Wan Ho, Hong Kong, for exemption from requiring radioactive substances licence if the total quantity of radioactive substances does not exceed the limit specified in Section 21.3 below.

2. It shall be the responsibility of a graduate member of the science staff, who shall be designated the source custodian, to supervise the use of sealed radioactive sources within the school. Should the source custodian leave the school for any reason, a fresh application for exemption will have to be made in respect of the newly appointed source custodian.

3. The source custodian shall be responsible for the procurement, storage, issuance and return of sources and the correct use of all sources.

4. The source custodian shall arrange for routine checks, at intervals not exceeding 12 months, of the condition of all sealed sources by wipe test and the efficiency of monitoring instruments. All the results shall be entered into a logbook which shall be made available for inspection by Radiation Board on request. (*Wipe test -The source is wiped with a swab or tissue, moistened with ethanol or water; the activity removed is measured. Acceptance limit: 200 Bq)

5. All sealed sources failing the routine checks should be considered as defective and withdrawn from use until proven otherwise by a competent laboratory approved by the Radiation Board.

6. The teacher in charge of a class shall account for all sources before the period of instruction is concluded.

7. Sources shall be used by a student only when under the direct supervision of a teacher.

8. The immediate responsibility of radiation safety in any experiment involving ionising radiation shall rest with the teacher in charge.

9. No sources shall be taken out of the school premises approved by the Radiation Board.

21.3 Storage and Labelling

1. Maximum amount in store

   The type, quantity and activity of sources kept in a school laboratory should be the minimum practicable and shall in all cases be no greater than the following exemption limit:

Sealed sources	**Quantity**
Cobalt-60, Strontium-90, Radium-226, Americium-241	· Not more than two sources for each type · Each source not exceeding 200 kBq in activity
Insoluble radium-226 sources to be used with diffusion cloud chamber	· Not more than 10 such sources · Each source less than 750 Bq in activity

   Remarks: Should a school wish to use other sources or radioactive substances not in the Physics Standard Equipment and Furniture Lists issued by the Education Bureau in year 2004, the school shall apply to the Radiation Board for a licence (Tel: 2977 1868)

2. All sources should be kept in a locked metal container.

3. Access to this container shall be limited to an authorised staff member of the school.

4. The metal container shall be permanently labelled in such a manner to indicate that it contains radioactive substances.

5. Individual sources shall be stored in separate, appropriately labelled containers or compartments within the locked metal container.

6. Each source shall be easily identifiable by the user.

7. Sources and their containers shall be permanently labelled with the type of radionuclide together with the activity at a specified date.

21.4 Handling of Sources

Sources shall be handled with care and unnecessary handling of sources should be avoided. The following rules shall apply :

1. Sources shall be transported between the laboratory and their place of storage within the same school premises in their dedicated containers.

2. **Sources shall only be handled by tongs or forceps.** Teachers should note that specially designed tongs for the safe handling of sources are available from commercial suppliers.

3. Alpha-emitting radioactive sources shall be handled with extreme care because of the necessarily fragile nature of their construction.

4. Sources should whenever possible be kept at a distance greater than 30 cm from the user, and should be pointed away from the human body.

21.5 Damage to, Loss of and Disposal of Sources

1. Retention of defective, obsolete or unnecessary radioactive sources is undesirable and positive steps shall be taken for the safe disposal of such sources. They shall either be returned to the suppliers and the Radiation Board be notified, or be disposed of in a manner approved by the Radiation Board.

2. In the event of damage to, or loss of any sources, the following shall be notified immediately:

   Physicist on-duty (Tel : 7110 3382 call 1912) and

   Senior Occupational Health Officer, Labour Department (First Call Tel: 9689 0378)
   (Second Call Tel: 9689 0450)

In all cases, the Secretary of the Radiation Board shall be notified in writing within 48 hours.

21.6 The Degree of the Hazard

When due consideration is given to the limitation on the type of source, the activity of radioactive substances to be used in schools, and the time in any one year such sources will be used by any one teacher or student, the degree of hazard from exposure to ionizing radiation to both teachers and students is very small. However, it is essential that students appreciate the nature of the hazard and the degree of care considered necessary in the handling of radioactive substances.

22 USE OF LASERS

A laser is a collimated, highly coherent, directional and monochromatic beam of light either visible or invisible. Appropriate safety precautions should be taken when lasers are used in schools.

If schools have any enquiries or difficulties in safe use of laser, they should consult the Electrical and Mechanical Services Department at 1823 or *info@emsd.gov.hk* direct.

22.1 Classification of Laser Products

Classifications of laser are specified in the International Electrotechnical Commission (IEC 60825-1) and American National Standards Institute (ANSI Z136.1) standards.

The following table summarizes the latest classification of lasers.

Previous ANSI Standard Hazard Classes	**New Hazard Classes IEC60825-1 and ANSI Z136.1**
Class I: Cannot emit laser radiation at known hazard levels	Class 1: Inherently safe under reasonably foreseeable conditions of operation, including the use of optical instruments for intrabeam viewing
	Class 1M: Safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam
Class II: Emits visible laser beams above Class I levels but at a radiant power not above 1 mW	Class 2: Emits visible laser beams. Not inherently safe for eyes, but protection by natural aversion responses, such as blink reflex (<0.25 second), is usually adequate
	Class 2M: Emits visible laser beams. Eye protection normally by aversion responses including blink reflex (<0.25 second) is adequate, but may be more hazardous if the user employs optics within the beam
Class IIIA: Intermediate power lasers (1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended	Class 3R: Direct intrabeam viewing is potentially hazardous but the risk is lower than Class 3B lasers
Class IIIB: Moderate power lasers (5-500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit, whichever is lower). In general Class IIIB lasers will not be a fire hazard, nor are they generally capable of producing a hazardous diffuse reflection	Class 3B: Direct intrabeam viewing may be hazardous but under certain conditions they may be safely viewed via a diffuse reflector. Output power of continuous wave not exceeding 0.5 W

Class IV: High power lasers (500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard	Class 4: High output power of continuous wave exceeding 0.5 W. Capable of producing hazardous reflections, may cause eye and skin injuries and could constitute a fire hazard

22.2 General Requirements

1. Schools should only use Class 1 or Class 2 lasers for teaching purposes.

   Remarks: **Class 3R** (previous graded as **Class IIIA**) laser pointers are available in the commercial market. Laser beam from such pointers may lead to damage of the eyes if viewed directly. Such pointers should not be used. If teachers wish to use a laser pointer in presentation, it would be safer to use a Class 2 or lower laser pointer.

2. A graduate science teacher should be appointed to be responsible for the procurement, storage, issue and return of lasers and associated safety equipment.

3. The teacher-in-charge should draw up a list of safety rules and operating procedures, and ensure that these are observed when experiments involving the use of lasers are carried out.

4. Any person using the laser should be familiar with its operation procedures and the safety precautions.

22.3 Safety Precautions

22.3.1 Alert for Exposure to Laser Beam

1. Students should be reminded that laser beams may lead to damage of the eyes if viewed directly or indirectly.

2. **Never view the source of a laser beam directly** and no part of the skin should be exposed to the direct beam.

3. No collimating instrument such as a telescope or microscope should be used to view the laser beam directly.

22.3.2 Use of Protective Equipment

1. Whenever possible, non-reflective or absorbing materials should be used in the vicinity of the laser to prevent specular (mirror-like) reflection.

2. When reflection cannot be avoided, for example at a lens surface, position some protective screens so that students and teachers are not exposed to the reflection of the laser beam.

3. The protective screens should be made of non-flammable materials. They should be optically opaque and painted a matt grey colour.

4. All persons who may enter or work in the laser area and are liable to be exposed to laser radiation should wear appropriate protective goggles.

22.3.3 Position of Laser

1. The laser beam path should be positioned well above or below the eye level of the students.
2. The laser source should be rigidly fixed so that the direction of the beam cannot be inadvertently altered.
3. The laser should not be fired unless it is correctly aimed at the target area. Do not align the laser beam with the power on.

22.3.4 Conducting Experiments

1. When a laser is in operation, warning signs (see Appendix V) should be displayed in conspicuous locations both inside and outside the experiment area and on doors giving access to the area.
2. Experiments with lasers should be carried out in brightly lit rooms to avoid enlarging the pupils of the eyes.
3. Students should be given a briefing on safety precautions of the local laser set up. They should stand behind the laser before firing. They should never be closer to any part of a laser experiment than 1 m when the power is on.
4. The laser should be switched off immediately after an experiment.
5. When not in use the laser should be kept under lock and key so that it is accessible only to authorised members of the staff.

22.3.5 Accidental Exposure

1. In case of accidental exposure to a laser beam, students should react instantly by closing the eyes and turning the head away.
2. Any accidental exposure or even suspicion of exposure of the eyes to a laser beam should be reported and medical treatment should be sought at once.

23 FIRST AID IN THE LABORATORY

Schedule 2 of the *Occupational Safety and Health Regulation* and Regulation 55(2) of the *Education Regulations* state that at least 2 teachers in every school shall be trained in administering first aid. Teachers and school staff qualified in administering first aid should be in a better position to render valuable assistance in the event of emergencies and accidents. School principals should encourage their science staff and students to undergo some form of training in first aid. These training courses can be obtained from the Hong Kong Red Cross, the Hong Kong St John Ambulance Association, the Auxiliary Medical Services, etc.

In the event of any serious injury, or whenever in doubt, medical aid should be sought without delay. Schools can call an ambulance to send the patient(s) to hospital. **All injuries to the eyes should be regarded as serious cases.**

23.1 Action in an Emergency

23.1.1 Fainting

A certain degree of faintness or dizziness may result from any accident, and the following measures should be taken:

1. Ensure the patient's air passages remain open and clear and that he or she is breathing adequately. Loosen any tight clothing. If breathing and pulse stop, cardiopulmonary resuscitation must be applied immediately (see Section 23.2) and call an ambulance at the same time.
2. Observe the level of responsiveness based upon eye opening, and verbal and motor responses. Note any changes in the state of unconsciousness.
3. Check breathing rate and pulse regularly.
4. Examine and treat any serious injuries.
5. Examine possible cause of fainting.
6. Place the patient in the recovery position (see Section 23.3).
7. Cover the patient with a blanket.
8. If the patient recovers consciousness, reassure and observe him/her. Advise him/her to see a doctor.
9. Do not give anything to an unconscious patient by mouth.

23.1.2 Electrical Injury

1. Under safe circumstances, switch off the power supply, and remove the victim from contact with the electrical source. Never touch the patient with bare hands until you are sure that he/she is no longer in contact with the source. If you cannot break the current immediately, stand on some dry insulating material, such as a wooden box, and remove the patient from the source with other dry insulating objects.

2. Check the point of contact on the body for burn, which may be severe. Place a sterile dressing over the burn and secure with a bandage. Seek medical treatment.

3. It is essential that defibrillation and cardiopulmonary resuscitation must be started immediately if the shock has produced respiratory and cardiac arrest. (see Section 23.2)

23.1.3 Heat Burns and Scalds

1. Place the affected area under slowly running cold water until the pain fades.

2. Remove any rings, watches, belts, shoes or other constricting clothing from the injured area before it starts to swell, but do not remove any clothing adhering to the burn.

3. Do not apply lotions, ointments or any other chemicals to the injured area.

4. Do not break blisters or remove any loose skin.

5. Cover the affected area with a dry, sterile dressing/gauze and then secure with bandage. Never use adhesive dressing.

6. As far as possible, immobilise the affected part so as to minimise pain.

7. For severe burns, medical aid should be sought without delay.

23.1.4 Chemical Burns

When handling chemical burns, only water should be used for first-aid treatment. Do not apply any chemical to the affected area.

1. Place the affected area under slowly running cold water until the pain fades.

2. Remove any contaminated clothing carefully, but avoid making contact with the chemical yourself.

3. For severe burns, medical aid should be sought without delay. It is essential that flooding of the affected area be continued until an ambulance arrives. The Material Safety Data Sheet (MSDS) of the chemical should also be taken to the hospital for reference or identification.

23.1.5 Eye Injuries

1. All eye injuries should be regarded as serious cases and medical treatment should be sought without delay.

2. If any chemical has entered into the eye, flush the eye with cold running water or use the eye wash unit immediately for at least 10 minutes. Ensure that water drains away from his/her face and not into the other eye. Do not attempt to neutralise the chemical in the injured eye with acid or alkali. Advise the patient not to rub his/her eye.

3. Do not attempt to remove foreign objects such as glass pieces from the eye. Keep the patient still and send for medical aid immediately.

4. Cover the eye with a sterile eye pad.

23.1.6 Cuts and Bleeding

1. Avoid touching the wound with bare hands or having direct contact with blood. Always use a pair of disposable plastic/vinyl gloves.

2. Protect the wound with a sterile swab. Clean the area around the wound with water, using liquid soap if necessary. Take care not to wipe off any blood clots.

3. If bleeding persists, apply direct pressure. Apply a proper dressing after bleeding has stopped.

4. In serious cases, the patient should lie down with the injured part raised. Apply direct pressure to the wound over a clean dressing. If bleeding continues, do not remove the dressing, but apply further pads on top of the original one. Then bandage the wound firmly. Excessive blood loss may lead to shock. Medical assistance should be summoned immediately.

5. Blood-contaminated materials should be properly handled and the following precautionary measures need to be taken:

   - Avoid touching blood-contaminated materials with bare hands. Always use a pair of disposable plastic/vinyl gloves.
   - Use household bleach (diluted with water in the proportion of 1:5) to clean up the contaminated areas.
   - Blood-soiled gloves, dressings and swabs, etc. should be placed in double plastic bags and then sealed for disposal.

23.1.7 Swallowing Chemicals

1. If the chemical has not been swallowed, ask the patient to spit it out and wash the mouth with plenty of water.

2. If the chemical has been swallowed, give the patient plenty of water or milk to drink. Medical assistance should be summoned immediately.

3. If medical consultation has to be sought, the Material Safety Data Sheet (MSDS) of the swallowed chemical should be sent along to hospital.

23.1.8 Inhalation of Toxic Gases

1. Open any doors and windows. Remove the patient to a safe place without endangering yourself.

2. Check his/her airway and ensure it is not blocked.

3. Place him /her in the recovery position (see Section 23.3) even if he/she is conscious. This allows him/her to aspirate even if he/she vomits.

4. If the patient's breathing stops, induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If the pulse also stops, start cardiopulmonary resuscitation and defibrillation if necessary. (See Section 23.2)

5. Seek medical aid immediately.

23.2 Cardiopulmonary Resuscitation

If injury results in unconsciousness and breathing and pulsation stop, cardiopulmonary resuscitation should be carried out. First-aid treatment should be given without delay, otherwise the brain cells will be damaged within 3-4 minutes. Cardiopulmonary resuscitation includes artificial respiration and chest compression.

The following are descriptions of artificial respiration and chest compression. They should not be regarded as a substitute for the training offered by first-aid organisations. These procedures should be conducted by persons qualified in administering first aid.

23.2.1 Cardiopulmonary Resuscitation (CPR) (Revised protocol by American Heart Association in 2010)

CPR is indicated for any person who is unresponsive with no breathing, or who is only breathing in occasional agonal gasps, as it is most likely that they are in cardiac arrest. If a person still has a pulse, but is not breathing (respiratory arrest), artificial respiration may be more appropriate.

CPR Protocol

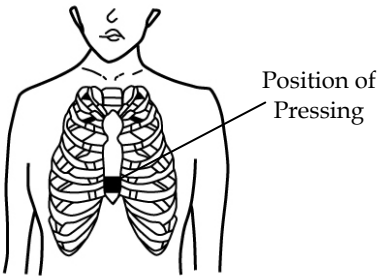
1. Ensure the environment is safe for administering First Aid.
2. Lay the patient on his/her back and check his/her response. If the patient is unresponsive, seek help immediately.
3. Tilt head, lift chin and check breathing.
4. Check the airway and watch for chest expansion. Ensure it is free from obstruction.
5. If the patient has no sign of breathing and pulse seek medical aid and access the automated external defibrillator (AED) immediately.
6. Place the heel of one hand on the lower half of the patient's breastbone.
7. Cover this hand with the heel of the other hand and interlock your fingers.
8. Keeping your arms straight, press down about 5 cm and then release.
9. After 30 compressions, open the patient's airway using the head-tilt, chin-lift method. Pinch the patient's nose and make a seal over the patient's mouth with yours. Use a CPR mask if available. Give the victim TWO breaths big enough to make the chest rise in one second. Let the chest fall. (If the first aider does not feel comfortable with this step, just continue to do chest compressions at a rate of at least 100/minute.)

10. Continue to press 30 times at a rate of 100 times per minute.

11. Repeat steps 9 and 10 until one of the following cases occurs:

    i. Signs of the patient's breathing and pulse appear, or
    ii. Medical support arrives, or
    iii. First aider is exhausted.

During the process of cardiopulmonary resuscitation, artificial respiration and chest compression should be carried out alternatively. The ratio of chest compression and artificial respiration is 30:2 whether there are one or more first aiders. Always check if there is any sign of return in breathing and pulse. If the pulse returns, chest compression should be discontinued. However, artificial respiration should be continued until natural breathing is restored.



Position of Pressing

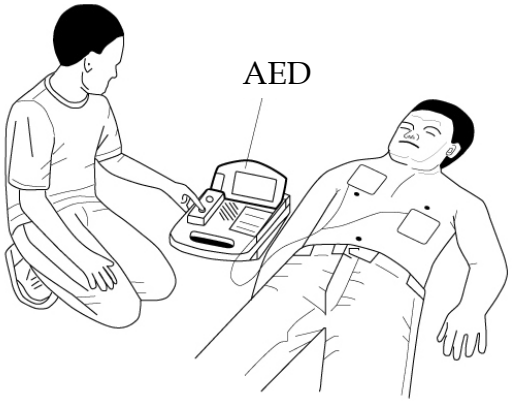
23.2.2 Automated External Defibrillation (AED)

Uncorrected cardiac conditions (ventricular tachycardia, ventricular fibrillation, asystole) rapidly lead to irreversible brain damage and death. After approximately three to five minutes, irreversible brain/tissue damage may begin to occur. For every minute that a person in cardiac arrest goes without being successfully treated (by defibrillation), the chance of survival decreases by 7 percent per minute in the first minutes, and decreases by 10 percent per minute as time advances beyond about 3 minutes.

AEDs are designed to be used by laypersons who ideally should have received AED training. AED can act as a pacemaker if the heart rate is too slow (bradycardia) and perform other functions which require a skilled operator able to read electrocardiograms.

An automated external defibrillator requires minimal training to use. It automatically diagnoses the heart rhythm and determines if a shock is needed. Automatic models will administer the shock without the user's command. Semi-automatic models will tell the user that a shock is needed, but the user must tell the machine to do so, usually by pressing a button. In most circumstances, the user cannot override a "no shock" advisory by an AED.

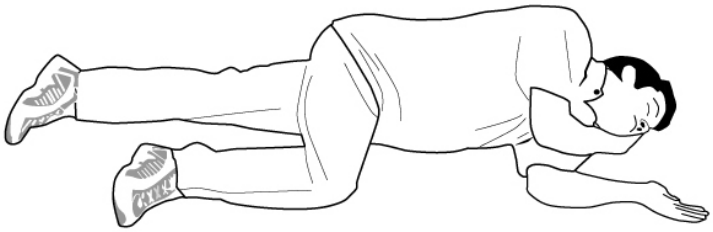
Schools are encouraged to install an AED to provide extra protection to their students and staff. School principals should encourage their science staff to undergo AED training and only persons who have completed a relevant course are permitted to use the AED. These training courses can be obtained from the Hong Kong St John Ambulance Association, etc. Regular checking of the equipment should be conducted by a qualified person.



Automated External Defibrillator

23.3 Recovery Position

If the patient loses consciousness but his/her breathing and pulsation continue, place him/her in the recovery position. Such a position enables the patient to vomit freely from the mouth.



Recovery position

23.4 First-aid Facilities

23.4.1 The First-aid Box

Each science laboratory should be equipped with a first-aid box marked clearly with "FIRST AID" and "急救". Sections (3) and (4) of Regulation 55 of the *Education Regulations and Schedule 2 of the Occupational Safety and Health Regulation* require, respectively, that all science teachers and laboratory technicians should be familiar with the contents of the first-aid box and their use and that all first-aid boxes shall be kept fully equipped at all times.

The first-aid boxes should be installed in prominent and easily accessible positions in the science laboratories. Their contents should be regularly checked to ensure that all the recommended materials and equipment are kept in sufficient quantity as well as maintained in good condition at all times.

The following is a list of first-aid items recommended for school science laboratories:

- Adhesive plaster
- Adhesive plaster (waterproof type)
- Antiseptics, e.g. Savlon
- Bandages (of different sizes)
- Casualty report card / sheet
- Disposable plastic/vinyl gloves
- Elastic bandage (2″ & 3″)
- CPR masks
- Forceps
- Marker pen
- Safety pins
- Scissors
- Sterile adhesive dressings (of different sizes)
- Sterile cotton buds
- Sterile cotton wool
- Sterile dressings/gauze (of different sizes)
- Sterile eye pad
- Surgical / paper tape (1″)
- Triangular bandages

It is recommended first-aid boxes include an item list for ease of checking the contents. A first-aid manual should also be kept inside each laboratory for reference. Other items such as ointments (which may accelerate absorption of some chemicals through skin) should not be provided in the first-aid boxes for laboratories.

In each school, a team of 2 or more staff members should be designated to be responsible for the first-aid boxes and their names and contact numbers should be put on the box. Schools should also ensure that at least one member of the team is available during normal school hours. A notice specifying the names of the members of the team has to be affixed to the first-aid boxes.

23.4.2 Eye Wash Station

Each science laboratory should have an eye wash station, equipped with either an eye wash bottle or an eye wash basin, beside the first-aid box for rinsing eye purpose. The eye wash bottle should always be kept clean, with the distilled water inside being replaced regularly to prevent growth of germs.

Eye wash bottle

24 LABORATORY ACCIDENTS AND INSURANCE

When an accident involving injuries occurs in a laboratory, first aid should be administered to the injured as appropriate, and the school principal should be notified as soon as possible. In the event of any serious injury, or whenever in doubt, medical aid should be sought without delay. The most effective way of securing medical aid urgently is to make a 999 telephone call for an ambulance. All injuries to the eyes should be regarded as serious.

24.1 Accident and Incident Records

A laboratory accident is an unplanned and uncontrolled event in which the action or reaction of an object, substance, or person results in personal injury, illness or death.

A laboratory incident includes undesired circumstances and near misses which have the potential to cause accidents; however, it involves no personal injury, illness or death.

A record of all laboratory accidents (including minor accidents) / laboratory incidents in each science laboratory should be kept by the teacher-in-charge of the laboratory and the Coordinator of the Standing Committee on Laboratory Safety. Each entry should contain: names of persons involved (teachers/laboratory staff/students), place, date, time, nature of accident/incident, cause of accident/incident, experiment being performed, extent of injury and treatment given and corrective actions taken.

Following each serious laboratory accident (e.g. an accident in which medical advice has been sought), a detailed accident report, using the standard report form in Appendix X, should also be sent to schools' respective Regional Education Offices.

The safety management systems (e.g. the Standing Committee on Laboratory Safety) of schools should review the laboratory accident and incident records when monitoring the standard of laboratory safety in their schools. Appropriate preventive measures should then be taken to minimise the occurrence of laboratory accidents.

24.2 Common Laboratory Accidents Reported in Schools

As one of the ways to monitor the standard of safety in school science laboratories, the Education Bureau conducts surveys of laboratory accidents occurring in science laboratories on a triennial basis. The latest report of "Survey on School Laboratory Accidents" can be found on the EDB website at *http://cd1.edb.hkedcity.net/cd/science/laboratory/content_survey.html*. The information so obtained was analysed and the findings disseminated to all secondary schools, drawing their attention to accidents that are common in science laboratories, as well as preventive measures that can be taken.

The nature/causes of commonly reported accidents are summarised below:

Type of Accident	Nature/Cause
Cuts	Small cuts caused by broken glass apparatus (e.g. test tubes, or glass tubing), tools (e.g. dissecting instruments, cork borer or cutter) or sharp edges.
Heat burns or scalds	Carelessness in handling hot objects (e.g. tripods, glassware, metal rods/plates, crucibles or combustion spoons), hot liquids, Bunsen flame or lighted matches.
Chemicals on skin	Spillage of chemicals during transfer or heating of chemical liquids, washing up of apparatus containing chemical mixtures, opening the container of chemical or breakage of glass containers. Concentrated sulphuric acid, phenol and sodium hydroxide were the most common harmful chemicals involved. Students' mischievous behaviour of pouring chemicals on others.
Chemical spillage	Small-scale spillage of chemicals during transfer. Spillage of mercury from broken mercury thermometers or from its container. Incorrect techniques exercised by students in using apparatus such as separating funnel.
Eye accidents	Chemical liquids which splashed into the eyes, giving rise to slight irritation or discomfort. Chemicals commonly involved were copper(II) sulphate, dilute acids and alkalis. Students unintentionally rubbed their eyes with hands contaminated with chemicals. Students looked at bright light through a magnifying glass.
Substances catching fire	Accidental ignition of flammable liquids (e.g. ethanol or ethyl ethanoate). Ignition of gas coming out from defective burner tubings or from opened gas tap not connected to Bunsen burner. Ignition of blackout curtain by focused sunlight from optical instrument.
Discomfort arising from inhalation of gases	Discomfort after inhaling a small amount of chemical vapour (e.g. sulphur dioxide, bromine or ammonia) from reaction mixtures or town gas from leaking gas taps.
Bites by animals	Rats biting students and laboratory staff during experiments or when being prepared for dissection experiments.
Others	Accidents of various natures were reported. Over 90% of the cases under this category were mere accidental breakage of glassware or damage of equipment. Students were hurt when they knocked against the floor, stools, benches, or cupboards. Tasting of chemicals (e.g. copper(II) sulphate) by students.

24.3 Insurance

Schools should ensure that adequate insurance has been obtained to cover public liabilities for damages arising from fire, accidents and injuries to students and other persons as well as the employees' compensation as required by the *Employees' Compensation Ordinance*.

Aided and caput schools may refer to the latest circular on the Block Insurance Policy arranged by the Education Bureau. Private schools (including schools under the Direct Subsidy Scheme) may refer to the Circular on "Insurance in Schools" issued by the Education Bureau to obtain adequate insurance cover.

APPENDIX I

EDUCATION REGULATIONS IN CONNECTION WITH SAFETY IN SCHOOL LABORATORIES

(21) (1) The responsible person shall ensure that all necessary safety precautions are adopted in school workshops and science laboratories and shall modify or extend those precautions as the Permanent Secretary may require.

(2) The principal and (in the case of a school without IMC) supervisor shall ensure that no instruction is given in the use of tools or the operation of machines or in science experiments except by

(a) a responsible teacher;
(b) (in the case of tools or machines) a workshop instructor employed in the school to assist a responsible teacher; or
(c) (in the case of science experiments) a laboratory technician employed in the school to assist a responsible teacher.

(24) The Permanent Secretary may limit the number of pupils who may at any one time receive instruction in any school workshop or science laboratory.

(26) All machinery, machine tools, hand tools and other equipment in a school workshop or science laboratory shall be suitable for the courses and shall be maintained in proper working order.

(27) No pupil shall be permitted to enter any school workshop or science laboratory unless a teacher is present.

(31) No poisonous or dangerous substance shall be kept without the permission of the Permanent Secretary in any place in school premises except in a science laboratory or a store room that has been approved in writing for such purpose by the Permanent Secretary.

(32) The principal of every school shall appoint a teacher to be in charge of every science laboratory and store room which has been approved by the Permanent Secretary under regulation 31.

(33) A teacher who is appointed under regulation 32 to be in charge of a science laboratory or a store room shall:

(a) cause every poisonous substance and dangerous substance in such laboratory or store room :
   i. to be kept in a proper container clearly marked with the name of the substance, and with the word "Dangerous" or the words "危險" or any word or words of similar meaning; and
   ii. to be stored in a locked room or cupboard, except when the substance is being used for the purpose of a lawful experiment in practical science which is carried out under the control of a teacher; and
(b) keep the key to such locked room or cupboard in his/her control.

APPENDIX II

OCCUPATIONAL SAFETY AND HEALTH IN SCHOOLS

With effect from May 1997, the safety and health of employees in schools is protected by the *Occupational Safety and Health Ordinance* and its subsidiary Regulation. It is the responsibility of employers to ensure, as far as reasonably practicable, the safety and health of all employees at work. Employees should, as far as reasonably practicable, cooperate with their employers to comply with the requirements of the law so as to protect the safety and health of themselves and any other persons that may be affected.

To successfully manage safety and health at work, the Labour Department has advised every school to establish an occupational safety and health management system which includes the following elements:

a) a safety and health policy statement to show the management's commitment;
b) organization structure of the management system, with a clear allocation of safety responsibilities;
c) an assessment of the safety and health risks which should be updated when situations change;
d) safety and health regulations to be observed in the workplace;
e) education, instruction and training on occupational safety and health;
f) emergency plans, drills and first aid arrangements,
g) a regular review of the system to ensure its effectiveness; and
h) documentation to keep proper record and ensure continuity of activities.

The Education Bureau has advised all secondary schools to set up a Standing Committee on Laboratory Safety (SCLS) (see Chapter 2). The SCLS can help promote the standard of laboratory safety through closer coordination and better equip schools to deal with emergency situations. Though SCLS is rather similar to the above system, schools should actively review their safety management systems to ensure that the requirements of *Occupational Safety and Health Ordinance* are also observed to protect the safety and health of their employees at work.

Further information about the subject or assistance can be obtained from the Occupational Safety and Health Branch of the Labour Department (Tel: 2852 4074) or on the Internet web pages of the Labour Department at *http://www.info.gov.hk/labour*.

APPENDIX III

LABORATORY SAFETY INSPECTION CHECKLIST

This safety checklist is intended for use by laboratory staff in secondary schools. It facilitates the maintenance of the safety standard of secondary school science laboratories. This checklist is by no means exhaustive. Schools may modify the checklist in accordance with the needs and conditions of their school laboratories.

Note: D = daily, W = weekly, M = monthly, T = once a term

Frequency Note				Descriptor	Check Mark	
D	**W**	**M**	**T**		Yes	No
				First-aid Equipment		
D				1. Is the first-aid box fully equipped and easily accessible?		
	W			2. Is the eye wash bottle clean and the distilled water replaced?		
				Fire-fighting Equipment		
	W			1. Is the CO_2/dry powder fire extinguisher serviceable and fully charged for immediate use?		
	W			2. Is the fire blanket available for immediate use?		
	W			3. Are the sand buckets dry and free from rubbish?		
				Personal Protective Equipment		
	W			1. Are there sufficient safety spectacles/goggles available for immediate use?		
	W			2. Are the safety spectacles/goggles clean, free from scratches and in good condition?		
	W			3. Is the safety screen available for immediate use?		
	W			4. Is the face shield available for immediate use?		
		M		5. Are the safety goggles for laser protection (if any) available for immediate use?		
		M		6. Have the safety spectacles/goggles, face shield and safety screen been cleaned with detergent/disinfectant?		
	W			7. Are laboratory gowns and protective gloves (e.g. disposable plastic gloves, chemical/heat resistant gloves and leather gloves for animal handling) available for immediate use?		
	W			8. Is the respirator with suitable cartridges available for immediate use?		
				Exits/Passages		
D				1. Are all exits/passages free from obstructions?		
D				2. Are all entrances to the laboratories locked by the end of the school day to avoid unauthorised entry?		
	W			3. Do all exit signs illuminate?		
				Electrical Supply		
	W			1. Are plugs, sockets and switches securely screwed, without cracks and free from signs of overheating?		
	W			2. Are electrical fittings free from loose/exposed wires?		
			T	3. Does the residual current device operate when the test button is pressed?		
D				4. Is the main switch switched off by the end of the school day (if applicable)?		

Frequency Note				Descriptor	Check Mark	
D	W	M	T		Yes	No
				Gas Supply		
	W			1. Are Bunsen burners maintained in good condition (e.g. the barrels are free from obstructions, the collars are not stuck, etc.) and the tubing free from any signs of deterioration?		
D				2. Have all gas taps been closed after lessons?		
D				3. Is the main gas supply valve switched off by the end of the school day?		
		M		4. Is town gas tubing still in good condition and within its expiry date?		
				Water Supply/Drainage System		
		M		1. Are the water taps functioning properly?		
		M		2. Are the catchpot recovery traps/sinks free from leakage?		
				Ventilation		
		M		1. Are the exhaust fans functioning properly?		
				Fume Cupboard		
D				1. Is the fume cupboard functioning properly?		
D				2. Is the working area inside the fume cupboard clean and clear for immediate use?		
		M		3. Has the fume cupboard been tested within the past year?		
				Floor		
D				1. Is the floor kept in a safe condition (e.g. no loose floor tiles, no slippery areas, etc.)?		
				General Storage		
D				1. Are all hazardous chemicals kept in a locked store/cupboard?		
D				2. Do all hazardous chemicals carry suitable hazard warning symbols?		
	W			3. Have blurred labels on reagent bottles been replaced?		
	W			4. Are incompatible chemicals (e.g. hydrochloric acid and methanal, strong oxidizing agents and strong reducing agents, etc.) separately stored from each other?		
	W			5. Are corrosive chemicals stored at a low level and protected from kicking?		
		M		6. Are reactive chemicals (e.g. phosphorus, alkali metals, etc.) covered with sufficient immersion fluids?		
		M		7. Are short-life chemicals (e.g. diethyl ether, alkali metals, etc.) free from any signs of deterioration?		
		M		8. Is the safety information (e.g. MSDSs) for all the hazardous chemicals stored readily available?		
		M		9. Are all radioactive substances (if any) stored in a locked metal container?		
		M		10. Are heavy items stored at a low level?		
			T	11. Is the quantity of each chemical stored in the laboratory kept to a practical minimum and just sufficient for routine uses?		
		M		12. Is the current chemical inventory available?		
			T	13. Is the laser (if any) kept under lock and key?		

Frequency Note				Descriptor	Check Mark	
D	W	M	T		Yes	No
				Storage of Chemical Wastes		
	W			1. Are chemical wastes properly separated and stored?		
	W			2. Are the storage pails and catcher trays free from signs of leakage?		
				Emergency Response Equipment		
	W			1. Are the emergency shower and eyewash unit easily accessible?		
		M		2. Has the emergency shower and eye wash unit been tested within the past year?		
		M		3. Is the spill control kit for dealing with chemical spills in good condition and readily accessible?		
				Others (please specify)		

Signature:			
Inspecting Personnel:		**Date:**	

APPENDIX IV — RISK ASSESSMENT FORM

<table>
<tr><td colspan="4">Title of the Experiment / Task:</td></tr>
<tr><td colspan="4">Outline of the procedures:</td></tr>
<tr><td>Hazardous substances being used or made (e.g. chemicals, microorganisms), hazardous procedure or equipment</td><td>Nature of the hazards
(e.g. toxic, flammable, potentially infectious)</td><td>Control measures and precautions
(e.g. substitute chemicals; reduce scale; use fume cupboard, safety screen, protective gloves or safety spectacles, etc.)</td><td>Source(s) of information
(e.g. Handbook on Safety in Science Laboratories, MSDSs or Hazcards, etc.)</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Disposal of residues:</td><td rowspan="2">Prepared by: _____

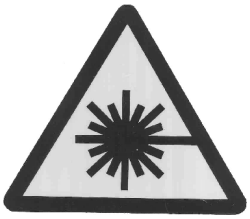
Date: _____</td></tr>
<tr><td colspan="3">Remarks:</td></tr>
</table>

APPENDIX V

SAFETY SYMBOLS

Safety symbols such as warning signs and hazard warning symbols serve to caution laboratory users as well as all those in the vicinity.

1. Warning signs—Standard warning signs have been established for a number of hazardous situations, such as handling of radioactive sources and operation of laser. The metal container of radioactive sources should be permanently labelled with a warning sign to indicate that it contains radioactive substances. When a laser is in operation, warning signs should be displayed in conspicuous locations both inside and outside the experiment area and on doors giving access to the area. Some examples of warning signs are shown below:



DANGER
Laser beam

CAUTION
Radiation

2. Hazard warning symbols—Containers of hazardous chemicals, such as reagent bottles, should bear appropriate hazard warning symbols which convey information on the hazardous nature of the substances. Examples of some common hazard warning symbols are shown below:

	New hazard warning symbols	Old hazard warning symbols
Physio-chemical Hazards		
		

	New hazard warning symbols	Old hazard warning symbols
		
Health Hazards		
		
		
		
		

APPENDIX VI

AN ABSTRACT OF SCHEDULE 1 TO WASTE DISPOSAL (CHEMICAL WASTE) (GENERAL) REGULATION

Acids, alkalis and corrosive compounds

Acetic acid above 10% acetic acid by weight

Chromic acid above 1% chromic acid by weight

Fluoboric acid above 5% fluoboric acid by weight

Formic acid above 10% formic acid by weight

Hydrochloric acid above 5% hydrochloric acid by weight

Hydrofluoric acid above 0.1% hydrofluoric acid by weight

Nitric acid above 5% nitric acid by weight

Perchloric acid above 5% perchloric acid by weight

Phosphoric acid above 5% phosphoric acid by weight

Sulphuric acid above 5% sulphuric acid by weight

Ammonia solution above 10% ammonia by weight

Potassium hydroxide solution above 1% potassium hydroxide by weight

Sodium hydroxide solution above 1% sodium hydroxide by weight

Potassium hypochlorite solution above 5% active chlorine

Sodium hypochlorite solution above 5% active chlorine

Hydrogen peroxide solution above 8% hydrogen peroxide by weight

Acids or acidic solutions, NES with acidity equivalent to above 5% nitric acid by weight

Bases or alkaline solutions, NES with alkalinity equivalent to above 1% sodium hydroxide by weight

NES = Not Elsewhere Specified

APPENDIX VII

SOME COMMON PLANTS KNOWN TO CONTAIN IRRITANTS

Alocasia odorata (Alocasia)

Euphorbia milii (Crown of Thorns)

Euphorbia pulcherrima (Poinsettia)

Euphorbia tirucalli (Milk Bush)

Excoecaria agallocha (Milky Mangrove)

Narcissus tarzetta (Chinese Sacred Lily)

Nerium indicum (Oleander)

Rhus chinensis (Sumac)

Rhus hypoleuca (Sumac)

Rhus succedanea (Wax Tree)

Thevetia peruviana (Thevetia)

Vinca rosea (Periwinkle)

APPENDIX VIII

Glucose-6-Phosphate Dehydrogenase (G6PD) Deficiency

G6PD deficiency is a genetic disease and would last for life. It is found that some 4.5 per cent and 0.5 per cent of local born males and females babies respectively suffer from G6PD deficiency.

G6PD is a very important enzyme in our body, especially for the normal functioning of red blood cells. When people with G6PD deficiency are exposed to haemolytic (capable of destructing red blood cells) chemicals, they are at a higher risk of suffering from haemolytic anaemia. Some of these haemolytic chemicals that may be found in secondary school science laboratories are listed below:

- Camphor
- Menthol
- Methylene blue
- Naphthalene (e.g. in mothballs)

A reminder should be added to practical activity involving the abovementioned chemicals, and teachers should double check with students to see if anyone has G6PD deficiency and take appropriate safety measures when any of these chemical is to be used. For example, the use of naphthalene in the experiments such as melting point determination and the study of cooling curves should be replaced by wax or octadecan-1-ol, which are safer alternatives.

The above list of chemicals is by no means exhaustive and it is very important for schools to scrutinise students' medical records and devise appropriate safety measures for students' participation in various science practical activities in and out of the laboratory.

In addition to G6PD deficiency, some students may suffer from different sickness and require special attention when they participate in practical activities. Schools are advised to request parents to report G6PD deficiency and any acute diseases suffered by their children. Please also read Section 2.6 and Section 6.6.

APPENDIX IX

DEALING WITH EMERGENCY SITUATIONS DURING OUTDOOR / FIELDWORK ACTIVITIES

The teacher/instructor or group leader should take up the role of a leader in an emergency. If the teacher/instructor in charge is injured, another teacher/instructor in the group should take up this role. All the participants should follow the instructions of the leader and the whole team should work together to overcome the difficulty.

1) In case of getting lost

a) Keep calm and stay together;

b) Conduct regular head count;

c) Locate the present position based on knowledge of the last known position;

d) Decide whether to go back, to go to an open space, or to stay where you are;

e) If it is decided to stay at the spot, try to make known your location as conspicuously as possible, such as sending out distress signs/signals with a torch or whistle. (For example, blow your whistle, flash your torch or wave other objects six times, and repeat it every one minute to attract the attention of the rescue party.)

f) Use mobile phone or walkie talkie to contact other persons.

2) In case of a hill fire

Keep calm and do not run unless absolutely necessary as panic only makes you exhausted and hampers good judgment. Try to escape by taking the following steps:

a) Abandon highly inflammable material and non-essential equipment;

b) Drink water and saturate handkerchiefs and clothing;

c) Keep away from dense vegetation and undergrowth;

d) Head in the opposite direction or to the side, or rear of a fire;

e) Avoid moving uphill where there are steep slopes, and move downhill as far as possible;

f) Beware of fallen power lines, falling burnt-out trees, and be alert to any change in wind direction.

If flames have cut off your escape route, participants should:

a) cover the body with adequate clothing (NOT synthetic).

b) hold the breath as far as possible in dense smoke, and keep low as the air closest to the ground is cooler and fresher;

c) cover the body with a completely wet garment (if possible) or damp dirt; cover the mouth and nose with a wet handkerchief or a piece of wet cloth;

d) jump into a reservoir or river if possible and cover the face with a wet garment to keep out of smoke and fumes;

e) roll on the ground or use other clothes (e.g. woollens) or blankets to smother it if the clothes catch fire;

f) find shelter in a drain, ditch, tunnel, etc. and abandon all the inflammable items.

3) In case of heavy rain (Amber, Red or Black Rainstorm Warning)

Rain can be particularly heavy and persistent, causing floods and landslips resulting in casualties. The Rainstorm Warning System aims to alert teachers and students of the occurrence of heavy rain and there are three levels of warning: AMBER, RED and BLACK.

Amber Rainstorm Signal

Heavy rain has fallen or is expected to fall generally over Hong Kong, exceeding 30 millimetres in an hour, and is likely to continue.

Red Rainstorm Signal

Heavy rain has fallen or is expected to fall generally over Hong Kong, exceeding 50 millimetres in an hour, and is likely to continue.

Black Rainstorm Signal

Very heavy rain has fallen or is expected to fall generally over Hong Kong, exceeding 70 millimetres in an hour, and is likely to continue.

Heavy rain causes flooding and makes streams rise rapidly to form dangerous torrents. Sometimes, it even washes away bridges and footpaths. It is not advisable to cross a river on foot if the water level reaches the knee. Except in life-threatening situations, wading through a river in heavy rain should be avoided. When there is a need to cross a river, the best way to do it is to use a bridge.

If it is unavoidable to cross a river on foot, the following rules should strictly be followed:

a) The teacher /instructor in change should check if each participant is ready and is tied to a rope with the help of teammates on the bank while crossing the river. A 30 metre hill walking rope of 9mm diameter is recommended;

b) Avoid jumping from boulder to boulder;

c) Do not cross if you can hear rocks rolling along underneath the water;

d) Take small steps to maintain a steady posture;

e) Each participant should face upstream while crossing the river and should be tied to a rope fastened to the bank to ensure safety.

f) Generally the safest crossing point is the place between the bends of a river as the flow of water at the outside bend of a river is more powerful and the water is deeper there.

4) In the event of heat cramp, heat exhaustion and heatstroke

a) Be aware of any symptoms showing that the participant is feeling unwell. For instance, heart beat rate indicates the level of body strain under exercise. Participants should be reminded to inform the teachers/instructors once they feel unwell;

b) Let the patient lie down in a shady area with plenty of fresh air. Loosen any tight clothing and bend up both of his/her legs;

c) If the patent is conscious, ask him/her to drink some water to make up for the water loss;

d) Lower the body temperature of the patient by putting a wet towel or fanning over him/her where necessary;

e) Call for medical service as soon as possible if the condition is serious. Any patient who losses consciousness should be evacuated to hospital immediately.

APPENDIX X

REPORT ON ACCIDENT / INCIDENT CONCERNING SCIENCE EXPERIMENTS OR FACILITIES IN SCHOOL

To: Regional Education Office (HK / Kln / NTE / NTW *)
** Please delete whichever is inappropriate*

1. Name of School : _____

   Address : _____

   Tel. No. : _____ Fax No. : _____

   Name of Principal : _____

2 Occurrence of accident / incident

   Date : _____ Time : _____

   Place : _____

   Class : _____ No. of students in class : _____

3. Nature of accident / incident (e.g. fire, explosion, heat burns/scalds, chemical burns, etc.)

   _____

   _____

4. Student(s) involved in the accident / incident

   (i) Name : _____

   Age : _____

   Description of injury (if any) : _____

   (ii) Name : _____

   Age : _____

   Description of injury (if any) : _____

5. Teacher(s)/laboratory staff(s) involved in the accident / incident

   Name : _____

   Description of injury (if any) : _____

6. Cause of the accident / incident (e.g. wrong procedure, or carelessness or malicious action of students or others, faulty equipment, etc.)

_____

_____

_____

7. Title of the experiment performed when the accident / incident occurred (if applicable)

_____

_____

8. Distribution of students at time of accident / incident

   (i) Group experiment :
   Number of students in each group _____

   (ii) Demonstration experiment :
   Location of students _____

9. Location and activity of the teacher in charge of the class at time of accident / incident

_____

10. First aid given (if any)

_____

_____

11. Was any of the following telephoned for help? Yes / No *

	Put a "✓" as appropriate	Time notified	Time arrived
Police	☐	_____	_____
Fire Services	☐	_____	_____
Ambulance	☐	_____	_____

Action taken by the above on arrival:

_____

_____

12. Was the Regional Education Office (HK / Kln / NTE / NTW *) notified of the accident / incident by telephone? Yes / No *

Date and time notified: _____

13. Was the parent(s) or guardian(s) of the injured student(s) notified of the accident / incident?

    Yes / No*

14. Witness(es) to the accident / incident(if any)

    Name : _____

    Designation : _____

15. General remarks on the accident / incident (if any)

    _____

    _____

    _____

16. Particulars of the teacher in charge of the class at time of accident / incident (if applicable)

    Name (Print) : _____

    Qualifications : _____

    Teaching experience (number of years) : _____

17. Particulars of the laboratory technician in charge of the laboratory where the accident / incident occurred (if applicable)

    Name (Print) : _____

    Qualifications (including professional qualifications) :

    _____

    Working experience (number of years) : _____

18. Reporting person(s) (Put a "✓" as appropriate) :

    ☐ Teacher _____ _____

    (Name) (Signature)

    ☐ Laboratory technician _____ _____

    (Name) (Signature)

Signature of Principal: _____

Date : _____

APPENDIX XI

INCOMPATIBLE CHEMICALS

Some chemicals are "incompatible" because they react together to pose corrosive, toxic, fire and explosive hazards. As far as it is practicable, incompatible chemicals should be stored away from each other.

The following is a list of common chemicals and their major incompatible chemical(s):

Chemical	**Incompatible chemical(s)**
Ammonia (25%)	Acid, copper, Aluminium, zinc, galvanized metals, gold, silver, and alloys of these metals, halogens
Ammonium nitrate	Combustible materials, strong acids, organic materials, chemically active metals, powdered metals, nitrates(III) (nitrites), chlorates, sulphur
Bromine	Combustible materials, metals such as iron, copper and their alloys, alkalis
Calcium oxide	Water, fluorine and strong acids
Carbon, activated	Calcium chlorate(I) (calcium hypochlorite) and other oxidising agents
Copper	Hydrogen peroxide, acid chlorides, halogens and acids
Ethanedioic acid (oxalic acid)	Silver, mercury, alkalis, chlorites, iron and its compound
Ethanoic acid (acetic acid)	Alkalis, cyanides, sulphides, active metals, amines, oxides, carbonates, chromic acid, nitric acid, hydroxyl compounds, ethane-1,2-diol (ethylene glycol), Chloric(VII) acid, perchloric acid, peroxides, permanganates
Ethanol (ethyl alcohol)	Kerosene, thinner
Hydrogen peroxide	Combustible materials, metals such as copper, chromium, iron and their salts, nitric acid, potassium manganate(VII) (potassium permanganate), phenylamine (aniline)
Hypochlorites	Acids, activated carbon
Iodine	Ammonia (anhydrous or aqueous), ammonium salts, acetaldehyde, combustible materials, aluminium, chemically active metals, powdered metals, carbides

Chemical	Incompatible chemical(s)
Methanal (formaldehyde) and formalin	Strong acids, strong bases, alkali metals, amines, ammonia, phenol ***When mixed with concentrated hydrochloric acid, BCME (bis(chloromethyl) ether), a strong carcinogen, is formed.***
Nitrates	Sulphuric acid
Nitric acid, concentrated	Metals and organic compounds ***When mixed, a fire may occur or toxic fumes of oxides of nitrogen may produce.***
Potassium manganate(VII) (potassium permanganate)	Ethane-1,2-diol (ethylene glycol), propane-1,2,3-triol, benzaldehyde, sulphuric acid, hydrogen peroxide, chemically active metals
Propanone (acetone)	Trichloromethane (chloroform) (***When mixed, an explosion may occur.)***, concentrated nitric and sulphuric acid mixtures
Silver	Ethanedioic acid (oxalic acid), 2,3-dihydroxybutanedioic acid (tartaric acid), ammonia and ammonium compounds
Sodium	Water, aqueous solutions of chemicals, acids and halogenated hydrocarbons
Sodium nitrate(III) (sodium nitrite)	Cyanides, strong acids, combustible materials, organic materials, ammonium nitrate and other ammonium salts
Sulphides	Acids, zinc, copper, aluminium, and their alloys
Sulphuric acid	Alkalis, chlorates(V), chlorates(VII) (perchlorates), manganates(VII) (permanganates), ethanoic anhydride (acetic anhydride), combustible materials, cyanides, sulphides, metals ***Concentrated sulphuric acid reacts violently with water.***
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens

A comprehensive chemical compatibility guideline can be found on the website : *http://www.uos.harvard.edu/ehs/environmental/EPAChemicalCompatibilityChart.pdf.*

APPENDIX XII

USEFUL TELEPHONE NUMBERS

Departments/ Organisations	Telephone Numbers
Education Bureau	
Hong Kong Regional Education Office	2863 4646 (Fax: 2865 0658)
Kowloon Regional Education Office	3698 4108 (Fax: 2770 2012)
New Territories East Regional Education Office	2639 4876 (Fax: 2672 0357)
New Territories West Regional Education Office	2437 7272 (Fax: 2416 2750)
Science Education Section	3698 3438 (Fax: 2194 0670)
Chemical Waste Treatment Centre	2434 6450
Controlled Chemicals Group, Custom and Excise Department	2541 4383
Electrical and Mechanical Services Department	1823 Call Centre
Environmental Protection Department	2838 3111
Hong Kong Observatory	Dial-a-weather 187 8200
Licensing and Certification Command, Fire Services Department	2733 7619
Labour Department	
Occupational Safety and Health Branch	2717 1771
Senior Occupational Health Officer	2852 4045
Occupational Safety and Health Council	2739 9000
Radiation Health Unit, Department of Health	2886 1551
Physicist on-duty	7110 3382 call 1912