

# **SCHOOL OF BIOLOGICAL SCIENCES**

## **SAFETY MANUAL & AFTER HOURS ACCESS GUIDELINES**

### **TABLE OF CONTENTS**

Table of Contents .....	1
INTRODUCTION.....	7
PART ONE: Safety Guidelines for the School of Biological Sciences .....	9
Section One: General and Physical Safety .....	9
1.1 The School of Biological Sciences Safety Network .....	9
1.2 Safety Equipment and Procedures .....	9
1.2.1 General Safety Equipment .....	9
1.2.2 Fire Safety Equipment.....	10
1.2.3 Chemical Safety Information.....	10
1.2.4 Fires / Emergencies .....	11
1.2.4.1: Normal Evacuation Procedure (e.g. in the event of fire) .....	11
1.2.4.2: Earthquake .....	11
1.2.4.3: Volcanic eruption .....	11
1.2.4.4: Gas Leak.....	11
1.2.4.5: Hazardous Substance Spillage.....	12
1.2.4.6: Bomb Threat.....	12
1.2.5 Sick Room .....	12
1.2.6 Accidents, serious near misses, or work-related illnesses .....	12
1.2.7 Personal Security.....	13
1.2.8 Audio devices - Safety Guideline.....	13
1.3 The Cardinal Rules of Safety .....	13
1.4 General Laboratory Safety Rules .....	15
1.5 Physical Hazards.....	16
1.5.1 Glassware .....	16
1.5.2 Gas Cylinders.....	16
1.5.3 UV Light .....	16
1.5.4 X-Ray Diffraction Equipment.....	17
1.5.5 Cryogenic Materials .....	17
1.5.6 Asbestos .....	18
Section Two: Chemical Safety.....	19
2.1 General Considerations .....	19
2.2 Entry of Chemicals through Skin.....	19
2.3 Entry of Chemicals by Inhalation and Ingestion .....	19

2.4	Toxic and Corrosive Chemicals .....	20
2.5	High Risk Chemicals Commonly used in the School .....	20
2.5.1	Carcinogens / mutagens / teratogens (confirmed or suspected) .....	20
2.5.2	Acutely toxic.....	20
2.5.3	Chronically toxic .....	20
2.5.4	Cytotoxic drugs.....	21
2.5.5	Explosive.....	21
2.5.6	Corrosive materials .....	21
2.5.7	Flammable Solvents .....	21
2.5.8	Reactive Chemicals.....	22
2.6	Compressed Gases.....	22
2.7	Decontamination .....	22
2.8	Disposal of Chemicals .....	23
2.9	Handling Chemicals - Summary .....	24
Section Three: Biological Safety .....		25
3.1	Biohazardous Material - Handling, Containment and Disposal .....	25
3.1.1	Introduction .....	25
3.1.2	General Guidelines for Working with Biohazardous Material .....	25
3.1.3	Pipetting .....	26
3.1.4	Syringes and Needles .....	27
3.1.5	Centrifugation .....	27
3.1.6	Hand-washing.....	27
3.1.7	Containment Facilities - Class II Hoods .....	27
3.1.8	Biohazardous Waste Disposal .....	28
3.2	Handling Human Material.....	28
3.2.1	General Guidelines.....	28
3.2.2	Blood Accidents.....	29
3.2.3	'Needle Stick' Injuries .....	29
3.2.4	Hepatitis B Vaccine.....	29
3.3	Bacteria .....	29
3.3.1	General Guidelines for Potentially Pathogenic Strains .....	29
3.3.2	General Manipulations involving Bacterial Cultures and Suspensions .....	30
3.4	Recombinant DNA.....	30
3.4.1	Rules for the Molecular Biology Laboratory .....	30
3.5	Chemical Disinfectants.....	31
3.5.1	Introduction .....	31

3.5.2	Susceptibility of Microorganisms .....	31
3.5.3	Types of Chemical Disinfectants .....	31
3.5.4	Factors Affecting Activity of Disinfectants .....	31
3.5.5	Choice of Disinfectant .....	32
3.5.6	Properties of Commonly-Used Disinfectants .....	32
3.5.7	Contamination of Disinfectants .....	36
Table 1: Recommended Applications for Chemical Disinfectants in Microbiological Laboratories .....		37
Section Four: Radiochemical Safety .....		38
4.1	Basic Training .....	38
4.2	Radionuclide Laboratory Safe Practices in SBS.....	38
4.3	Emergency Procedure Following a Spill or Accident with Radioisotopes.....	39
4.4	Radioactive Waste Procedures .....	39
4.5	Useful Facts and Figures .....	40
4.5.1	Radiation and Radioactivity .....	40
4.5.2	Quantities and Units of Radiation Measurement .....	41
4.5.3	Doses and Exposure .....	41
Table 2: New Units for Use with Radiation & Radioactivity .....		42
4.5.4	Internal and External Exposure Hazards and Controls.....	42
4.5.5	Principles of Protection .....	44
4.5.6	Data on the Most Commonly used Radioisotopes.....	45
4.5.7.	The Main Characteristics of the Most Commonly used Radionuclides .....	47
Section Five: Electrical Safety .....		49
5.1	Introduction - Working with Hazardous Electrical Equipment .....	49
5.2	Reporting Faults.....	49
5.3	Safe Working Practices .....	49
5.4	Periodic Testing.....	49
5.5	Extension Cords .....	49
5.6	Power Boxes .....	49
5.7	Fuses .....	50
5.8	Damp Conditions .....	50
5.9	Imported Equipment .....	50
5.10	Warning Notices .....	50
5.11	Equipment Ventilation.....	50
5.12	Maintaining Electrical Equipment.....	50
5.13	Electrophoresis Equipment.....	50
5.14	Continuously Running Equipment .....	50
5.15	Electric Shock Treatment .....	50
5.16	Staff with Electrical Registration in the School of Biological Sciences.....	51

Section Six: Field Safety .....	52
6.1 Introduction .....	52
6.2 Field Work.....	52
6.2.1 Supervision.....	52
6.2.2 Responsibility of fieldwork participants.....	52
6.2.3 Fieldwork guidelines .....	53
6.2.4 Clothing .....	53
6.2.5 Staff/leader competence and ratio.....	53
6.2.6 Emergency procedures .....	53
6.2.7 Fieldwork on private land .....	54
6.2.8 General.....	54
6.3 Transport .....	54
6.3.1 Hazard recognition.....	54
6.3.2 Private vehicles .....	54
6.3.3 Public transport.....	54
6.3.4 Loading .....	55
6.3.5 Driver competence.....	55
6.3.6 Emergency Procedures .....	55
6.4 Specific Environments.....	55
6.4.1 Alpine and subalpine.....	55
6.4.2 Rivers, lakes, estuaries and the sea .....	55
6.4.3 Mines, quarries, cliffs, excavations and confined spaces .....	56
6.4.4 Electricity.....	56
6.5 Fieldwork for Graduate Students and Staff .....	56
6.5.1 Fieldwork guidelines .....	56
6.5.2 Fieldworker competence .....	57
6.5.3 Emergency procedures .....	57
6.5.4 General.....	57
6.6 Paperwork.....	57
Section Seven: School Vehicles.....	59
7.1 Vehicles .....	59
7.2 Boats .....	60
Section Eight: Waste Disposal .....	61
8.1 Introduction .....	61
8.2 Biological Waste.....	61
8.3 Clean Broken Glass .....	61

8.4	Ordinary Rubbish Bins / Waste Paper Bins .....	62
8.5	Solvent & Liquid Chemical Waste .....	62
8.6	Radioactive Waste .....	62
Section Nine: Safety in the Office .....		63
9.1	OOS Prevention.....	63
9.2	Office Design.....	63
9.3	Ventilation .....	63
PART TWO: Access to SBS Facilities - Guidelines.....		64
Section One: Introduction .....		64
1.1	Purpose .....	64
1.2	Disclaimer .....	64
Section Two: Safety – General Information.....		64
2.1	Getting Started. ....	64
2.2	Awareness in research.....	64
Section Three: Definitions / General Information .....		65
Section Four: SBS Guidelines and Protocols .....		65
Section Five: Risk Definitions .....		66
Table 1: Risk Definitions & Types of Approval .....		67
Section Six: Hours of Access: .....		69
Section Seven: Access for Contractors and Subcontractors .....		70
Section Eight: Personal Responsibility.....		70
Section Nine: Hazard Assessment .....		70
Section Ten: Competency Assessment.....		71
Section Eleven: Approval for After Hours Access .....		71
Section Twelve: Review of Approvals .....		71
12.1	How to apply for an approval .....	71
12.2	Who signs approvals? .....	71
12.3	Recording approvals .....	71
Section Thirteen: Security.....		71
Section Fourteen: Contacts .....		72
Section Fifteen: Faculty Contacts .....		72
Section Sixteen: University Contacts .....		72
Appendix 1: Safety Guidelines Acknowledgement Form.....		73
Appendix 2: Access to SBS Facilities – General Access Approval Form .....		74
Appendix 3: Access to SBS Facilities - Approval Form for Access Out of General Access Hours .....		75

Appendix 4: School of Biological Sciences Safety Rules – Summary.....	77
Appendix 5: First Aiders in SBS - buildings 106, 110, & 118.....	78
Appendix 6: Fire Wardens in SBS - buildings 106, 110, & 118 .....	79
Appendix 7: Location of First Aid Kits in SBS - buildings 106, 110, & 118.....	80

## INTRODUCTION

The Health and Safety in Employment (HASE) Act 1992, which came into effect on 1 April 1993, focuses on the prevention of harm arising out of work activities. Under the Act **everyone** in the workplace becomes responsible for the health and safety of themselves and others.

In this new era of workplace safety, it is no longer appropriate for Safety Committees working in isolation to formulate safety directives for workers to follow in a **passive** way. As a result, safety manuals such as this can no longer be viewed as the final word in workplace safety. They can, however, still serve as a useful **starting** point for workplace safety, by summarising basic information and safety guidelines for dealing with hazards that are common to many areas in that workplace. Beyond this, it is now necessary to put in place detailed hazard identification and risk assessment procedures, to provide hazard information and control measures and to carry out regular safety audits for **each separate area or process in the workplace**, as each will have its own unique set of additional hazards. To apply the Act correctly, a workplace health and safety program must be **active and ongoing**, and involve all staff and students.

It is pertinent at this point to reproduce the University of Auckland Policy Statement on Health and Safety, which summarises the new approach to safety in a way that has direct relevance to us all in the School:

### **The University of Auckland Policy Statement**

#### **HEALTH AND SAFETY**

*In accord with past policies and the Health and Safety in Employment Act, The University will do all that is reasonable and within its power to:*

- \* *Provide and maintain a healthy and safe environment for everyone who works, studies, visits or conducts business at The University.*
- \* *Encourage participation by all staff and students in monitoring, improvement, and promotion programmes so as to enhance health and safety standards.*
- \* *Provide adequate consultation processes for health and safety.*
- \* *Provide training and instruction in occupational health and safety and hazard assessment.*
- \* *Provide appropriate safety devices and protective equipment where necessary to ensure the health and safety of staff, students, and visitors.*
- \* *Ensure safety and absence of risk to health in connection with the use, handling, storage, and transport of articles and substances.*
- \* *Ensure contractors (and any subsequent sub-contractors) engaged by The University comply with relevant legislation and safety requirements of The University.*
- \* *Encourage all staff to set a high standard of safety so that students leaving The University can take with them an attitude which accepts good safety practice as normal.*

The **School of Biological Sciences Safety Manual & After Hours Access Guidelines** serves as a guide to approaching workplace safety in this way and is organised into two sections:

**Part One** is arranged into nine hazard categories, and gives basic guidelines for dealing with many of the hazards that will be encountered by staff and students in the School. Several of the sections have borrowed heavily from the Department of Molecular Medicine "Laboratory Safety Manual" (with alterations where necessary to make the text relevant to the School of Biological Sciences) with the kind permission of David Jenkins, Departmental Manager, Department of Molecular Medicine, Auckland University School of Medicine. **Part One** of the **School of Biological Sciences Safety Manual & After Hours Access Guidelines** should be read in conjunction with the **Faculty of Science Safety Manual**, which gives safety guidelines for dealing with hazards that are common to ALL Schools and Departments within the Faculty. By reading and applying the recommendations contained in these two manuals, **most** of the hazards associated with workplaces or processes in the School will be minimised or eliminated.

As indicated above, **all workplaces and processes have their own unique sets of hazards**, some of them quite specialised and unlikely to be covered in any standard safety manual of manageable size. These hazards must be addressed in a detailed hazard assessment of each workplace or process by the staff and students involved.

### **Part Two of the School of Biological Sciences Safety Manual & After Hours Access**

**Guidelines** contains requirements for gaining access to the SBS facilities and should be read in conjunction with the *Access to University Facilities Policy 2009*. The criteria outlined in this section are based on the FoS Access to Facilities Guidelines which in turn is based on the UoA Access to Facilities Policy 2009.

In a research environment such as the School of Biological Sciences, laboratories may contain a large number of separate hazards and work may involve few set processes. OSH suggests that in such situations, staff and students should approach the hazard identification process on an area by area basis. For example a large laboratory may have a chemical store, an equipment bay, an area where work with radioisotopes or electrophoresis is carried out etc. Hazards in each particular area should be identified in their general groupings (see below) and information provided about where the hazards are located and where hazard reference material can be obtained. This approach would be a "Hazard Identification by Area" as outlined in the Workbook.

In situations where work is not done on a static site, such as when staff and students are engaged in field work, it may be more appropriate to analyse hazards by process or task.

All people engaged in field trips are required to complete a Field Trip Risk Assessment forms before they go on the field trip. A field trip is all University related business conducted off campus and includes all academic research and contract activities, all student research activities and all teaching related field trips. The documents are available on the SBS intranet via the link:

[http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet\\_home.cfm?redirected&](http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&)

### **In summary, the School of Biological Sciences Safety Manual & After Hours Access**

**Guidelines** aims, in conjunction with the Science Faculty Safety Manual, to provide you with some **basic safety guidelines** plus **information that will help you to establish safe working practices in your work place**. It should be noted that this manual is the first attempt at such a document for the School and in line with the new approach to safety it will be regularly reviewed and updated as better ways of handling hazards are developed. You are invited to suggest improvements, additions or amendments to Peter Cattin, the School Safety Officer.



# PART ONE: SAFETY GUIDELINES FOR THE SCHOOL OF BIOLOGICAL SCIENCES

## *Section One: General and Physical Safety*

### **1.1 The School of Biological Sciences Safety Network**

The **School Safety Officer** is Peter Cattin (Room 118-103, ext. 87978 or 62645 in an emergency).

In addition, the following staff members have agreed to act as special advisors in the nine hazard categories detailed in this manual.

- |                                |                   |                               |
|--------------------------------|-------------------|-------------------------------|
| 1. <b>General and Physical</b> | Jeannette Keeling | (Room 318, ext. 88308)        |
| 2. <b>Chemical</b>             | Tom Brittain      | (Room 402B, ext. 88246)       |
| 3. <b>Biological</b>           | Mike Pearson      | (Room 338B, ext. 88371)       |
| 4. <b>Radiochemical</b>        | John Taylor       | (Room 334C, ext. 82854)       |
| 5. <b>Electrical</b>           | Bruce Anderson    | (Room 112, ext. 87244, 60181) |
| 6. <b>Field</b>                | Sandra Anderson   | (Room 244, ext. 87214)        |
| 7. <b>School Vehicles</b>      | Rabendra Singh    | (Room 117, ext. 85098)        |
| 8. <b>Waste Disposal</b>       | Peter Cattin      | (Room LC, ext. 87978)         |
| 9. <b>Office</b>               | Karen Jennings    | (Room LC, ext. 87215)         |

**A number of staff members in the School hold first aid certificates. These are listed in the current SBS Telephone Directory and in Appendix 5 at the end of this manual.**

#### **Other Useful Numbers**

24 hour security:	ext. 85000, 966 & 08003737550
Student Health:	ext. 87681 / 87682
Ambulance, police, emergency:	dial 1-111 from internal phones
Health & Wellness Manager:	ext. 89645
Hazards & Containment Manager:	ext. 86714 / 83789
Urgent maintenance:	ext. 87925, or ext. 85000 after hours

### **1.2 Safety Equipment and Procedures**

There are numerous items of safety equipment and sources of information for the safe handling and disposal of chemicals within the School. When beginning your work in the School, it is **your responsibility** at the earliest opportunity to:

- locate and familiarise yourself with the safety equipment nearest your place of work, and
- learn how to access the information sources.

#### **1.2.1 General Safety Equipment**

Safety showers or hand-held safety sprays

Eye-wash stations

First-aid kits

Gloves • vinyl or latex disposables for use with chemical, radiochemical and biological hazards

- insulated for use with hot or cold hazards
- Masks
  - non-toxic dust
  - toxic dust
  - "escape masks" (available in all major labs) with broad spectrum chemical vapour filters, that give approx. 10 - 15 minutes protection when evacuating work areas following a chemical spill or leak
- Goggles and face shields
  - impact-resistant
  - for use when handling liquid N<sub>2</sub> or corrosive chemicals
  - anti-UV

Gumboots, mop and bucket for use when cleaning up chemical spills

Fume cupboards

Radiation screens

Radiation monitors

**Note: If you use First Aid supplies or an escape mask, you should report the fact to your supervisor or lab manager so that stocks can be replenished.**

### 1.2.2 Fire Safety Equipment

- Fire extinguishers
- CO<sub>2</sub> (electrical / spirit / oil fires)
  - Dry powder (all classes of fire)

Fire hoses

Fire blankets

Safety showers or hand-held safety sprays

**Note: If you use a fire extinguisher, you should report the fact immediately to your supervisor or lab manager, and University Works Maintenance, ext. 87925. This is necessary so that the extinguisher can be recharged.**

### 1.2.3 Chemical Safety Information

There are three good sources of Material Safety Data in the School:

1. Chemical hazard reference texts (published by Sigma) are held in the cupboard beside the Level 2 photocopier.
2. Material Safety Data can be accessed via the SBS Home Page on the internet. For those who are unfamiliar with the Net, you must first open your World Wide Web browser (e.g. Netscape Navigator). In many cases the browser will open on the SBS Home Page - if this is not the case for your machine, the address of the SBS Home page is:

<http://www.sbs.auckland.ac.nz/>

If you click on SBS Staff Intranet on the right hand side and then scroll towards the bottom of the page to *Compliance & Safety* and then click on *Storage and Use of Chemicals in the University of Auckland*.

**Note: Material Safety Data from this source can be slow to load depending on your computer and the amount of traffic on the network. This source should be accessed at leisure before commencing work with an unfamiliar chemical. It is not suitable as an emergency reference.**

3. An alternative and faster source of safety data may be accessed on the Internet at the following address: <https://jr-chemwatch-net.ezproxy.auckland.ac.nz:9443/cwnz/>

### 1.2.4 Fires / Emergencies

The following procedures are reproduced from the "*University of Auckland Emergency Evacuation Procedures Manual*".

#### 1.2.4.1: Normal Evacuation Procedure (e.g. in the event of fire)

If you discover a fire or other emergency incident:

1. Initiate the evacuation scheme by operating the nearest alarm point.
2. Report, or arrange to have reported, the incident by dialling 1-111 on the nearest phone. Give details of the building name, street address, suburb and City and brief details of the incident. The Biology Building is 5 Symonds Street; the Thomas Building is 3/3A Symonds Street. Give floor and room number if you can.
3. Close down any process or machinery if possible to do so safely and without delay.
4. Leave immediately by the nearest exit. Move quickly but **do not run**. Close doors but **do not** turn off lights. **Do not** use any lift.
5. Report to Building Warden in the designated assembly area. If for some reason it is not possible to use the assembly area, move to a safe place.
6. Do not enter the building when the evacuation alarm is sounding.
7. Do not move back into any building until instructed to do so by the Building Warden.

#### 1.2.4.2: Earthquake

1. It is usually safer to remain inside a building in all but a major earthquake. Move away from windows that may break or anything that may fall. Take shelter under solid furniture or in a doorway.
2. Do not start evacuation until major shaking has stopped. When the evacuation alarm sounds, follow the normal evacuation procedure.
3. Be aware of possible aftershocks.
4. Listen to a radio for Civil Defence instructions.

#### 1.2.4.3: Volcanic eruption

1. Unless the building is collapsing, it is usually safer to stay inside a building during a volcanic eruption. Keep windows and exterior doors closed and shut off any ventilation system.
2. Listen to a radio for Civil Defence instructions.
3. If the evacuation alarm sounds follow the normal evacuation procedures. Obey any instruction from Civil Defence or Emergency Service personnel.

#### 1.2.4.4: Gas Leak

If you smell gas:

1. Extinguish all flames but do not switch on, or off, any electrical switch.
2. Move away from the contaminated area.
3. Do not activate the evacuation alarm. Initiate evacuation by giving verbal instructions to the occupants.
4. Telephone the Fire Service by 1-111 from an area not affected by the gas leak. Follow the instructions of Emergency Services personnel.

#### *1.2.4.5: Hazardous Substance Spillage*

1. Clear all people from the immediate area to a place of safety. If appropriate and safe to do so, activate the evacuation alarm and follow the normal procedure. Ensure nobody is allowed to enter the contaminated area without approval and the appropriate protective equipment.
2. If it is possible to do so by not placing anybody at risk of injury or fumes, trained personnel may take necessary measures to contain the spill. This can include righting a container or blocking drains to stop the spread of the incident.
3. Notify the Fire Service by 1-111 of the incident. Follow the instructions of the Emergency Services and appropriate University staff.

#### *1.2.4.6: Bomb Threat*

1. When a bomb threat is received, or a suspicious object discovered, it must be treated as genuine until proven otherwise.
2. Any receptionist receiving a bomb threat shall use the supplied Police Bomb Threat Checklist to obtain the maximum information for use by the police. Staff receiving and distributing phone calls must keep a copy of the checklist at the telephone.
3. Notify the police (on 1-111) and the Building Warden of the incident and evacuate the immediate area by giving verbal instructions.
4. Do not operate the alarm points, electrical switches, or use a mobile telephone as this may activate the device.
5. The Building Warden will determine what action to take and carry out searches of the building as required as they will be able to identify any suspicious object. Follow Police advice when assessing the information received and choosing the action to take.
6. **Do not** touch or move any suspicious object. Treat unusual or suspicious objects as a bomb as bombs can be made to resemble almost anything. The Police will determine the appropriate action to take with the object.

#### **1.2.5 Sick Room**

A sick room is located on Level 2 of the Thomas Building (Room 2.08B). Keys are available for the Thomas Sick Room from Room 259 **or** the Level 4 secretary (room 403). Access is through the door marked Women's Toilets (Room 208). The sick room is unisex so any males feeling unwell should also feel comfortable using this room as the Sick Room and the women's toilets have separate doors from a common lobby.

There is a second sick room on level 3 of the Biology Building (Room 3.04). Keys are available from the Student Resource Centre in the Biology Building (106) **or** from room 3.09. This sick room is also unisex.

#### **1.2.6 Accidents, serious near misses, or work-related illnesses**

Under legislation, accidents, serious near-misses, and work related illnesses **MUST** be reported by all University staff and students. This applies whether or not medical treatment was required. In the event of an accident or safety incident (near miss) you should:

- i) inform your supervisor and
- ii) complete an Accident/Incident Report form in consultation with the SBS Safety Coordinator.

Accident/Incident Report forms are available at:

[http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet\\_home.cfm?redirected&](http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&)

They are also available in all First Aid kits in buildings 110, 106 & 118 (Ref Appendix 7).

Return the top copy plus two photocopies of the completed and signed forms to the School Manager who will retain one copy and send a copy to the HR at Faculty and to Central HR.

### 1.2.7 Personal Security

Should you feel your personal security is at risk, inform the Security Desk on ext.85000, 966 or 08003737550. If the risk is serious and imminent, dial 1-111 and ask for the police, giving details of location (building name, street address, and floor and room number) and type of risk.

Always follow up by reporting the matter in writing to the School Manager, SBS.

### 1.2.8 Audio devices - Safety Guideline

1. Radios or other similar devices that play music / noise shall not be worn or operated in Workshops, Laboratories, or where any other safety critical tasks are undertaken.
2. iPods, walkmans or similar devices will not be worn or operated while driving a University vehicle, boat or any other vehicle (including tractors, ATV's or private vehicles) being used for University purposes or where any other safety critical tasks are being conducted.

The reasons for these safety procedures are to prevent:

1. Unwanted distractions to operators or other persons while working with machinery, hazardous substances, driving vehicles or other safety critical tasks, e.g. working at heights, electrical work.
2. Allow operators to hear vital instructions or warnings e.g. fire alarms.
3. To reduce the risk of hearing loss.
4. To prevent being a nuisance and annoying other staff and/or students.
5. To prevent introducing a device into a "Hazardous Zone" that may ignite vapours or fumes.
6. To prevent loose head phone cords becoming entangled in rotating parts of machinery or become caught on fittings.

## 1.3 The Cardinal Rules of Safety

1. **Know departmental emergency procedures** and the location of telephones, emergency exits, fire alarms, fire fighting or other emergency equipment, the identity of Building and Floor Wardens (listed in the SBS phone book), and the designated assembly areas. Read the operating instructions on fire extinguishers close to your area of work. Note the names of SBS staff members who hold first aid certificates (Ref Appendix G and also listed in the SBS phone book)
2. **Do not handle materials or operate apparatus that you do not fully understand.** Operations that are considered to be especially hazardous must be carried out only in areas set aside for the purpose and it is important that assistance can be summoned if needed.
3. **Be tidy.** One of the main causes of accidents results from equipment and materials being left in the wrong place. Do not leave unwanted chemicals, especially organic solvents, lying around. Clean up spillages immediately they occur.

4. **Corridors, passages and routes between benches and to exits must be kept clear** to permit free circulation at all times, and particularly to assist rapid evacuation in an emergency. For the same reason, access to switches and alarms must be kept clear.
5. Turn off gas, water, electricity and other supplies when not required.

## 1.4 General Laboratory Safety Rules

1. The University of Auckland has a “No Smoking” policy anywhere on any of its campuses or properties.
2. **Eating or drinking** is NOT permitted in laboratory areas. No food or drink is to be stored in laboratories (including cold rooms, refrigerators and freezers).
3. Lab coats or gowns must be worn in laboratories but must be removed when going to the tea room.
4. Gloves must be worn when handling:
  - (a) human and other body fluids
  - (b) radioisotopes
  - (c) infectious or potentially infectious materials
  - (d) certain specific chemicals (see Section 2: Chemical Safety).

**Note:** Care should be taken to prevent contaminated gloves coming in contact with laboratory furniture, door knobs, telephones etc. Gloves must be disposed of in yellow Biological Waste bins - never in ordinary rubbish bins.

4. Use appropriate protective clothing, safety screens and fume cupboards when necessary.
5. Safety showers or hand-held safety sprays are provided in most laboratories for use when clothing has caught on fire or a person has been splashed with harmful material.
6. **Never pipette by mouth.** Pencils and pens must not be placed in the mouth.
7. Never recap needles. Use needle disposal containers.
8. Any spills on floors, benches or equipment must be cleaned up immediately. Special treatment is required for spills of a biohazardous nature (see Section 3: Biological Safety).
9. Hands should be washed after completing each task and always before leaving the laboratory.
10. Any faulty equipment should be labelled clearly as such and removed from service. The fault should be reported to your supervisor or lab manager as soon as possible so that a repair can be organised.
11. Never carry out hazardous procedures alone in a laboratory or a workshop outside of normal hours. A serious disabling accident to a lone worker could cost a life through inability to obtain help.
12. Approved procedures should be used for safe handling and disposal of all hazardous materials.
13. All accidents must be reported immediately (see Section 1.2.6).

## 1.5 Physical Hazards

### 1.5.1 Glassware

A large number of accidents result from the careless handling of glass. These can be avoided by careful attention to the following:

1. All but elementary operations on glass should be done by a trained technician. Consult the University Glassblower (ext. 87508) if in doubt.
2. Carry lengths of glass tubing vertically.
3. Use a piece of protective material round the hands when snapping glass at a previously made scratch. Smooth off cut glass ends with heat, a file or emery paper.
4. Learn the correct way of inserting glass tubing into a rubber bung, bending glass or cutting glass. Consult a trained technician if in doubt.
5. Inspect new glassware for cracks or other flaws before use. Do not recycle or leave lying around broken or cracked items of glassware. These can be very hazardous to others.
6. Clear up broken glass immediately and dispose of it in the Broken Glass bin in your laboratory, **never** in ordinary rubbish bins.
7. Carry full Winchester bottles by the base or, preferably, in a Winchester carrier or sturdy bucket. Above all, do not carry Winchesters by the neck.
8. Do not store bottles containing chemicals in direct sunlight or close to heaters, otherwise increasing internal pressure may produce an explosion. Large carboys should be vented for the same reason.
9. Take care when fitting glass pipettes into pipette pumps. Use bulb-type pipette pumps whenever possible.

### 1.5.2 Gas Cylinders

1. Cylinders of gases must be stored and used in vertical position in an approved stand or chained or clamped to a wall or bench in a well-ventilated position.
2. Cylinders must be transported on a properly constructed trolley. The cylinder valve should be closed and the regulator removed prior to transport.
3. Care must be taken not to overheat or damage the cylinder or its valve.
4. Cylinder valves must not be lubricated.
5. Wherever practicable cylinders should be stored outside the building.
6. Never use hammers or excessive leverage to open a cylinder valve. If the valve does not open, return it to the supplier.

### 1.5.3 UV Light

The biological effect of exposure to UV radiation is dependent on the wavelength of the radiation. As the penetration of UV radiation is small, the effects are limited to the eyes and skin. The principal effect of excessive exposure is kerato-conjunctivitis which is more commonly known as "snow-blindness". The symptoms are similar to that resulting from grit in the eyes and an aversion to bright light. The cornea and conjunctiva show inflammation.

When using UV irradiation to examine agarose and acrylamide gels, take care not to expose the eyes to direct light or any reflection of it. **Wear full face masks which absorb UV light.** Cover hands, arms and neck to minimise exposure.



The other principle sources of UV radiation in the School are the germicidal UV lamps fitted to class II and laminar flow hoods. Be sure that the protective Perspex covers are in place before turning these lamps on. Other sources of UV light to be aware of are the special bulbs used in spectrophotometers, fluorometers and electrical arcs. The hazard from ozone generated by UV lights can be minimised by ensuring that there is adequate ventilation.

#### 1.5.4 X-Ray Diffraction Equipment

The X-ray diffraction facility is located in Room3 407 & 407A. This facility must not be used without prior authorisation from Ted Baker, Peter Metcalf or Chris Squire.

The X-rays produced by the equipment are finely collimated to an intense, narrow beam of less than 0.3mm across. Backscattered or residual X-rays are minimal. Direct exposure to the high-intensity X-ray beam can, however, cause serious skin burns. For this reason, access to the generator is strictly controlled by an interlocked sliding door, and the status of the generator and X-ray shutters are indicated by a series of coloured lights inside the compartment.

Access to the inner enclosure containing the generator is only permitted when the generator is not running or when it is running with the X-ray shutters closed (as indicated by the 'X-Rays On' light and the 'Shutter Closed' light). Entry is prohibited if the 'Shutter Open' light is illuminated.

#### 1.5.5 Cryogenic Materials

The two most common cryogenic materials encountered in biological work are solid carbon dioxide (dry ice) and liquid nitrogen. Solid carbon dioxide has a temperature of around -79°C and liquid nitrogen has a boiling temperature at -169°C. **Both are cold enough to cause severe "burns" on prolonged contact.** Both materials evaporate continuously in normal use and storage. They must never be stored in closed containers. The transition from liquid to gas phase is accompanied by large increases in volume, which may lead to explosive rupture of the container.

The greatest danger with these extremely cold substances is that of receiving "cold" burns from contact with them. Dry ice is the warmer of the two and being a solid it is less likely to burn than liquid nitrogen. However, solid carbon dioxide should never be handled with bare hands. Suitable scoops or thick fabric gloves should always be used.

Liquid nitrogen, because of its intense cold, and because it is a liquid, is far more dangerous than dry ice. Splashes of liquid nitrogen represent a considerable eye hazard therefore close-fitting goggles or a full face mask should be worn when decanting and transferring this material.

Brief contact of liquid nitrogen with the bare skin results in a layer of vapour forming between the skin and the liquid, and this has an initial insulating effect. However, this barrier quickly breaks down, the liquid nitrogen wets the skin, and a burn results. Where skin is covered with fabric, the fabric immediately gets wet and the skin is burnt at once. **For this reason, porous or fabric gloves must not be worn when handling liquid nitrogen.** Loose leather mittens are the safest form of hand protection as they can be quickly shaken off in an emergency. With both liquid nitrogen and solid carbon dioxide, wet hands and clothing add greatly to the chance of being burnt. The water will provide a better path of heat transfer, and turning to ice, cement the skin to the cold surface.

**Note: The first aid for cold burns is prompt immersion in cool, not hot water.**

When thawing vials that have been stored in liquid nitrogen, Perspex face protection must be worn. Any liquid nitrogen that has found its way into the vial will revert to gas very quickly,

and the subsequent pressure rise is likely to result in an explosion if the vial has been weakened.

#### **1.5.6 Asbestos**

Asbestos insulation material is present in some service ducts and on some concrete ceilings in the Thomas Building.

All asbestos in ceilings has been professionally encapsulated in accordance with the procedures laid down in *Safety in Construction, No 22, Asbestos Guide and the Asbestos Regulations, 1983*.

If the encapsulation appears to be breached, or persons are observed working on encapsulated surfaces, immediately notify your supervisor and the University Health & Wellness Officer 89645.

No unauthorised person should attempt to open service duct panels.

## **Section Two: Chemical Safety**

### **2.1 General Considerations**

Many chemicals and the procedures involving the handling of chemicals are potentially hazardous.

It is your responsibility to yourself and your fellow workers to minimise these risks.

A few general rules are helpful:

- Before handling any chemical with which you are unfamiliar check the literature for its properties and how to dispose of it safely after use. Refer to Section 1.2.3 for sources of Material Safety Data
- If using known toxic materials, handle them only in the recommended fashion.
- Make sure your fellow workers are aware of what you are doing - if you become incapacitated they need to know what to do!
- Follow basic lab protocol - i.e. NEVER consume any food or drink in the vicinity of the lab. Dress appropriately for the handling of toxic or corrosive substances.
- If in doubt on any point relating to chemical hazards, see the Chemical Safety Advisor (Refer to Section 1.1, SBS Safety Network).

### **2.2 Entry of Chemicals through Skin**

In general, the skin offers good resistance to the absorption of most chemicals. Chemicals must not be touched directly; all transfers and handling can be carried out with spatulas, scoops, paper, etc.

Care must be taken with organic solvents, since most of these dissolve the protective secretions of the skin. Dermatitis and allergic reactions can result from carelessness over a period of time; carcinomas have been recorded.

Gloves must be worn when handling toxic or corrosive materials and are **ABSOLUTELY MANDATORY** if any known carcinogen or radiochemical has to be manipulated. **Care must be taken to remove gloves before handling telephones or door handles to avoid contaminating them also.**

### **2.3 Entry of Chemicals by Inhalation and Ingestion**

**No food or drink may be consumed in any laboratory.** This primary precaution will significantly reduce the risk of inhalation or ingestion of harmful chemicals.

Operations involving harmful chemicals must be performed in a fume hood. It is useful to hang strips of fine paper inside the fume hood to confirm that there is sufficient throughput of air. Be aware that dangerous gases can be readily produced by accident, e.g. dilute acids combine with cyanogen bromide to generate hydrogen cyanide in a sink. It should also be noted that gases and vapours can react to produce even more dangerous products, e.g. formaldehyde and hydrochloric acid fumes combine to give the carcinogen bis-chloromethylether.

Dusts are likely to be generated by weighing, transfer of material and grinding. If you are unsure, ask your supervisor. Minimise the generation of dusts by using a spatula. Try to keep the distance between the container and the weighing pan to a minimum.

## 2.4 Toxic and Corrosive Chemicals

Whilst it is good laboratory practice to treat all lab chemicals as if they are potentially harmful, many chemicals used within the School are extremely hazardous and thus require specific additional precautions. Chemicals can exert toxic effects in a variety of ways, for example:

- by acute poisoning (i.e. producing rapid deleterious effects immediately following exposure)
- by producing chronic cumulative damage to tissues and organs after repeated exposure
- by sensitising some individuals to produce allergic reactions
- by acting in more insidious ways, e.g. as carcinogens, mutagens or teratogens
- by causing chemical burns and tissue destruction which may be further complicated by systemic toxic effects, e.g. acids, alkalis, toxins.

Remember that possible routes of entry (i.e. ingestion, inhalation, absorption through cuts or intact skin) will vary with the nature of the chemical, the presence of other chemicals and the techniques being used.

**The use of appropriate equipment and handling techniques, backed up by wearing protective clothing (gloves and safety glasses) is required for all toxic and corrosive materials.**

## 2.5 High Risk Chemicals Commonly used in the School

### 2.5.1 Carcinogens / mutagens / teratogens (confirmed or suspected)

Benzene

Benzidine and its salts

Methanesulphonic ethyl ester (EMS)

Phorbol myristic acetate (PMA, TPA) other phorbol esters

Chemicals that bind to or modify DNA (ethidium bromide)

Vinyl chloride

Many aromatic amines and azo derivatives

Methyl bromide

Carbon tetrachloride

Dioxan

Chloroform

Formamide

### 2.5.2 Acutely toxic

Boric acid

Di-isopropylfluorophosphate (DIFP)

Dimethyl sulphate

Cyanogen bromide

Methyl mercuric hydroxide

Sodium azide

### 2.5.3 Chronically toxic

Mercury

Acrylamide

Acetonitrile

Chloroform

#### 2.5.4 Cytotoxic drugs

Cyclophosphamide

#### 2.5.5 Explosive

Diethylether

Acetone

Chloroform

#### 2.5.6 Corrosive materials

Strong mineral acids, strong alkalis, acid chlorides, halogenated aliphatic carboxylic acids (e.g. trichloroacetic acid) and phenol are some commonly used compounds of this type. **To protect the eyes and mucous membranes, fume cupboards should always be used when handling concentrated acids or alkalis.**

**If corrosive chemicals are handled, gloves and eye protection must be worn.** Even the smallest droplet of such liquids should be washed out immediately if splashed in the eye. Alkali in the eye is in general more dangerous than acid. The penetration of acid is stopped by the protein it coagulates. Alkali is not and rapidly diffuses into the eye structure. It should be noted that wearing **contact lenses** introduces an extra hazard, as chemicals can be trapped between the lens and the eye, prolonging exposure and resulting in greater damage to the eye.

Gloves and safety glasses (or spectacles) should always be used when handling **phenol**, as exposure of even small areas of skin can be fatal. The latest skin decontamination procedure recommended by BDH is to swab the affected area for no less than 10 minutes with a 70:30 mixture of PEG 400 and Methanol. A bottle of this mixture should be beside the First Aid Kit in all laboratories where phenol is used.

Many strong denaturing solutions (e.g. guanidine isothiocyanate) also have a strong corrosive effect in contact with delicate tissues such as mucous membranes and eyes. Many proprietary DNA isolation kits incorporate 7 M guanidine isothiocyanate solutions as part of the initial resin binding step. Eye goggles should be worn when handling such solutions, especially when packing the resin in the column using a syringe. **Only Luer lock syringes** should be used because of the high positive pressures generated in the syringing step. If the column is blocked and is then forced off, the sudden release of pressure will result in guanidine solution being ejected at high velocity. Even small amounts of this solution splattered into the eye could result in permanent damage to the conjunctiva.

#### 2.5.7 Flammable Solvents

The quantity of solvents held in the laboratory should be kept to a minimum (15 litres maximum per laboratory).

Bottles of solvents are **best stored in cupboards**. They should not be stored on the bench, nor on shelves above the bench, nor on the floor where they may be accidentally knocked over by cleaning staff and **not near electrical equipment**. Flammable solvents should not be stored together with strong oxidising agents (nitric, perchloric or chromic acids). Separate stores are required for acids, alkalis, solvents and dry chemicals.

Special care should be taken when using solvents having a low flash point, i.e.:

acetone            -18°C

benzene           -11°C

diethyl ether	-45°C
ethanol	+12°C
methanol	+10°C
toluene	+4°C
hexane	-23°C

Work with these solvents in a fume hood. Ensure that there are no ignition sources (burners, electric motors) nearby when working with such solvents.

**Note: The storage of flammable solvents in refrigerators, cold rooms, and freezers represents a considerable fire hazard. If vapour leaks from the container it can be ignited by sparking thermostat contacts or the light switch mechanism. Many solvents will be above their flash points even in a refrigerator. These substances should only be stored in an intrinsically safe room (i.e. free from sources of ignition) or a freezer.**

### 2.5.8 Reactive Chemicals

Many chemical reactions give out large amounts of energy in the form of heat. If not carried out under controlled conditions, such reactions can result in explosions, vigorous splattering of material, ignition and/or evolution of toxic gases. The following, but by no means complete, list provides a number of known materials or mixtures in the departmental laboratory that can react suddenly and with little or no warning:

- strong acids with strong alkalis
- alkali with water or chlorinated solvents
- hydration reactions (adding water to hydrides, mixing concentrated sulphuric acid with water)
- hydrocarbons with chromic acid
- diethyl ether that has no peroxide inhibitors - diethyl ether stored for more than one year must be regarded as potentially explosive
- dry picric acid (trinitrophenol) - picric acid is in an unstable and potentially explosive condition if the crystals are not covered by a layer of water

Putting water into strong acid may result in a violent explosion. Remember to add concentrated acids to water and not vice versa. The easy way to remember this is:

- i) '**A**' comes before '**W**' in the alphabet and
- ii) '**A**'lways '**A**'dd '**A**'cid to water

## 2.6 Compressed Gases

Cylinders represent a significant potential hazard. Refer to Section 1.5.2 for correct procedures for using compressed gas cylinders.

Remember to use the appropriate reducing valves to give fine control of the flow of potentially toxic gases. Oxygen and hydrogen are particularly dangerous and should be used with care.

## 2.7 Decontamination

Always wipe up all chemical spills. **This applies especially to areas around balances.** Small spills of both solid and liquid should be wiped down with a damp sponge or mopped up with paper towels. Sponges used for clearing up should be well rinsed and replaced frequently as

they themselves can become a source of danger. In addition to being soaked with a brew of miscellaneous reagents, such sponges frequently contain splinters of broken glass.

Corrosives: Should small amounts of acid be spilled in the laboratory, do not try to wash it away. Add a large excess of solid sodium carbonate (or bicarbonate). This will neutralise the acid and absorb the moisture leaving a solid which can be swept away. Spillage of stored alkalis should be neutralised with diluted acetic acid and then water.

## 2.8 Disposal of Chemicals

- Many chemicals (at suitable dilution) can be washed down laboratory sinks with copious amounts of water.
- **Only solvents that are miscible in water should be disposed of in a sink**, and then only in small quantities.
- Many organic solvents when disposed of in sinks will dissolve either the plastic pipes or the caulking sealing compound causing leaks. **Small** quantities (microlitre amounts) of these compounds may be disposed of in tightly-capped polypropylene tubes (e.g. Microfuge tubes) as Medical (Biohazardous) Waste, either in the yellow bags or the large 'sharps bins' provided in each laboratory area. All Medical Waste is sealed prior to disposal and later incinerated.

Larger volumes of organic waste should be evaporated in a fume cupboard with a good draught, or accumulated in clearly-labelled containers for professional disposal (see Section 8.6)

- If you are in any doubt about disposal of any compound, please consult with the Chemical Safety Advisor before proceeding with disposal.
- Phenol and chloroform: Small volumes (microlitre amounts) may be disposed of in tightly-capped polypropylene tubes, as described above for organic solvents. Larger volumes should be evaporated in a fume cupboard until all traces of chloroform are removed, then the residual phenol washed down the fume cupboard sink with copious amounts of water.
- Carcinogenic / mutagenic materials: Please consult the Chemical Safety Advisor before disposing of these compounds.

The mutagenic nucleic acid stain **ethidium bromide** is used widely throughout the School. Ethidium solutions should be decontaminated before introducing them into the sewer system. The cost and effort required to carry out this procedure can be controlled by minimising the volumes of contaminated solutions e.g. by staining gels in a small volume of recycled stain solution **after** electrophoresis instead of including ethidium in both gel and electrophoresis buffer during the run. This has the added advantage of contaminating only one piece of laboratory equipment. One convenient decontamination method is the Bio101 EtBr Green Bag Disposal Kit (N.Z. agents Labsupply Pierce. See Jeannette Keeling ext. 88308 for alternative methods.

- Thermometers: Release of mercury vapour from instruments such as broken thermometers should be regarded as a serious hazard. If mercury is spilled on a dry surface, it can be contained by pouring on excess sulphur powder. The mixture can then be swept up. Be sure to wear gloves during cleaning up procedures. See the Chemical Safety Advisor about disposal.

## 2.9 Handling Chemicals - Summary

- Follow the General Safety rules detailed in Section 2.1. In particular, it is your responsibility to obtain Material Safety Data on any chemical with which you are unfamiliar, **before** you begin working with it.
- Treat all chemicals as potentially harmful.
- Note hazard warnings displayed on labels and read any literature supplied by manufacturer.
- Handling of volatile or highly toxic chemicals (particularly in situations likely to produce aerosols or fine powders), must be carried out in a fume hood.
- Wear appropriate protective clothing including gloves and safety glasses when working with toxic or corrosive chemicals.

**Note: Some organic chemicals can penetrate rubber and/or plastic gloves.**

- **If you get a corrosive substance in your eye**, wash out immediately with copious amounts of water over a period of at least 2 minutes. Don't delay. Every second counts! Hold the eye open or get a colleague to do this, and then use the sterile saline from your First Aid kit to flush the eye. Seek medical advice immediately.

**Note** the special warning regarding the wearing of **contact lenses** in Section 2.5.6.

- Know the location of safety showers and fire extinguishers.
- Do not use needles and syringes to transfer toxic chemicals.
- Label all reagents clearly and identify special hazards.
- If bulk chemicals are decanted into smaller containers, ensure that containers are **clearly and correctly labelled**.
- Do not store hazardous chemicals at or above eye level, nor on the floor where they may be knocked.
- Do not store strongly interacting chemicals next to each other, i.e. concentrated acids should be stored away from strong bases, oxidising agents should be stored away from reducing agents and flammable solvents.
- Do not hold large stocks of flammable solvents in laboratory areas. The maximum permitted volume per laboratory is 15 litres. Stocks in excess of this should be stored in the Dangerous Goods Store.
- Dilution of strong acids: Acid into water ('A' comes before 'W'). Putting water into strong acid may result in a violent explosion with splashing of acid.
- Clean up all chemical spills immediately! This especially applies to the areas around the balances. In case of a major spill, do not try to clear the spill yourself. Evacuate the area and call for assistance.



## **Section Three: Biological Safety**

### **3.1 Biohazardous Material - Handling, Containment and Disposal**

#### **3.1.1 Introduction**

1. **All researchers** planning experiments with genetically modified organisms (GMO's) or potentially hazardous organisms must contact the University of Auckland Biological Safety Committee to gain approval for their research prior to starting. Regulations for work with GMO's are detailed in the "New Zealand Code of Practice for Small Scale Genetic Manipulation Research".
2. The following areas of research are classed as potentially biohazardous:
  - Cell culture involving cell lines of human or primate origin. This includes cell lines transformed with viruses (e.g. EBV, SV40).
  - Cell culture involving "hybridoma" cell lines especially those derived from interspecies fusions.
  - Growth of tumours in immunosuppressed xenogenic hosts, such as "nude" mice.
  - The handling of human blood, serum and tissue specimens.
  - Experiments using bacteria, viruses and parasites, grown in vivo or in vitro.
  - Experiments involving recombinant DNA including recombinant viruses, bacteria and yeasts.
3. Never use cells from staff or their relatives to generate cell lines, due to the high risk of re-exposure to histocompatible transformed lines.

#### **3.1.2 General Guidelines for Working with Biohazardous Material**

1. **UNDER NO CIRCUMSTANCES SHOULD ANY LIQUIDS BE PIPETTED BY MOUTH.** Always use plugged pipettes and the appropriate automatic pipetting device.
2. Follow Faculty and School Safety Guidelines.
3. Treat all human blood and body fluids, bone marrow, tissue culture and tissue specimens as if they were contaminated with an infectious agent.
4. Use the appropriate containment conditions (e.g. Class II hood for handling human material or a pathogen) for your experiment.
5. Disposable gloves must be worn when handling biohazardous materials. They must be disposed of into biohazard waste containers immediately upon conclusion of task. Care should be taken to prevent contaminated gloves coming in contact with laboratory furniture, door knobs, telephones, etc.
6. Wherever possible, use disposable pipettes and tubes rather than washing glassware.
7. Disinfect biohazardous material immediately or contain in biohazard bags for autoclaving. See the Biological Safety Advisor if you are unsure that contaminated material has been properly contained. Contaminated material must be carried in a leak-proof container when being transported out of the laboratory.
8. Contaminated recyclable glassware and equipment must be decontaminated before being washed. Equipment which cannot be disinfected must be autoclaved. Refer to Section 3.5, which has been reproduced from the Australian / New Zealand Standard 1995 (*Safety in Laboratories Part 3: Microbiology*), for details of appropriate chemical disinfectants.

**Note** that quaternary ammonium compounds, phenolic compounds and ethanol are not effective against bacterial spores and that ethanol is slow in its germicidal action.

9. Avoid techniques which have a high potential for creating aerosols (e.g. sonication, vortexing, blowing out pipette contents, centrifuging unsealed tubes). Any aerosol generating manipulation must be carried out in a biohazard cabinet. Sealed tubes must be used for centrifuging hazardous materials, using covered buckets to minimise contamination in the event of tube failure.
10. Institute a regular routine of cleaning and decontaminating bench tops and surfaces of hoods where biohazardous material is handled, by wiping with an appropriate disinfectant (see Table, Section 3.5). This should be done at least once a day. In any case, keep laboratory and bench tops clean. This especially applies to hood surfaces and ancillary rooms such as the cold room. Keep the floors clear. Mop floors of laboratories at regular intervals.
11. Segregate and dispose of all biohazardous waste correctly (see Section 3.1.8: Biohazardous waste disposal). Take appropriate precautions with contaminated sharps and needles. **DO NOT RECAP NEEDLES WITHOUT USING A NEEDLE GUARD. DO NOT SEPARATE NEEDLES AND SYRINGES.** Dispose of intact needle and syringe by placing in approved sharps container. Decontaminate all other waste before placing in appropriate waste container.
12. Clearly label all biohazardous material and remove biohazardous labels from material which has been decontaminated. Do not use containers with printed biohazardous labels (e.g. autoclave bags, sharps bins etc) for other purposes.  
Cupboards, refrigerators, and freezers used for storing biohazardous material should be clearly labelled indicating the nature of the material stored within, and carry the universal biohazard sign.
13. Report any accident or any spillage of biohazardous material immediately to your supervisor and the Biological Safety Advisor (see Section 1.1: SBS Safety Network). You must also complete an Accident Report (see Section 1.2.6).
14. Report any suspected infection immediately to your supervisor and to the Biological Safety Advisor.

### 3.1.3 Pipetting

Rules for safe pipetting are:

1. **NEVER PIPETTE BY MOUTH.** Always use plugged pipettes.
2. Do not mix solutions by alternate suction and blowing - aerosols may be created and/or droplets may be dispersed.
3. No material should be forcefully expelled from a pipette.
4. Air should be bubbled through a solution.
5. Take care not to drop biohazardous solutions from a pipette. Discharge liquids from pipettes as close as possible to the receiving fluid or agar, or allow the contents to run down the side of the receiving vessel.
6. Do not blow out the last drop from a pipette.
7. If pipetting biohazardous material ensure a disinfectant-soaked towel is placed on the working surface.

### 3.1.4 Syringes and Needles

The use of hypodermic syringes and needles should be kept to a minimum because their use is likely to generate aerosols. The following practices are recommended when using hypodermic syringes and needles:

1. Always use a biological cabinet when using hypodermic syringes and needles with biohazardous material.
2. Always use syringes fitted with a Luer-lock and be sure that the needle is fitted securely.
3. Fill syringes carefully to minimise frothing.
4. Avoid the use of syringes to forcefully expel liquid into a tube to mix contents.
5. When removing a syringe from a rubber-stoppered vial, wrap the needle and stopper in an alcohol saturated paper towel to minimise aerosols.
6. Inoculate animals with hand positioned behind needle to avoid 'needle stick' injuries.
7. Be sure animal is properly restrained and be alert for any unexpected movements.
8. Before and after injecting, rub the injection site with disinfectant.
9. **Always discard needles in a sharps bin dedicated for infectious material. Do not attempt to replace the needle sheath without a needle guard. Do not attempt to separate needle and syringe.**

### 3.1.5 Centrifugation

Because of the aerosol generation involved in centrifugation and the possibility of accidental spills, all centrifuging of biohazardous material must be performed in a small centrifuge inside a Class II Hood.

1. Before centrifuging, inspect all tubes for cracks.
2. Always use sealed tubes. Additional sealing can be provided by a layer of Parafilm around the junction of tube and cap.
3. **Always use rotor buckets with bucket covers.** The integrity of the seal should be checked periodically.
4. Avoid filling the tube so that the cap becomes wet: if the rim becomes soiled and seals imperfectly, some fluid will escape down the outside of the tube.
5. Remember that opening screw cap closures may generate aerosols if the inside of the cap has become contaminated. Covered buckets and centrifuge tubes should be opened or filled only in a Class II Hood.

### 3.1.6 Hand-washing

1. Refer to the Table, Section 3.5 for recommended methods of hand disinfection.
2. For “hygienic” hand washing, use liquid soaps, not bar soaps, because organisms can survive for some time on the bar.

### 3.1.7 Containment Facilities - Class II Hoods

Risks caused by infectious organisms are reduced by handling these agents in specially designed Class II Hoods. **ONLY CLASS II HOODS PROVIDE BOTH CONTAINMENT AND A STERILE WORK ZONE. NEVER USE A CROSSFLOW HOOD FOR HANDLING BIOHAZARDOUS MATERIAL.**

1. To ensure that hoods are functioning correctly, they should be tested and certified annually.
2. Work as far back in the hood as is comfortable to ensure proper containment of hazardous work.

3. All waste generated in these hoods must be decontaminated by treatment with chemical disinfectant (see Section 3.5) or by autoclaving prior to disposal. Be sure that approved bags are used to contain biohazardous material.
4. Decontaminate all surfaces in hoods after use (see Table, Section 3.5).
5. Flush hoods by continuing operation for ten minutes after use.
6. Turn UV light on to sterilise between uses.
7. Always leave hoods clean and tidy after use.

### 3.1.8 Biohazardous Waste Disposal

1. The following material must be decontaminated, either by the use of chemical disinfectants (see Section 3.5) or by autoclaving, before following general rules for the disposal of Biological Waste (see Section 8)
  - a) all material of human origin
  - b) all material that has come in contact with a known pathogen
  - c) all material that has come in contact with or been used in recombinant DNA work.
4. Sharp (e.g. disposable pipettes and Pasteur pipettes) and non-sharp (e.g. plastic dishes, tubes and flasks) contaminated waste should be separated prior to decontamination.
5. After decontamination, sharp waste should be disposed of in the large Medical (Biohazardous) Waste pails. **Note** that there are special small Medical Waste "sharps bins" for needles and syringes.
6. After decontamination, non-sharp waste should be disposed of in the yellow Medical (Biohazardous) Waste bags.
7. All Medical Waste is sealed prior to disposal, and incinerated.
8. Used gloves should never be discarded in ordinary rubbish bins.

## 3.2 Handling Human Material

### 3.2.1 General Guidelines

Treat all material from humans except well established human cell lines as potentially infectious. For tissue culture of human material, the investigator must follow the Guidelines for Working with Biohazardous Material (see Section 3.1).

1. **NEVER PIPETTE BY MOUTH**
2. All tissue culture work involving human material must be performed in a Class II Hood.
3. Disposable gloves must be worn and disposed of after completion of task. Wash hands promptly after removing gloves. **Do not allow contaminated gloves to come into contact with doors, telephones, etc.**
4. **Never use vacuum aspiration.** Pipette supernatants to a disposable tube and decontaminate by treatment with chemical disinfectant or autoclaving.
5. Use disposable equipment wherever possible. At the completion of the experiment all equipment that has come in contact with human material must be decontaminated by treatment with chemical disinfectant or autoclaving, before disposal into Medical (Biohazard) waste containers.
6. Needles and syringes must be placed in a sharps bin. **Do not attempt to separate needle and syringe. Discard both joined together.**
7. Blood samples may only be taken by appropriately qualified staff. When drawing blood always use a needle-guard to re-sheath a needle. **Never attempt this operation without one.** Always use with the concave cup side toward the operator.

8. Soak glass pipettes at least 30 minutes in a fresh hypochlorite disinfectant (see Table, Section 3.5). Rinse and autoclave. Metal instruments to be soaked in 1% Virkon (**not** hypochlorite) prior to autoclaving.
9. Haemocytometers to be wiped with fresh hypochlorite disinfectant following use to count human cells.
10. **Allow plenty of time in each experiment for cleaning and decontamination!**

### 3.2.2 Blood Accidents

1. Wear gloves throughout the cleanup procedure.
2. Spills must be cleaned up with a fresh hypochlorite disinfectant.
3. Dispose of gloves into a Medical (Biohazardous) Waste container immediately upon conclusion of task. Wash hands immediately.

### 3.2.3 'Needle Stick' Injuries

1. If you sustain a 'needle-stick' or similar injury involving blood, you must inform your supervisor and complete an Accident Report (see Section 1.2.6) as soon as possible. Please do not assume that because blood is drawn from a colleague that it is safe.
2. If the Hepatitis status of the 'donor' is unknown then they will have to be contacted and tested as soon as possible.
3. Should the 'donor' be positive for Hepatitis B antigen and the injured person have low or non-existent levels of antibody to Hepatitis B, then a prophylactic injection of gamma globulin will have to be given **WITHIN 72 HOURS OF SUSTAINING THE INJURY**. The results of the tests may not be known until the next day so it is a **matter of urgency that the Hepatitis B status of both donor and recipient are known**. Please do not automatically assume that you have sufficient levels of antibody because you have been vaccinated.

### 3.2.4. Hepatitis B Vaccine

The Hepatitis B vaccine offered to staff is the recombinant yeast-derived Engerix B (20pg/dose). This vaccine is safe and effective although the duration of its effect is not yet known. It is important that workers realise that they should be tested to ensure that they possess antibodies against Hepatitis B, should they sustain an injury which involves contaminated blood.

## 3.3 Bacteria

### 3.3.1 General Guidelines for Potentially Pathogenic Strains

1. **NEVER PIPETTE BY MOUTH.**
2. Keep the laboratory door closed.
3. **All manipulations involving pathogenic bacteria must be contained within a Class II Hood.**
4. Disinfect work surfaces daily and immediately after spills of bacteria (see Section 3.5).
5. Disinfect (see Section 3.5) or autoclave contaminated items such as glassware and laboratory equipment before washing or reuse.
6. Always use mechanical pipetting devices. Never allow bacterial solutions near the mouth.
7. Always wear gloves. Wash hands promptly after removing gloves. Bacteria may be present as a consequence of small tears, entry at the wrist, or solvent penetration.
8. Wash hands frequently and **always before leaving the laboratory.**

9. Always wear a laboratory coat. Do not wear any protective clothing outside the laboratory.
10. Minimise all procedures and manipulations that form aerosols. **Never use vacuum aspiration.** Pipette supernatants to a disposable tube and decontaminate.
11. Avoid the use of hypodermic needles and syringes.
12. **Allow plenty of time in each experiment for decontamination!**

### 3.3.2 General Manipulations involving Bacterial Cultures and Suspensions

Do not allow any infectious material to leave the Class II hood until you are sure that it will not pose an infection risk to yourself or anyone else in the vicinity. Make sure that any tubes are enclosed in a leak-proof container.

1. Avoid vortexing. Swirling a liquid culture will mix it effectively with a minimum of aerosol. When resuspending a liquid culture, allow a few minutes to elapse before opening the container. This will allow aerosols to settle.
2. Insertion of a hot loop into a liquid can cause splattering. To minimise aerosol, allow the inoculum loop to cool in the air or on the inside of the container. Be aware that subsequent flaming will also generate aerosols.
3. If plates are obviously wet take special precautions opening them as the liquid may contain viable bacteria.
4. Aerosols are often created when opening screw-capped or plugged tubes and bottles. This happens when a film of contaminated liquid between the rim and the cap is broken.
5. See the Biological Safety Advisor before attempting to open any sealed glass ampoules containing infectious material (lyophilised, solid or liquid).
6. Always use blending apparatus in a Class II hood. Use a disinfectant-soaked paper towel over the top of the blender. Sterilise the device and residual contents promptly.

**Pipetting, centrifugation, and the use of syringes and needles all generate aerosols. It is important therefore, that the following guidelines which are designed to minimise aerosol formation be needed.**

## 3.4 Recombinant DNA

### 3.4.1 Rules for the Molecular Biology Laboratory

Investigators in Molecular Biology laboratories must adhere to the following safety guidelines. Many of these measures are basic microbiological laboratory practises. Other measures, such as immediately destroying unwanted cultures and disinfecting waterbaths, will reduce the possibility of contamination by unwanted phages or antibiotic resistant bacteria.

1. **NEVER PIPETTE BY MOUTH.**
2. The basic rule of no eating, drinking and not applying cosmetics in the laboratory must be strictly observed.
3. Unaccompanied visitors and children are not permitted in the laboratory.
4. Bacteria and viral vectors must be destroyed by contact with fresh hypochlorite disinfectant for at least 30 minutes, or by autoclaving before disposal.
5. All disposable material that has come in contact with recombinant DNA must be disposed in Biohazard bags.
6. All contaminated glassware or plastic ware must be soaked in sodium hypochlorite before washing.

7. All water baths should contain disinfectant (100 micrograms cetyl pyridinium chloride per litre is suitable) and the water should be changed at regular intervals.
8. All spills on the workbench or floor must be decontaminated using an appropriate chemical disinfectant.
9. Laboratory coats should be worn during experimentation and not worn outside the laboratory.
10. All manipulations should be recorded in a laboratory notebook.
11. Tubes, bottles and other storage vessels containing recombinant DNA must be clearly labelled with the contents, your name and the date.
12. The laboratory should be locked at all times after hours when unoccupied.

### **3.5 Chemical Disinfectants**

Section 3.5 has been reproduced from the Australian / New Zealand Standard 1995 (*Safety in Laboratories Part 3: Microbiology*).

#### **3.5.1 Introduction**

Pressure steam sterilisation (autoclaving) is the most reliable means of decontamination. However, this method is not applicable in all situations. Chemical disinfection is often the only practical method of decontamination for large spaces or surface areas and for heat-labile materials or equipment. Where time permits, heat-labile materials and equipment may be sterilised by gaseous ethylene oxide or by ionising radiation.

#### **3.5.2 Susceptibility of Microorganisms**

Microorganisms vary in their susceptibility to chemical disinfectants. Lipid-containing viruses and the vegetative forms of most bacteria are relatively susceptible. Fungi, acid-fast bacteria (*Mycobacterium* spp.) and non-lipid-containing viruses are less susceptible while bacterial spores are resistant to the action of many chemical disinfectants. The causative agents of scrapie and Creutzfeldt-Jakob disease are extremely resistant to chemical disinfection.

#### **3.5.3 Types of Chemical Disinfectants**

Many chemical disinfectants are available under a variety of trade names. Examples of chemical disinfectants with a broad spectrum of activity against a range of microorganisms, including some sporicidal activity, are:

- (a) Halogens, e.g. chlorine and iodine
- (b) Aldehydes, e.g. formaldehyde and glutaraldehyde
- (c) Oxidizing agents, e.g. peracetic acid, peroxygen biocide and hydrogen peroxide.

Chemical disinfectants with a more limited antimicrobial spectrum include:

- (a) Alcohols, e.g. ethyl and isopropyl alcohols
- (b) Phenolics
- (c) Quaternary ammonium compounds
- (d) Chlorhexidine
- (e) Acids and alkalis.

#### **3.5.4 Factors Affecting Activity of Disinfectants**

Variables that may affect the action of chemical disinfectants include:

- (a) Concentration and formulation of the disinfectant
- (b) Effective period of contact time

- (c) Temperature
- (d) pH
- (e) Relative humidity
- (f) Inactivation by organic matter or cellulosic and synthetic materials.

### 3.5.5 Choice of Disinfectant

The choice of a chemical disinfectant often represents a compromise between the requirement for a broad antimicrobial spectrum, the limitations of the situation or type of materials being disinfected, and any disadvantages of particular disinfectants. A chemical disinfectant which is suitable for a particular purpose or situation depends not only on the types of microorganisms likely to be present, but also on the control or provision of the conditions that can promote its effectiveness in that situation. Other properties of the disinfectant must also be considered, such as possible corrosive, bleaching or staining effects and its flammability. The effect it may have on personnel as a toxic irritant, any sensitising action and its carcinogenic potential must also be taken into account.

When attempting to inactivate high concentrations of an infectious agent, a good 'rule of thumb' is to use a sequence including more than one solution, based on more than one chemical principle. For example, immersion in detergent followed by rinsing and immersion in hypochlorite is likely to be more effective than either solution used alone. Exposure to detergent, hypochlorite and then UV light would be even better. Application of some basic biochemical knowledge helps. A virus that is membrane-enveloped will obviously be more susceptible to detergent than one that is not.

See the Table at the end of Section 3.5 below for recommended methods for chemical disinfection in microbiological laboratories.

### 3.5.6 Properties of Commonly-Used Disinfectants

#### Chlorine

In the form of sodium hypochlorite or other chlorine-releasing compounds, chlorine is active against vegetative forms of bacteria and viruses and is the preferred chemical disinfectant for HIV and hepatitis viruses. It is less effective against spores. Chlorine combines rapidly with proteins, so, in the presence of organic materials, the concentration of chlorine needs to be increased to overcome this organic demand. For example, an equal volume of 5000-10,000  $\text{mg l}^{-1}$  (0.5-1%) available chlorine is required for the inactivation of HIV and hepatitis viruses in blood or serum.

Because the effective strength of chlorine solutions decreases on storage, working solutions should be freshly prepared each day. Stabilised solutions of sodium hypochlorite with added sodium chloride are preferred as these solutions maintain a greater effective chlorine concentration. For effective biocidal action, a pH range of 6-8 is optimum. High concentrations of hypochlorite solutions are corrosive to stainless steel and other metal surfaces and tend to bleach and damage fabrics.

A cheap and useful decontaminant with good wetting properties can be prepared by adding a non-ionic detergent to a solution containing approximately 500  $\text{mg l}^{-1}$  (0.05%) of available chlorine to give a detergent concentration of 0.7% v/v. This solution is suitable for disinfecting contaminated pipettes.



## Iodine

Iodine, in aqueous or alcoholic solution, has a wide spectrum of antimicrobial activity including some sporicidal action. It has the disadvantage of staining skin and may cause irritation and sensitisation.

Iodophors are organic compounds of surface active agents and iodine which rely on the slow release of iodine for activity. Free iodine reacts more slowly with organic matter than does chlorine, but inactivation may be significant in dilute iodine solutions. The optimum pH for activity is in the neutral to acid range. Decomposition occurs at temperatures above 40°C with the release of iodine vapour which is toxic on absorption. Povidone-iodine is used as a skin disinfectant.

## Formaldehyde

A solution of about 37% w/v formaldehyde gas in water is known as formalin. A solution of 5% w/v formaldehyde, i.e. about 13% v/v formalin, is a good decontaminant but it has a strong, irritating odour. Solutions of 8% v/v formalin in 80% v/v alcohol are considered to be very good for disinfection purposes because of their effectiveness against vegetative bacteria, spores and viruses. Formaldehyde is also available in its polymerised form, known as paraformaldehyde, which, on heating, decomposes to formaldehyde gas.

Formaldehyde is a useful space decontaminant for rooms, cubicles and biological safety cabinets; however, for proper effectiveness, it should only be used when the relative humidity (R.H.) is between 70% and 90%. Below this range, formaldehyde is less active; and, above it, difficult-to-remove polymers are deposited on surfaces. For space decontamination, formaldehyde can be generated by heating paraformaldehyde suspended in silicone oil (viscosity 350 mm<sup>2</sup>/s)\* to 160°C. A formaldehyde concentration of 5.0 g/m<sup>3</sup> of space to be decontaminated should be used. If necessary, the humidity should be raised by evaporating water placed in a beaker. \* 1mm<sup>2</sup>/s = 1 cSt

Where the R.H. is less than 40%, 20 mL of water per cubic metre of space should be evaporated into the room; where the R.H. is between 40% and 50%, 15 mL of water per cubic metre should be evaporated; where the R.H. is greater than 50%, 10 mL of water per cubic metre should be evaporated. A contact time of 15 h should be permitted to achieve decontamination. If the space is large, the use of an electric fan is recommended to assist in the distribution of formaldehyde gas. For effective decontamination, the room temperature should be 21°C or more. The concentration of formaldehyde gas generated by this method is not flammable.

Formaldehyde, generated by boiling formalin, may also be used to decontaminate biological safety cabinets. A concentration of 22.4 mL of formalin per 1 m<sup>3</sup> of space should be used.

When the ambient relative humidity is less than 50%, an extra 6 mL of water per 1 m<sup>3</sup> of space should be added to the formalin. When the ambient relative humidity is greater than 50%, 3 mL of water per 1 m<sup>3</sup> of space should be added to the formalin.

After decontamination, formaldehyde should be neutralised with ammonia generated by heating 7.5g of ammonium carbonate per cubic metre of space to 110°C. A 1 h reaction time should be permitted and the area ventilated for several hours before entry of personnel is allowed.

**Precautions are necessary for handling formaldehyde and for when entering rooms which have been decontaminated by gaseous formaldehyde as it is a highly toxic gas and is currently classified as a probable human carcinogen.** Under certain conditions, formaldehyde can react with free chlorine or chloride ions to form an unstable compound, bis-chloromethylether, which is a potent carcinogen. Hypochlorite solutions and hydrochloric acid

should therefore be removed from equipment or spaces being decontaminated by formaldehyde.

### **Glutaraldehyde**

Glutaraldehyde (1,5-pentanedial) is available as a 2% (w/v) aqueous solution which is activated as a disinfectant by the addition of an alkaline buffer. After activation, its useful life may be restricted to 14 d or 28 d, depending upon the formulation used. It is also available in a stable, glycol-complexed formulation (1% or 2% w/v) which does not require activation and which has reduced odour and irritancy. Glutaraldehyde is active against a wide range of microorganisms, including sporing bacteria, although a time period of between 3 h and 10 h (depending upon the manufacturer's recommendations) is required for reliable sporicidal action. Its main advantages are that it is non-corrosive to metalware and does not harm plastics, rubber or the cement mounting of lenses. Glutaraldehyde is used for the disinfection of certain types of medical equipment. After disinfection, such instruments must be rinsed well to remove the glutaraldehyde.

**Glutaraldehyde is irritating to the eyes and mucous membranes, but less so than is formaldehyde. It may cause dermatitis and respiratory problems in some handlers.**

Measures should be taken to protect handlers from exposure to its liquid or vapour. These include the wearing of waterproof, impervious, protective gloves for handling instruments that have been immersed in glutaraldehyde. Containers of glutaraldehyde disinfectant should always be covered and good ventilation, preferably mechanical exhaust ventilation over the container, should be provided. Care should be taken to avoid contamination of the work area by glutaraldehyde solutions. For example, after instruments are placed in glutaraldehyde disinfectant, the gloved hands should be rinsed under running water before the lid is replaced on the container; when the instruments are removed from the disinfectant, any excess glutaraldehyde should be drained back into the container. The tap used for rinsing the instruments under running water should be located as close as practicable to the disinfectant container. Rinsing under running tap water is preferable to rinsing in containers of still water because traces of glutaraldehyde are retained in the latter. However, these traces are not sufficient to prevent contamination of the water by *Pseudomonas aeruginosa* or other potentially pathogenic bacteria. For some purposes, water sterilised by heat or bacteria-retentive filters is used for final rinsing.

### **Peracetic Acid**

Peracetic acid (2% v/v) is used as a decontaminant when material is being transferred into plastics isolators containing gnotobiotic animals. It can also be used in disinfectant showers for personnel who are completely covered in waterproof protective clothing. Peracetic acid (2% v/v) is also a good decontaminant for clean, grease-free surfaces.

Peracetic acid solutions have a pungent odour and are irritating to the mucous membranes and highly corrosive. Protective face and respiratory protection should be worn and adequate extractive ventilation provided when the chemical disinfectant is used. A stabilised, non-corrosive formulation has been developed for use in a system of high-level disinfection of instruments.

### **Peroxygen Biocides**

The peroxygen system (e.g. 'Virkon') consists of potassium peroxymonosulphate, sodium chloride and an inorganic surfactant acting at a low (acid) pH level. In a 1% w/v concentration, this strongly oxidising disinfectant is active against a range of microorganisms, including fungi and viruses. However, it has been shown to be ineffective against *Mycobacterium* spp. It is corrosive to metalware and damaging to fabrics but less so than is sodium hypochlorite of equivalent activity.

## Hydrogen Peroxide

Hydrogen peroxide is active against a range of microorganisms although fungi are relatively resistant and bacterial spores and enteric viruses require a higher concentration than the 3% w/v generally used for disinfection. A major advantage is the absence of toxic end-products of decomposition.

## Alcohols

A 70% w/w (approximately 80% v/v) solution of ethyl alcohol or a 60-70% v/v solution of isopropyl alcohol provides a useful disinfectant for clean surfaces and the skin. As a skin disinfectant, alcohols are used either alone or in combination with other disinfectants. Emollients, such as glycerol, are also added to counteract the drying effect of alcohols on skin.

Alcohols are active mainly against vegetative bacteria, *Mycobacterium* spp. and the lipid-containing viruses and are inactive against spores. They evaporate from surfaces leaving no residues. However, they may cause swelling of rubber, hardening of plastics and weakening of the cement around lenses in instruments. The alcohols are unsuitable for application to proteinaceous material as they tend to coagulate and precipitate surface proteins which may then result in protection of the microorganisms present. Because of their flammability, alcohol disinfectants should be used sparingly in biological safety cabinets and not with equipment that is likely to produce sparks.

## Phenolics

The synthetic phenolics (clear soluble fluids) do not have the pungent odours, highly corrosive and skin irritancy properties of the crude parent compounds, phenol and lysol. They are active against bacteria and lipid-containing viruses but are inactive against spores and the non-lipid-containing viruses. A major advantage of the phenolics is that they are not deactivated by organic matter. They may cause toxic effects if ingested.

## Quaternary Ammonium Compounds

Quaternary ammonium compounds (QACs) are cationic detergents with powerful surface-active properties. They are effective against Gram-positive bacteria and lipid-containing viruses, e.g. herpes and influenza, but are less active against Gram-negative bacteria and non-lipid-containing viruses and are inactive against *Mycobacterium* spp. and bacterial spores. QACs tend to be inactivated by protein adsorption, anionic soaps and detergents, and cellulosic and synthetic plastics materials. They are non-toxic, inexpensive, non-corrosive to metals and non-staining. Because of their detergent properties, they have been used mainly in formulations of cleaning agents in the food industries.

## Chlorhexidine

Various formulations of chlorhexidine (as chlorhexidine gluconate) with compatible detergents and ethyl alcohol, or ethyl and isopropyl alcohols, are used as skin disinfectants. The alcoholic formulations have shown to be effective against HIV. In general, aqueous chlorhexidine is active against Gram-positive bacteria, only moderately active against Gram-negative bacteria and inactive against sporing bacteria, *Mycobacterium* spp. and non-lipid-containing viruses. Alcohols in the skin disinfectant formulations extend the spectrum of activity of chlorhexidine. Chlorhexidine is of low toxicity, except for neurological tissues, and rarely causes hypersensitivity. It is compatible with quaternary ammonium compounds but is incompatible with soap and anionic detergents. Chlorhexidine is widely used in skin disinfectant formulations, but is not recommended as a general disinfectant.

## Acids and Alkalis

All acids are corrosive and care must be taken with their use. Acids are effective against a wide range of microorganisms. Hydrochloric acid solution of 2% concentration can be used in

places contaminated with urine, blood, faeces, and in sewage collection areas. Acetic and citric acids are effective for general use against many viruses. A solution of 0.2% citric acid is recommended for personal decontamination. Phosphoric and sulphamic acids are used in food processing areas.

Alkalis have activity against a wide range of microorganisms even in the presence of heavy organic loads in such places as drains and areas contaminated by sewage.

Alkalis are disinfectants of choice for many animal holding areas or animal facilities. Sodium carbonate 4% solution can be used as a wash for animal cages and animal transport vehicles. Sodium metasilicate 5% solution is used as a wash for aircraft and air transport crates. Sodium hydroxide 4% (v/v) for 1 h is recommended for reducing the infectivity of Creutzfeldt-Jakob and other unconventional (prion) agents.

**Note:** *Material Safety Data Sheets (MSDS) shall be obtained from the supplier or distributor for any chemical disinfectant used in the workplace. A request for the relevant MSDS should automatically accompany the initial order for materials. MSDS provide information on the identity, physical characteristics, potential health hazards and precautions to be taken for safe storage, use and disposal of chemicals. The laboratory supervisor shall ensure that all persons have access to MSDS for all the substances that they use in the workplace and that they are read and understood by all concerned. MSDS, as obtained from suppliers, shall not be altered although additional information may be appended and clearly marked as such.*

### 3.5.7 Contamination of Disinfectants

Working solutions of disinfectants should be frequently replaced with freshly prepared dilutions from stock solutions. This applies particularly to those disinfectants which are subject to inactivation by organic or other materials, loss of stability or significant dilution through the introduction of wet instruments. Otherwise, the inactivated, exhausted or diluted disinfectants may become contaminated and may even support the growth of the bacterial contaminants. The containers or dispensers used should also be emptied and decontaminated between batches and their contents not merely 'topped up'.

The "In-use" test detects contamination in chemical disinfectants. A 1 mL sample of the disinfectant is added to 9 mL of diluent containing a suitable inactivator. Ten drops (each 0.02 mL) are placed on each of two nutrient agar plates; one is incubated at 37°C for 3 d and the other at 22°C for 7 d. Five or more colonies on either plate indicate a problem of contamination requiring investigation.

**Table 1: Recommended Applications for Chemical Disinfectants in Microbiological Laboratories**

Site or Equipment	Routine or Preferred Method of Usage	Acceptable Alternative
Benches and surfaces (not obviously contaminated).	Alcohols, e.g. 70% w/w (= 80% v/v) ethyl or 60-70% v/v isopropyl - swabbed	Clear soluble phenolics*
Biological safety cabinet (BSC) work surfaces.	Glutaraldehyde† (with cabinet fan operating) – swabbed.	Clear soluble phenolics* after bacteriological work.
BSC before servicing or testing.	Formaldehyde vapour at 70-90% relative humidity (RH) at $\geq 21^{\circ}\text{C}$ for 15 h	
Centrifuge rotor or sealable bucket after leakage or breakage.	Disinfection not the preferred method. Autoclaving at $121^{\circ}\text{C}$ for 15 min recommended.	Glutaraldehyde† for 10 min or clear soluble phenolics* for bacterial spills for 10 min.
Centrifuge bowl after leakage or breakage.	Glutaraldehyde† for 10 min (swabbed twice within the 10 min period then wiped with water).	Clear soluble phenolics* for bacteria spills for 10 min.
Discard containers (pipette jars).	Chlorine disinfectant at 2 000-2 500 mg/l (0.2-0.25%), freshly prepared and changed daily.	Peroxygen biocide at 1% w/v conc. (except for <i>Mycobacterium</i> spp.) or clear soluble phenolics* for bacteriological work (changed weekly) or detergent with autoclaving for virus work.
Equipment surfaces before services or testing.	Surfaces disinfected according to manufacturers' instructions.	Alcohol (80% v/v ethyl or 60-70% v/v isopropyl) except when its flammability poses a hazard or glutaraldehyde† then water.
Gnotobiotic animal isolators.	Peracetic acid at 2% v/v conc - swabbed	
Hand disinfection.	Chlorhexidine (0.5-4% w/v) in alcoholic formulations for 2 min.	Isopropyl (60-70% v/v) or ethyl alcohol (80% v/v) with emollients or Povidone-iodine (0.75-1% av. I) for 2 min.
Hygienic hand wash.	Chlorhexidine (4% w/v) in detergent formulation (or alcoholic formulations) for 15 sec.	Detergent cleansers or soap for 15 sec.
Spills of blood/serum (or viral cultures)	High concentrated chlorine at 5000-10 000 mg/l (0.5-1%) for 10 min (active against hepatitis viruses and HIV).	Glutaraldehyde† or peroxygen biocide (1% w/v) for 10 min.
Spills of bacterial cultures.	Clear soluble phenolics* (unaffected by organic load) for 10 min.	High concentration chlorine disinfectant or peroxygen biocide or Iodophor* for 10 min.

\* Dilute according to manufacturer's instructions.

† Glutaraldehyde as 2% w/v activated aqueous or 1% w/v glycol-complexed formulations.

## **Section Four: Radiochemical Safety**

### **4.1 Basic Training**

**All users of radioactivity in SBS must:**

1. Know some of the basic properties of alpha, beta and gamma radiation, e.g., penetrating ability, charge.
2. Know various definitions concerning radiation, the conventional units used to measure radiation quantities.
3. Understand the concept of radioactive half-life and be able to do simple calculations of remaining activity after an elapsed period of time.
4. Know what the principal radionuclides in use in SBS are and whether they are beta or gamma emitters.
5. Know and understand the four principal pathways of potential internal contamination: inhalation, ingestion, punctures, absorption, and how to protect against internal exposure.
6. Know and understand the three principles of external protection: distance, time, and shielding.
7. Understand the different types of shielding available and which type of material affords the best shielding for the various radionuclides used.
8. Follow safe practices for use of radioactivity in the School of Biological Sciences, as detailed in Section 4.2 below

**A minimum basic knowledge of radioactivity and radionuclides can be gained by reading and understanding Section 4.5 of this manual (*Radiochemical Safety - Useful Facts and Figures*).**

### **4.2 Radionuclide Laboratory Safe Practices in SBS**

**These rules MUST be followed at all times**

1. **NEVER PIPETTE BY MOUTH.**
2. No smoking or eating permitted in the work area.
3. Gloves and laboratory coat are required to be worn when using radionuclides. Always remove your gloves after handling isotopes. Never answer phones or walk into non-radioactive areas with gloves on. Check gloves routinely for contamination.
4. Hands, shoes and clothing should be frequently monitored.
5. Work with radioactive materials in an approved hood or designated work area, unless the safety of working on an open bench can be demonstrated.
6. Radionuclide work should be conducted in an impervious tray or pan, lined with absorbent paper.
7. Utilise shielding and distance whenever possible.
8. Dispose of liquid and solid radioactive waste in appropriate containers.
9. Refrigerators containing radionuclides shall not be used for storing food.
10. Monitor radionuclide work areas at least once daily for contamination.
11. Thoroughly wash hands after manipulating radionuclides, before eating or smoking, and on completion of work.
12. Report accidental inhalation, ingestion, injury or spills to your supervisor and submit an Accident/Incident Report (refer Section 1.2.6) as soon as possible.

13. Review pertinent safety practices frequently, especially before using a new radionuclide.

**All laboratories must have appropriate dose monitoring equipment.**

(Beta radiation must be monitored with a monitor fitted with a Geiger-Muller tube. Gamma emission must be monitored with a scintillation monitor fitted with a sodium iodide crystal probe).

**Failure to comply with the guidelines invites closure of your laboratory until you comply with safe work practices.**

**All users of radioactivity are required to follow the Code of Safe Practice for the use of UNSEALED RADIOACTIVE MATERIALS published by the National Radiation Laboratory at the Ministry of Health**

#### **4.3 Emergency Procedure Following a Spill or Accident with Radioisotopes**

1. Place absorbent material over the spill to keep it from spreading.
2. Notify others in the area and limit access to the spill area.
3. Monitor yourself for contamination and decontaminate immediately if you find any.
4. Label the boundaries of the spill area with "Caution - Radioactive Material" tape.
5. Gather cleaning supplies-moistened paper towels and detergent. Wear protective clothing (lab coat, gloves and shoe covers if necessary) while decontaminating the spill area. Begin cleaning at the edges of the spill and work towards the centre. Minimize the volume of water used to decontaminate the spill area.
6. Dispose of all cleanup materials as radioactive waste.
7. Notify your supervisor and submit an Accident Report.

**Personnel contamination:**

- (a) Skin contamination: Go to the nearest sink and wash the affected area repeatedly with soap and water until no more radioactivity is removable. A mild scrub brush may be used. Do not use organic solvents on skin. If detectable contamination remains after several washings, wait half an hour and wash again. Notify your supervisor and submit an Accident Report.
- (b) Eye contamination: Flush with copious amounts of water. Notify your supervisor and submit an Accident Report.
- (c) Contaminated Lab Coat, Clothing or Shoes: Remove the contaminated item(s) and check the skin underneath for contamination. Place the item(s) in a plastic bag which is labelled with "Caution Radioactive Material" tape. Consult your supervisor and/or the SBS Radiochemical Advisor for further instructions.

#### **4.4 Radioactive Waste Procedures**

Radioactive Waste is defined as any waste that contains or is contaminated with radioactive material. This includes liquids, solids, animal carcasses and excreta, used scintillation counting liquids (LSC) etc.

**Radioactive waste must never be placed in any non-radioactive waste container or disposed of in the sink.**

**No general (i.e. non-radioactive) waste may be disposed of in radioactive waste containers - this keeps volumes of radioactive waste to a minimum and hence minimises disposal costs.**

#### Specific waste disposal procedures:

1. Segregation by half-life: Short half-life wastes (radioactive half-life of less than 100 days) must be kept separate from long half-life wastes (radioactive half-life of greater than 100 days).
2. Dry solid waste must be disposed of in double lined thick plastic bags and labelled with the name of the laboratory, estimated amount of radioactivity, the isotope and the date. Bags should be placed in the designated waste storage area (consult your supervisor).
3. Liquid radioactive waste must be collected separately from dry waste and stored in plastic containers. Waste containers must be labelled with the name of the laboratory, estimated amount of radioactivity, the isotope, and the date. Containers must be placed in the designated waste storage area (consult your supervisor).
4. Liquid scintillation vials containing radioactive material must be kept separate from other liquid waste. If an organic-based scintillant was used, the scintillant must be evaporated in a fume hood prior to disposal. Label and dispose in designated waste storage area (consult your supervisor).
5. Pipettes of glass or plastic and needles contaminated with radioactive material must be kept separate from all other radioactive waste. Glass and plastic pipettes should be placed in a cardboard box or other suitable container, labelled "Caution - radioactive material" and placed in the designated waste storage area (consult your supervisor). Hypodermic needles should be disposed of in a plastic container specifically designed for their disposal and labelled "Caution - Radioactive Material". This container should be placed in the designated waste storage area (consult your supervisor).

## **4.5 Useful Facts and Figures**

### **4.5.1 Radiation and Radioactivity**

IONISATION	is the process by which a neutral atom or molecule acquires a positive or negative charge.
RADIATION	particle or wave energy which is emitted or transmitted through matter or space.
ALPHA PARTICLE	a fast-moving ( ${}^4\text{He}^{2+}$ ) nucleus
BETA PARTICLE	an electron, of negative or positive charge, emitted from a nucleus during radioactive decay.
GAMMA RAY	a penetrating, short-wavelength form of electromagnetic radiation emitted from a nucleus during radioactive decay.
X-RAY	a penetrating, short-wavelength form of electromagnetic radiation produced when a beam of high speed electrons strike a material.
RADIOACTIVITY	the property of certain unstable elements of spontaneously emitting radiation which is capable of ionising atoms or molecules in its path.
BREMSSTRAHLUNG RADIATION	a type of electromagnetic radiation, similar to x-rays, resulting from the deflection of fast moving beta particles by nuclei in an absorbing medium. Production of this radiation increases with the atomic number of the absorber.



#### 4.5.2 Quantities and Units of Radiation Measurement

The **QUANTITY** of radioactive material in a sample is defined by its **ACTIVITY**.

**ACTIVITY** is measured in terms of disintegrations per unit time.

A curie (Ci) is a basic unit used to describe the quantity of radioactivity in a sample of material.

The subunit milli equals  $10^{-3}$  and is frequently used as a prefix for the unit rem or curie.

The subunit micro equals  $10^{-6}$  and is frequently used as a prefix for the unit curie.

**RADIOACTIVE DECAY** is the process of transforming the nuclei of an unstable radioactive material towards stability, resulting in the emission of ionising radiation and a decrease of its radioactivity.

**HALF LIFE** is the time it takes for 50% of a radioactive substance to disappear by radioactive decay. The half-life is unique for each radionuclide and cannot be altered by physical or chemical means. When a radionuclide is internally deposited, the **RADIOLOGICAL HALF-LIFE** can be combined with the **BIOLOGICAL HALF-LIFE** of the chemical to which it's tagged, to yield an **EFFECTIVE HALF-LIFE**, representing the removal rate of the substance by both radiological decay and biological elimination.

**RADIOLOGICAL** -due to radioactive decay.

**BIOLOGICAL** -due to radioactive material in a body being eliminated through excretion or secretion.

#### 4.5.3 Doses and Exposure

A **ROENTGEN** is a unit of radiation exposure based on the number of ionisations produced in air due to gamma or x-ray interaction.

The new Exposure unit is the **Coulomb/kg** (see Table below for conversion).

The acronym **RAD** stands for "radiation absorbed dose" and quantifies the amount of energy deposited from ionising radiation interaction per gram of material.

The new Absorbed Dose unit is the **Gray** (see Table below for conversion).

The acronym **REM** stands for "Roentgen equivalent [in] man" and is the dose equivalent based on the number of rads times a weighting or **QUALITY FACTOR** to better estimate the biological impact of a particular type of radiation absorbed in the body.

$$\text{rem} = (\text{Absorbed Dose, in rads})(\text{Quality Factor, QF})$$

The new Dose Equivalent unit is the **Sievert** (see Table below for conversion).

For most purposes involving ionising radiation currently used in SBS, Roentgens, rads, and rems are approximately equal numerically.

**DOSE** is the amount of radiation energy absorbed.

**Table 2: New Units for Use with Radiation & Radioactivity**

QUANTITY	OLD UNIT	NEW UNIT	EQUIVALENCE
Activity	Curie (Ci) ( $3.7 \times 10^{10}$ dps)	Becquerel (Bq) (1 dps)	1 Ci = $3.7 \times 10^{10}$ Bq
Exposure	Roentgen (R) ( $2.58 \times 10^{-4}$ C/kg)	Coulomb/kg (C/kg)	1 R = $2.58 \times 10^{-4}$ C/kg
Absorbed Dose	rad (100 erg/gm)	Gray (Gy) (1 J/kg)	1 Gy = 100 rad
Dose Equivalent	rem	Sievert (Sv)	1 Sv = 100 rem

#### 4.5.4 Internal and External Exposure Hazards and Controls

##### Internal Radiation Hazards and Control

Internal exposure results when the body is contaminated with radioactive material by:

- inhalation
- ingestion
- puncture
- absorption

Internally deposited radioactive material produces continuous radiation exposure until it decays and/or is eliminated through body fluids.

All internal radioactive sources are of concern, but alpha emitters do more harm, rad for rad, than do other forms of radiation. When deposited in a vital organ, alpha particles can cause considerable damage due to their relatively high energies (4 to 9 MeV), size, charge, and short travel path. Many alpha emitters concentrate, as calcium analogues, in the bone, where removal rates are very low.

Low energy beta emitters are primarily internal radiation hazards, whereas high energy beta emitters, e.g.  $P^{32}$ , present more of an external hazard. Beta particles are lighter and have less charge than alpha particles, thus resulting in a longer travel path. The biological effects produced from the same amount of absorbed beta radiation energy is less than that from alpha radiation.

From the standpoint of internal hazards, X and  $\gamma$  rays are not as significant as  $\alpha$  or  $\beta$  particles.

**Specific protection guides** - pertaining to the principal pathways of entry:

**A. Inhalation**

- Always use a chemical fume hood for work with potentially volatile iodine compounds or gaseous tritium evolvers.
- Guard against equipment generating aerosols.

**B. Ingestion**

- **Never pipette by mouth.**
- No eating, drinking, or smoking in an area where radionuclides are used.
- Do not store food or drinks in a cold room or refrigerator which is designated for radioactive material.

- Wash hands after using radioactive materials, especially before eating or smoking.

**C. Puncture**

- Dispose of syringes and pipettes promptly in approved containers.
- Guard against glass breakage and puncture injury.
- Do not attempt to re-cap needles before disposal.

**D. Absorption**

- Use plastic-backed absorbent paper on lab bench.
- Use double containment for storage and when transporting radioactive materials.
- Wear lab coat and disposable gloves when handling radioactive materials.
- Change gloves frequently.
- Monitor yourself for contamination at frequent intervals.

**External Radiation Hazards and Control**

An external hazard is a source of ionising radiation that remains outside the body, but which emits radiation capable of either (a) penetrating sufficiently to dose the lens of the eye, or (b) penetrating the outer dead layer of skin to reach live skin cells or other internal organs.

External radiation may originate in many different ways: in X-ray machines or other devices specifically designed to produce radiation, such as a sealed source irradiator; in devices where production of X-rays is a side effect, such as an electron microscope; and from various radionuclides, such as gamma or high-energy beta emitters.

Alpha particles from radionuclides do not constitute an external radiation hazard, because even the most energetic ones will not penetrate the dead layer of skin to reach live skin cells or other internal organs.

**Potential External Hazards in SBS**

Radionuclides in the Laboratory

Na<sup>22</sup> a high energy gamma emitter:

511 keV gamma  
1275 keV gamma

Na<sup>24</sup> a high energy gamma and beta emitter:

1369 keV gamma  
2754 keV gamma  
1389 keV beta

P<sup>32</sup> a high energy beta emitter: 1710 keV

P<sup>33</sup> a moderate energy beta emitter: 248 keV

Cr<sup>51</sup> a moderate energy gamma emitter: 320 keV (9% of decays)

I<sup>125</sup> a low energy gamma emitter: 27-35 keV

I<sup>131</sup> a moderate energy gamma emitter: 364 keV

#### 4.5.5 Principles of Protection

If it is not feasible to do away with the external radiation source, then exposure of personnel to external radiation may be controlled or limited by one or more of the following methods, either singly or in combination:

- (a) maximising the distance from the source
- (b) minimising time of exposure;
- (c) shielding the radiation source.

##### Distance

The dose rate for most gamma and x-rays varies with the inverse square of the distance from a "point" source. Therefore, the further away you stand from a source of radiation, the smaller the dose you receive. For this reason, remote handling devices are recommended to minimize doses to the extremities.

$$\text{Dose rate} = \text{dose rate at 1 meter}/(\text{distance})^2$$

Doubling the distance from a radiation source will give 1/4 the exposure

For example: if the dose rate at 1 meter = 10 mR/hr

then: the dose rate at 2 meters = 2.5 mR/hr ( $2^2 = 4$ )

and: the dose rate at 3 meters = 1.1 mR/hr ( $3^2 = 9$ )

Likewise, if the dose rate at 2 meters is 2.5 mR/hr, it is four times or  $2^2$  larger at 1 meter, or 10 mR/hr.

##### Time

The less time you stay in a radiation field, the smaller the dose you receive.

$$\text{Dose} = \text{dose rate} \times \text{time}$$

##### Shielding

Placing shielding between yourself and a source of penetrating radiation will decrease your dose.

ALPHA shielding not necessary

LOW ENERGY BETA ( $C^{14}$ ,  $H^3$  and  $S^{35}$ ), shielding not necessary

HIGH ENERGY BETA ( $P^{32}$ ,  $Y^{90}$  and  $P^{33}$ , a moderate energy beta) 9mm Lucite (dense plastic)

**Note:** Plastic bench shields must be used when working with  $P^{32}$  and  $P^{33}$ , vial shields must be used for those source vials containing mCi quantities of  $P^{32}$  which are not already shielded by the manufacturer.

GAMMA OR X-RAY ( $I^{125}$ ,  $I^{131}$ ,  $Cr^{51}$ ), lead shielding is only recommended for specific types and amounts of gamma-emitters used.

**Note:** For iodinations when using mCi quantities of  $I^{125}$ , 0.75mm lead is necessary. All iodinations must be in an approved fume hood

#### 4.5.6 Data on the Most Commonly used Radioisotopes

##### Tritium

The beta emission from tritium is of low energy and gives rise to no external radiation hazard, and therefore makes it difficult to monitor tritium contamination. Care is therefore required when handling compounds containing this nuclide. Gloves should be worn at all times.

Always add  $^3\text{H}$  thymidine to proliferation assays in a Class II hood where any aerosols will be contained. Any radioactive aerosol will be blown directly onto the operator if a laminar flow hood is used.

##### Carbon<sup>14</sup>, Phosphorus<sup>33</sup>, and Sulphur<sup>35</sup>

Although the metabolism of these compounds containing these nuclides is different, they have comparable radiation hazards. These three nuclides emit relatively low energy beta radiation and their use presents no hazard from external radiation when handling amounts less than 1mCi. Beta radiation from these three nuclides is absorbed by the container, but be wary of looking down into the open top of the vessel (this especially applies to containers that carry the concentrated nuclide). A thin end Geiger-Muller tube will detect less than 10% of the beta particles incident upon it. Contamination with these nuclides can be difficult to detect, therefore extra care is required.

In the case of Carbon-14, the long half-life (about 6,000 years) means that contamination may build up over a long period of time, and unless effectively dealt with, will remain a problem permanently.

$^{35}\text{S}$ -labelled amino acids used for protein labelling generate radioactive decomposition products during thawing and subsequent labelling reactions. Additional precautions should be observed when handling these compounds. Always thaw vials of  $^{35}\text{S}$ -labelled amino acid in a fume hood using a needle through the rubber septum to vent the vial before opening it. When incubating the labelled amino acids with cells, always contain the labelling media in a plastic tray with a separate container of activated charcoal to absorb any  $^{35}\text{S}$ -labelled volatile compounds that may escape into the incubator. If biosynthetic labelling experiments are performed regularly, always use the same incubator and change the water in the bottom tray after every second experiment.

In general, Phosphorus-33 labelled compounds do not require shielding over and above those necessary for Carbon-14 and Sulfur-35 labelled compounds. Phosphorus-33 compounds however, are metabolised in bone and such compounds will have a high toxicity if ingested. As with Carbon-14 and Sulfur-35, accurate assessment of contamination will be difficult using normal survey meters. Extra care therefore, needs to be taken to avoid contamination and possible subsequent ingestion. In SBS we require researchers working with  $\text{P}^{33}$  to follow the same safety practices used for  $\text{P}^{32}$ .

##### Phosphorus<sup>32</sup>

The beta emission from this nuclide has a maximum energy of 1.7 MeV, which means that external radiation is an important hazard. Containers and work areas should be shielded with Perspex. Over an open solution emission of  $^{32}\text{P}$  can be substantial. This will not be appreciably attenuated in a few centimetres of air. A hand or face over such a container could receive a considerable radiation dose in a short time. It is important that workers using this nuclide be shielded during all manipulations involving solutions that contain greater than 0.1 mCi of  $^{32}\text{P}$ . The cornea in particular, is susceptible to damage and Perspex safety goggles should be worn if the face cannot be adequately shielded with a Perspex screen. Lead is an unsuitable screen for  $^{32}\text{P}$  as the beta radiation from this nuclide can give rise to more hazardous

Bremsstrahlung radiation from lead. Bremsstrahlung radiation consists mainly of higher energy gamma radiation.

A useful formula for estimating the dose rate from  $^{32}\text{P}$  at short distances is:

$$\text{Dose rate (mSv per hour @ 10 cm)} = 0.76 \times \text{Activity (MBq)}$$

The inverse square law can be incorporated to calculate the distance at other distances.

$$\text{e.g. Dose rate at 1 mm} = 0.767 \times \text{Activity} \times 1002.$$

#### Iodine-125 and Iodine-131

The metabolism of iodine involves its concentration and long retention in the thyroid gland, and because of the high concentration in the small volume of tissue comprising this organ, all radioisotopes of iodine have a relative high toxicity. In many chemical forms these nuclides are volatile and inhalation of the radioactive material in a gaseous form is a significant hazard. Iodination of proteins, which involve the use of high activity unsealed radioactive sources of  $^{125}\text{I}$  and the generation of radioactive iodine gas in the reaction, **must only be performed in a designated fume hood in a High Activity Radiation Area by trained workers (You must consult with your supervisor and the SBS Safety Committee before undertaking iodinations).**

The gamma radiation emitted by these two isotopes of iodine give rise to significant external gamma radiation hazard from activities commonly in use. The provision of lead shielding is necessary. Isotopes of iodine must be monitored using a scintillation monitor fitted with a sodium iodide crystal detector.

The dose rate at one metre from a point source of  $^{125}\text{I}$  is given by the equation: Dose Rate (mSv per hour @ 1 metre =  $0.0019 \times \text{Activity (MBq)}$ .

(Similar equations are available for other gamma emitters.)

Because of the concentration of iodine in the thyroid gland, it is recommended that persons routinely handling in excess of 1 mCi of  $^{125}\text{I}$  should verify that there has been no uptake of radioactive material by external counting of the thyroid gland, 4 to 48 hours after the work has been completed.

**Remember: Work with any of these radionuclides must be undertaken in work areas that are clean, tidy, and free of clutter. Such work practices will minimise the risk of contamination and accidental spills.**

#### 4.5.7. The Main Characteristics of the Most Commonly used Radionuclides

<p><b><u>Carbon 14</u></b> Physical half-life : 5730 years Biological half-life : 10 days (whole body) Effective half-life : 10 days (whole body)</p> <p>Type of decay: <math>\beta^-</math> to <math>^{14}\text{N}</math> <math>E_{\text{max}} = 0.156 \text{ MeV}</math> Critical organ: fat Maximum Permissible Burden: 180mCi Max range in air = 23cm Screening: none required, emission won't penetrate skin.</p>	<p><b><u>Phosphorus 33</u></b> Physical half-life: 25.4 days Type of decay: <math>\beta^-</math> to <math>^{33}\text{Cl}</math> <math>E_{\text{max}} = 0.249 \text{ MeV}</math> Critical organ: bone Maximum Permissible Burden: 32mCi Max range in air = 49cm Screening: 5mm Perspex</p>
<p><b><u>Hydrogen 3 (Tritium)</u></b> Physical half-life: 12.26 years Biological half-life: 12 days (whole body) Effective half-life: 12 days (whole body) Type of decay: <math>\beta^-</math> to <math>^3\text{He}</math> <math>E_{\text{max}} = 0.018 \text{ MeV}</math> Critical organ: whole body Maximum Permissible Burden: 2000mCi Max range in air = 5mm Screening: None required, emission won't penetrate skin.</p>	<p><b><u>Chromium</u></b> Physical half-life: 27.8 days Biological half-life: 616 days (whole body) Effective half-life: 26.6 days (whole body) Type of decay: Electron capture and <math>\beta^+</math> ray to <math>^{51}\text{V}</math> <math>\beta^+</math> ray = 0.032 MeV X-ray = 0.005 MeV Auger electron = 0.004 MeV Critical organ: GI tract; whole body Maximum Permissible Burden: 1100mCi Unshielded exposure rate 1cm from 1 mCi source for soft tissue = 1.8 mSv/hr Screening: Lead at higher concentrations.</p>

<p><b><u>Phosphorus 32</u></b></p> <p>Physical half-life: 14.3 days</p> <p>Biological half-life: 257 days (whole body) 1155 days (bone)</p> <p>Effective half-life: 13.5 days (whole body) 14.1 days (bone)</p> <p>Type of decay: <math>\beta^-</math> to <math>^{32}\text{S}</math> <math>E_{\text{max}} = 1.71 \text{ MeV}</math></p> <p>Critical organ: Bone</p> <p>Maximum Permissible Burden: 3mCi (bone)</p> <p>Max range in air = 6.5 metres</p> <p>Screening: 100mm Perspex</p>	<p><b><u>Iodine 125</u></b></p> <p>Physical half-life: 60 days</p> <p>Biological half-life: 138 days (thyroid)</p> <p>Effective half-life: 42 days (thyroid)</p> <p>Type of decay: Electron capture and <math>\gamma</math> ray to <math>^{125}\text{Te}</math></p> <p>Critical organ: thyroid</p> <p>Maximum Permissible Burden: 4 mCi (whole body) 1.2 mCi (thyroid)</p> <p>Unshielded exposure rate 1cm from 1 mCi source for soft tissue = 14 mSv/hr</p> <p>Screening: 3mm thick lead</p>
	<p><b><u>Sulphur 35</u></b></p> <p>Physical half-life: 87 days</p> <p>Biological half-life: 90 days (whole body) 1530 days (skin)</p> <p>Effective half-life: 14 days (whole body) 82 days (skin)</p> <p>Type of decay: <math>\beta^-</math> to <math>^{35}\text{Cl}</math> <math>E_{\text{max}} = 0.168 \text{ MeV}</math></p> <p>Critical organ: skin, testis</p> <p>Maximum Permissible Burden: 0.18 mCi (testis); 400 mCi (skin)</p> <p>Max range in air = 22cm</p>



## ***Section Five: Electrical Safety***

### **5.1 Introduction - Working with Hazardous Electrical Equipment**

Most of the electrical equipment within the School of Biological Sciences will be used by a large number of people and care must be taken to ensure there is no possibility of any electrical shock hazard. Therefore it is imperative that any electrical work (including fitting and rewiring plugs) be performed by electrically certified technicians. Most electrical hazards can be avoided by careful attention to the following:

### **5.2 Reporting Faults**

Report any faulty equipment immediately to the SBS Workshop on extensions 87244 or 85098. Outside normal working hours and where prompt attention is required ring the University Security Desk, extension 85000. Your concern will be relayed to University Works Department staff that are on call.

**Switch off the faulty equipment and remove from service, or leave a warning notice** if it is likely to be a hazard to other workers.

Faults in fixed wiring are the responsibility of University Property Services. These faults must be reported immediately to Bruce Anderson, ext. 87244 who will pass them onto Property Services.

### **5.3 Safe Working Practices**

1. Do not interfere with or alter the fixed electrical supply to an office or laboratory.
2. Do not attempt construction of electrical equipment or carry out alterations or repairs to it unless you are qualified under the Electrical Registration Act. Consult the School's Service staff for advice and help.
3. Do not use electrical equipment that has frayed or exposed electrical leads or faulty or incorrect wiring of plugs. Such equipment is dangerous.
4. Protect wiring from mechanical or heat damage.
5. Do not open covers on any equipment that leaves potentially "live" circuits exposed.
6. When an item of equipment is situated at a distance from a power point, the electrical lead should not run along the floor. If necessary, place hooks along the wall to raise the lead above the floor.

### **5.4 Periodic Testing**

Ensure all metal work is properly earthed and protective casings and shields are in place. Have the earth of portable equipment checked periodically for continuity. Consult the School's Workshop staff if in doubt.

### **5.5 Extension Cords**

Do not use extension cords as a substitute for fixed wiring. Additional power outlets can be requested from the University Works Department. Such requests must be made through Bruce Anderson, ext. 87244.

### **5.6 Power Boxes**

When power boxes are used that enable a number of appliances to be run from one power outlet, care must be taken to ensure that the circuit is not overloaded. Where possible, use power boxes with circuit breakers attached. However, it is better to once again request more permanent power outlets.

## 5.7 Fuses

Replace fuse cartridges only with that of the correct size (amperage). Consult the Workshop staff if in doubt.

## 5.8 Damp Conditions

In wet or damp conditions a residual current device should be used. Protective rubber gloves and boots should be worn.

## 5.9 Imported Equipment

Equipment made outside New Zealand may have wire colours and voltage settings that are different from the New Zealand standards. It is advisable to have new imported apparatus checked by an electrically certified technician. **Plugs may only be fitted or rewired by an electrically certified technician.**

## 5.10 Warning Notices

Display warning notices in places where specific dangers are present (high voltage, high power transmitters, lasers, unearthed equipment, etc).

## 5.11 Equipment Ventilation

Keep clothes, paper and other flammable materials well clear of heaters or other equipment producing heat as a function of their operation.

## 5.12 Maintaining Electrical Equipment

Keep all objects and dust away from air vents required by equipment for cooling as this will increase the risk of fire. Spillages should be immediately removed, as these can cause electrical short circuits which may lead to metal cases becoming "live" or to fire. Refrigerated centrifuges should have their chambers cleaned and dried after use as these chemical traces and water can cause corrosion to mechanical and electrical components.

## 5.13 Electrophoresis Equipment

Treat all electrophoresis equipment as potentially "live" and dangerous.

**All gel boxes must be fitted with safety lids.**

## 5.14 Continuously Running Equipment

Turn off and preferably unplug all electrical apparatus that is not in use. Any electrical equipment left operating and unattended should have the control switch clearly marked and instructions for switching off in the case of emergency posted on the laboratory door.

## 5.15 Electric Shock Treatment

In the case of a person suffering from electrical shock:

1. Disconnect the power and remove the casualty from it.
2. If the casualty cannot be isolated from the power, **do not touch!** Dial 1-111 at the nearest phone.
3. If the casualty has been made safe, commence CPR. Remember: '**A.B.C!**'

### **'A'**irway

Open and clear the airway:

- quickly turn casualty on side
- remove foreign matter from mouth

- place neck and jaw in correct positions
- check breathing:
  - listen to breath
  - watch for chest movement
- if breathing, leave casualty on side - keep airway clear

### **'B'reathing**

If not breathing, quickly turn casualty on back and start expired air resuscitation, mouth to mouth or mouth to nose:

- open and clear airway
- initial two full breaths in two seconds (one every second)
- check carotid pulse
- if breathing returns, place the casualty on side - keep airway clear

### **'C'irculation**

Check carotid pulse. If absent, begin external cardiac compression:

- place the heel of one hand on the lower half of the sternum
- lock the other hand to the first by grasping wrist or interlocking fingers
- keep fingers off the chest
- compression depth to 1/3 of chest depth i.e. 4-5cm for adults
- **One operator:** 30 compressions to every 2 breaths
- **Two operators:** 30 compressions to every 2 breaths

## **5.16 Staff with Electrical Registration in the School of Biological Sciences**

The following list gives the names of people who will give you assistance and advice on any electrical problems that you may have:

Bruce Anderson	Room 112	ext. 87244, or 60181 in an emergency
Rabendra Singh	Room 117	ext. 85098

## **Section Six: Field Safety**

### **6.1 Introduction**

The basis of the *Off Campus Research & Teaching – Guidelines for Field Researchers & Field Trip Supervisors* (available at [http://web.auckland.ac.nz/uoas/science/sci-fac-intranet/sbs-intranet/sbs-intranet\\_home.cfm?redirected&](http://web.auckland.ac.nz/uoas/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&) under Compliance & Safety) is to establish a systematic approach to identifying and assessing hazards related to fieldwork activities within the School, and to outline practical steps to eliminate, isolate or minimise these. This approach is used for a range of likely hazards associated with undergraduate and graduate field courses. The same principles should be applied to managing hazards specific to graduate and post-graduate research projects, and/or future courses or projects involving fieldwork. Emergency procedures for a range of foreseeable situations are also proposed.

The onus on staff supervising fieldwork is to inform/advise participants of likely hazards and their management. The onus on fieldwork participants is to heed the information/advice provided. All staff and students participating in fieldwork for the University must submit a completed schedule to the School Manager for approval at least two weeks prior to undertaking fieldwork.

### **6.2 Field Work**

#### **6.2.1 Supervision**

The academic staff member teaching the course is the designated supervisor of fieldwork undertaken and as such is directly responsible for the safety of all students conducting field work either by way of course-related practical work or as post graduate research in the field.

The fieldwork supervisor must have a sound knowledge of the hazards involved and have taken all reasonable steps to ensure general safety.

It is the duty of the supervisor to ensure students have been adequately informed of hazards associated with the fieldwork, and advised how to eliminate or reduce their impact to a manageable level.

The supervisor must be trained in outdoor first aid.

The supervisor is responsible for ensuring the party is complete at the end of fieldwork.

Outside contractors involved in fieldwork should be able to demonstrate they have an effective OSH system in place, and should be briefed by the supervisor on their role in the safety and supervision of students.

#### **6.2.2 Responsibility of fieldwork participants**

All fieldwork participants must be sufficiently informed to be able to recognise potential danger, manage hazards effectively, and be familiar with emergency procedures.

Individual participants are responsible for taking all reasonable steps to ensure the health and safety of themselves and others.

Participants in fieldwork must be physically capable relative to the conditions encountered. Those with a medical condition likely to require special consideration must declare this to the fieldwork supervisor and personally ensure the availability of appropriate medication. Other factors (i.e. inability to swim, understand English etc.) which may compromise safety must similarly be notified to the organisers at the preparation stage of the fieldwork.

Participants are advised to obey all safety instructions given by the fieldwork supervisor, and report any injury or near injury. Adequate clothing and footwear for the type of weather and

terrain likely to be encountered must be worn. Safety equipment must also be worn where this is appropriate.

Individuals acting independently of the main group of participants are responsible for advising the supervisor of where they are going and when they will return.

### **6.2.3 Fieldwork guidelines**

The fieldwork preparation must consider the scope of the fieldwork, organisation, likely hazards, possible emergency situations and associated factors. Resources carried should be sufficient to meet with unexpected situations.

Fieldwork should be within the capability of the majority of the group, and should allow for the needs of individuals who may require extra assistance.

Fieldwork should be avoided in adverse weather, and alternative activities planned as a contingency.

All preparations for fieldwork should be documented to provide evidence of due diligence should this be required.

A designated person within the School must be notified of details of intentions prior to departure to the field, including:

- route/map reference
- timetable
- number and names of fieldwork participants
- emergency provisions
- means of communication and contact details
- expected time of return.

### **6.2.4 Clothing**

The type and duration of fieldwork, environment, and prevailing weather conditions should be assessed to dictate appropriate clothing. Cold wet conditions require waterproof clothing which also acts as a windproof shell, and layers of thermal garments (wool or polypropylene) including a hat. Hot sunny conditions require light garments which screen sunlight, and protective sunscreen. High visibility clothing is also recommended. Jeans and denim are not generally suitable clothing for fieldwork activities. Footwear should also be appropriate to field conditions. Ill-equipped personnel who present a potential risk to safety should not be allowed to participate in field courses.

### **6.2.5 Staff/leader competence and ratio**

For low hazard fieldwork, a ratio of 1 leader per 20 participants is recommended. The leader may be a University staff member or a suitably qualified individual nominated by the fieldwork supervisor.

At least one person per 20 fieldwork participants should be a qualified first aider (St. Johns First Aid Certificate), and equipped with a first aid kit. Emergency food (i.e. chocolate, high energy bars, barley sugars) should also be carried.

Factors to be considered in selecting personnel to assist with field trips include knowledge and technical skills, first aid skills, fitness, experience and communication skills.

### **6.2.6 Emergency procedures**

The person within the School holding details of the fieldwork must be aware of the appropriate action to take in the event of an emergency. A standard procedure should be in place in the event of field trips not reporting back safely.

Suitable communications equipment such as a cell phone, radio or satellite phone must be carried in all situations where there is a possibility that an emergency might require outside assistance. Contact schedules should be arranged and observed.

The standard first aid kit carried should comprise a sling, bandages, antiseptic, aspirin (or similar), plasters, tweezers, scissors, insect repellent, sun block, antihistamine, first aid manual, notebook, pencil and safety pins, and thermal blanket. Additional first aid items should be included where appropriate for specific situations.

Food and drink should be sufficient for the planned fieldwork, and an emergency supply should also be included in the provisions.

At least one member of each fieldwork group must carry a map (of appropriate scale) and a compass, and be competent in the use of these. Other members of the group must be kept informed of location and planned movements in case they are parted.

#### **6.2.7 Fieldwork on private land**

Work on private sites must be with the permission of the landowners and in compliance with their requirements. Information from the landowners regarding potential hazards and how to manage them should be requested during fieldwork preparation. The landowner should be provided with information on the date, time and duration of the visit, number in the party, objective of the visit, and emergency procedures. The landowner should also be informed on departure.

Contact should be made with manuhenua, and any areas of spiritual significance avoided.

#### **6.2.8 General**

Equipment used in fieldwork must be checked prior to use and maintained by the operator. Equipment faults should be reported to the field technician before the equipment is likely to be relied upon.

Leisure activities in the field, outside fieldwork activities, require reasonable behaviour and the approval of the supervisor. Individuals are responsible for the health and safety of themselves and others. A policy on alcohol should be determined at the outset by the supervisor.

Responsibility includes a consideration of the environment. Where toilet facilities are not available, care must be taken not to contaminate waterways, and excreta must be buried. Non-biodegradable waste must be carried, sorted and disposed of at an appropriate recycling or disposal facility.

### **6.3 Transport**

#### **6.3.1 Hazard recognition**

The risk of road accidents and stowage hazards during travel must be recognised and managed. Refer to Section 7: School Vehicles for driving guidelines which must be observed.

#### **6.3.2 Private vehicles**

Where privately owned vehicles (staff or students) are used for fieldwork transportation, their owners must ensure the insurance cover is valid under all the conditions for which the vehicle is to be employed.

#### **6.3.3 Public transport**

Where public transport is used, field group members should ensure materials carried comply with the carriers' requirements.

#### **6.3.4 Loading**

The limits for maximum passenger numbers in vehicles should be observed.

Safe stowage of materials, trailer towing and vehicle loading are the responsibility of the driver.

Roof racks should be used with caution. They must not be overloaded, and loads must be properly secured. The vehicle Owner's Manual should be consulted for correct procedures regarding the installation and use of a roof rack.

#### **6.3.5 Driver competence**

The fieldwork supervisor must be satisfied with the competence of drivers. All persons driving School vehicles must be over 21 years of age and have signed the SBS vehicle register at the Schools Reception.

Four wheel off-road driving, towing trailers, and the operation of mechanical systems such as hoists, power take-offs, winches or hydraulic systems should be undertaken only by persons with suitable experience.

#### **6.3.6 Emergency Procedures**

An appropriate road emergency sequence would be:

- prevent exposure of others to the hazard
- assist injured persons and administer first aid where necessary
- contact emergency services
- contact the University.

### **6.4 Specific Environments**

#### **6.4.1 Alpine and subalpine**

The fieldwork supervisor must be experienced with hazards associated with these conditions, and must inform participants of these and their management. Participants in fieldwork in alpine and subalpine conditions should be aware of the main hazards of hypothermia and sun stroke and their treatment, and equipped to cope with all possible weather for the season.

In poor visibility conditions, participants should travel closely together and check bearings frequently. In the event of a person becoming lost, he/she should remain stationary and raise an alarm.

When negotiating steep inclines, care must be taken that persons below are not in the path of dislodged material. The edges of steep faces should be avoided. Injury should be treated as necessary and the field work plan reassessed accordingly.

For further information publications by the New Zealand Mountain Safety Council should be consulted, i.e.:

- Bushcraft Manual
- Safety in the Mountains- a Field Guide
- Managing Risks in Outdoor Activities

#### **6.4.2 Rivers, lakes, estuaries and the sea**

The fieldwork supervisor must be experienced with water-related hazards, and must inform participants of these and their management. Participants in fieldwork involving water should be aware of the associated hazards of hypothermia, immersion and drowning, and must be able to swim and look after themselves in water.

Where boats are used, the person in charge must be qualified to operate the craft and is responsible for safety. A minimum of Day Skipper certification is required for operation of powered boats.

The maximum loading of craft must not be exceeded. Boats must carry an anchor, throw rope, oars and a bailer. Powered craft should also carry spare fuel, a tool kit, flares and a VHF radio or cell phone. All people aboard must wear lifejackets.

Care must be taken in the vicinity of outfalls, intakes, currents and tides. Caution must also be exercised when landing and unloading craft. Boats should always be approached on the upstream side to avoid injury between the boat and obstacles.

Clothing which may become heavily waterlogged (including waders and gumboots) should not be worn.

Tide tables and tidal range should be checked where relevant to determine safe working periods, and marine forecasts consulted.

Where there is the possibility of falling into deep or fast flowing water where assistance may be required to reach safety, solo working is prohibited.

In an emergency, a person swept away in fast flowing water should swim or float on the back with feet pointing downstream. Where possible the use of lifelines should be used in preference to entering the water to rescue another person.

For further information, publications by the New Zealand Water Safety Council should be consulted, i.e.:

- Water Wise - A Safety Handbook for all Aquatic Activities
- Rivers - the power to kill
- Hypothermia and Water

#### **6.4.3 Mines, quarries, cliffs, excavations and confined spaces**

The likely site hazards must be assessed by the fieldwork supervisor or a suitably competent and experienced person. Participants in fieldwork involving mines, quarries, excavations and confined spaces should be aware of the main hazards of burial, contact with hazardous services, gas accumulation and restricted access.

Participants must cooperate fully with the requirements of site management, and inform the site supervisor of their whereabouts. Protective clothing and specialist equipment should be worn where necessary. Atmosphere monitoring must precede entry to confined spaces.

For further information the relevant OSH documents should be consulted, i.e.:

*Guidelines for the Provision of Facilities and General Safety in the Construction Industry*

*Approved Code of Practice for Safety in Excavations and Shafts for Foundations*

*Safety in Confined Spaces*

#### **6.4.4 Electricity**

Where electricity is used in fieldwork situations, the apparatus must be served by an isolating transformer or residual current device to prevent electrocution, and extreme caution should be exercised in the presence of water.

### **6.5 Fieldwork for Graduate Students and Staff**

#### **6.5.1 Fieldwork guidelines**

Graduate students and staff undertaking research fieldwork on a regular basis must consult with the field technician to establish a safety schedule which takes into account the possible hazards, their management and emergency procedures for the particular work involved.



Fieldworkers must have read and be familiar with the relevant parts of the safety manual, and have signed to acknowledge their understanding and agreement with the management of these hazards and emergency procedures.

A designated person within the School (secretary, supervisor or technician) must be notified of all relevant details pertaining to each field trip, and be aware of the appropriate action to take in the event of an emergency (see section 6.2.6).

#### 6.5.2 Fieldworker competence

Persons undertaking extensive fieldwork should be encouraged to obtain first aid qualifications. Fieldworkers must also be competent in the use of map and compass and carry both. Fieldworkers must be aware of the appropriate action to take in an emergency.

#### 6.5.3 Emergency procedures

Students working in isolated locations or potentially dangerous situations **must not work alone** and must carry a radio either permanently manned or with regular schedules OR a cell phone OR a satellite phone for more remote areas where cell phone coverage is unpredictable or lacking.

A contingency plan should be drawn up in the case that schedules are not received.

Students must carry a fully equipped first aid kit appropriate to the fieldwork situation. Emergency items (torch, chocolate, matches, knife, survival bag, whistle, candle, 'first response' first aid belt, compass, map, watch, emergency locator beacon and protective clothing) should be carried at all times.

Emergency food supplies in a sealed container (e.g. chocolate, pasta) should be included in the provisions.

Where a vehicle is left in a remote location, or work is from a base camp, information on the intended itinerary should be left clearly visible for the assistance of emergency services.

#### 6.5.4 General

Weather forecasts should be checked and fieldwork postponed in the event of deteriorating weather conditions.

Backpacks should be lined with a thick polythene bag for waterproofing gear, and for use as a survival bag in an emergency.

Candles and gas cookers must not be used in tents or unventilated spaces.

Drinking water from sources which may be contaminated should be boiled for 3 minutes to destroy pathogens.

The previous Sections of this schedule should be read and relevant precautions heeded.

### 6.6 Paperwork

All field trips by all staff and/or students require a *Field Trip Risk Assessment & Management (RAM) Sheet* available at: [http://www.science.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet\\_home.cfm?redirected&](http://www.science.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&) to be completed and approved by the School Manager. When the field trip forms part of a teaching paper, the course coordinator must provide to the School Manager:

1. Completed and approved "*Guidelines for Field Researchers and Field Trip Supervisors*"
2. Student driver agreements for all students
3. Student passenger agreements for all students
4. Field trip declaration forms for all students.

All course coordinators must read and understand the *SBS Vehicle Policy*, *Field trip documents*, *RES Field Trip Arrangements & Costs & the Field trip Conditions & Obligations – u-grad student’s document*. All of these documents are available on the SBS intranet.

All post graduates conducting field work must complete a *Field Trip Risk Assessment & Management (RAM) Sheet* available at: [http://www.science.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet\\_home.cfm?redirected&](http://www.science.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&) in the *Guidelines for Field Researchers and Field Trip Supervisors* document. These sheets must be submitted to the School Manager at least 14 days prior to the intended field trip to enable sufficient time for changes to be made to the documents and to provide an opportunity for the student to obtain additional pieces of gear as deemed necessary by the School Manager.

In the case of field trips for taught courses, it is the responsibility of the course coordinator to provide an approved *Field Trip Risk Assessment & Management (RAM) Sheet* and to ensure that all students attending the field trip have signed all necessary documents before embarking on the field trip. For research field trips attended by post graduates, it is the responsibility of their supervisor/PI to ensure the *Field Trip Risk Assessment & Management (RAM) Sheet* has been completed, submitted, and approved by the School Manager at least 14 days prior to the trip. Once approved, the same *Field Trip Risk Assessment & Management (RAM) Sheet* may be used repeatedly for future field trips provided all of the contacts are notified of the dates of the next intended field trip prior to the trip and the contacts are all notified immediately the member has returned from the field trip.

## ***Section Seven: School Vehicles***

### **7.1 Vehicles**

1. The School has one automatic van, two manual minibuses, one manual ute and a trailer with a fibreglass tank to collect seawater. All are available for use by staff and postgraduate students aged 21 or over, with a full driver's licence - Class B. Vehicles must be booked at Reception. For legal reasons, no fee may be charged to people transported in our vans and minibuses. Use of the vehicles is strictly for University business only chargeable to a University 'cost centre'. Anyone driving a School vehicle must have signed the van drivers' declaration, available from Reception.
2. The possession of a driving licence is taken to mean that the holder has been taught and successfully tested for safe driving techniques. Nevertheless, drivers must make a conscious effort to drive safely. They should always remember that the large, rear-wheel-drive vans have different characteristics to the smaller front-wheel-drive cars that they are probably used to. In particular, the vans are more affected by wind and the rear wheels are likely to skid if the vehicle is accelerated hard on bends in marginal conditions. The School has one set of chains for those expecting to encounter snow or mud.
3. The vehicles are maintained according to the manufacturer's recommendations and any deficiencies found are promptly rectified. However, it is the responsibility of the driver to check, as far as is reasonably practical, that vans are in a safe condition; e.g. that a tyre is not flat and that the handling of the vehicle does not feel abnormal. Report any problems promptly to Rabendra Singh, Room 117, ext. 85098 or Bruce Anderson on 87244.
4. Vehicles must not be overloaded. Take particular care with roof racks and trailers. All passengers must have a proper seat. If you are going off on field work, ensure that you have completed all necessary documents (ref 6.6 above) and that the designated people in your Risk Assessment Plan have been notified of all of the details of the trip.
5. All vans are fitted with tow bars with 1 $\frac{7}{8}$  inch balls, and round trailer light sockets. If you are unused to using a trailer the following points are important:
  - Do not attempt to mismatch 1 $\frac{7}{8}$  inch balls and couplings with the new 50mm standard tow ball.
  - Ensure that the locking arrangement on the coupling is locking the coupling to the ball.
  - The safety chain on the trailer must be securely shackled to the tow bar.
  - Plug in the trailer lights and check that all lights are working as they should be. This is best done with two people.
  - Tie down any load securely; the vibration of the trailer is very demanding on rope and knots, and it is a good idea to stop after a few kilometres to check and retighten everything.
  - The maximum speed limit for a vehicle and trailer is 90 km/h.
  - Avoid braking on bends - the combination of van and trailer may cause the trailer to jack-knife.
6. Alcohol or drugs must not be consumed by the driver of a vehicle.

## 7.2 Boats

1. The School has a Stabi-Craft 509 boat and trailer for use by staff and students. Also available for use with the boats are safety aids such as lifejackets, EPIRB, flares, fire extinguisher, satellite phone and radio. Only people holding at least a 'Day Skipper' certificate are permitted to use a boat with a motor. The course for the 'Day Skipper' certificate covers basic boat handling theory, safe practices, and rules of the road, but includes no practical component.
2. People lacking practical experience in small boat handling must get advice and assistance from more experienced members of the School. The aluminium boats used by the School are almost impossible to row against appreciable wind or sea conditions. They must be used with great care, in sheltered conditions, and with a good weather forecast.
3. Detailed instructions for safe boat handling are contained in the NZ Coastguard Federation's publication *Safety in Small Craft*. A copy is available in the School from Schannel van Dijken in Room 106-BB02. This is also the set text for the 'Day Skipper' certificate. All boat users should study it. Also available in the School are the Leigh Marine Laboratory's *Diving and Boating*, and National Institute of Water and Atmospheric Research's *Hydrologists' Safety Manual*. Both of these manuals contain detailed good practices for the safe use of boats.

## ***Section Eight: Waste Disposal***

### **8.1 Introduction**

1. There is increasing pressure on the University to dispose of its toxic and other wastes properly. It is very important that for safety and social responsibility, the procedures detailed here are followed exactly. In the past, failure to properly segregate waste has led to needle-stick injuries and refusals to take University waste at the tip.
2. The School relies on the co-operation of everyone to recycle as much material as possible. Aluminium drink cans should be taken to the special bins in the Student Resource Centre or outside the Staff Common Room. A4 paper can be used again on the reverse side for drafts, email printouts etc. We have green bins scattered about for recycling paper. Cardboard boxes should have any packing removed and then be flattened and left for the cleaners to put in the cardboard recycling bin.

### **8.2 Biological Waste**

1. Yellow Medical (Biohazard) Waste bags and pails are kept in the cage in the driveway to the south of the Thomas Building.
2. **Biohazard waste must be decontaminated prior to disposal** (see Section 3.1.8).
3. Biological material, animal and vegetable, plastic ware (e.g. plastic dishes, tubes and flasks, micropipette tips, disposable gloves, contaminated wipes etc) should be placed in the **yellow bags** marked with the biohazard symbol. When full - do not overfill - tie off the neck securely with tape or string, fold over and tie again. These bags must go out for disposal (incineration) into the Thomas Building cage before 9.00 am each day. They must not be left in this public area overnight. The cage is outside the spiral staircase on the southeast corner of the Thomas Building and the key is hung on a hook in the passage immediately outside the receptionists' door.
4. Bags containing offensive or perishable material may be kept in the freezer before disposal. Because tip operators cannot be expected to know if waste is harmless or not, use the bags to dispose of things that may look dangerous to the uninitiated, such as unused agar plates.
5. **Nothing** that is capable of puncturing the bags or injuring any person handling them, may be placed in a rubbish bag. This includes such things as syringe needles, Pasteur pipettes, broken glass, and items made of hard plastic including disposable pipettes.
6. 'Sharps' (syringe needles, scalpel blades), Pasteur pipettes, hard plastic disposable pipettes, unclean broken glass etc, must be disposed of in the hard plastic, yellow 4 L MediSmart pails. These are incinerated without being opened and the cost of the pail includes this disposal. For this reason, no other brand of 'sharps' container may be used because it will not be collected by the MediSmart contractor. MediSmart pails must go out for disposal onto the Thomas Building cage at the foot of the spiral staircase. Please ensure all rubbish pails have their lids properly fixed to their bases to prevent any possibility of spills.
7. As these containers are expensive they must be used efficiently. This means keeping them until they are full and not using them for material, such as clean broken glass, that could be disposed of more cost effectively.

### **8.3 Clean Broken Glass**

Broken glass must not go into the ordinary rubbish bins as this is very dangerous to the cleaning staff.

If the glass is uncontaminated, place it in the 'broken glass only' bin provided in your laboratory. Periodically this bin can be emptied into the glass specific green wheelie bin kept in the drive outside the Biology Building. Wear eye protection when tipping.

Contaminated glass must either be cleaned and disposed of in the “broken glass only” bin as above or disposed of as medical waste in a 'Sharps' pail.

#### **8.4 Ordinary Rubbish Bins / Waste Paper Bins**

The contents of these are collected and handled with no special precautions. Therefore nothing harmful must go into them. This includes 'sharps', broken glass and chemically and biologically contaminated waste. The only things they can be used for are paper that cannot be recycled, disposable hand towels, plastic packaging material and similar. The cleaners should empty these daily from laboratories, and weekly from staff offices. Office bins that need emptying between times should be left outside the office door.

#### **8.5 Solvent & Liquid Chemical Waste**

See Disposal of Chemicals, Section 2.8 for correct disposal procedures for small quantities of these materials. When large quantities of hazardous liquid chemical waste are being generated, these must be professionally disposed of. Accumulate waste in suitable bottles, clearly labelled with the contents and your name. Keep separate containers for the various types of liquid waste you are generating. **Do not mix different types of waste.** If you do this, there is a danger of adverse reactions occurring and the cost of disposal will go up, because the disposal company will need to analyse the material to determine what it is and how best to treat it. When your waste bottle is full, contact Keith Richards, Room 318, ext. 87287 and he will arrange for you to take it to a dangerous goods store to await proper disposal.

#### **8.6 Radioactive Waste**

See Radiochemical Safety, Section 4.4 for the procedures to be followed in disposing of radioactive waste.

## ***Section Nine: Safety in the Office***

In addition to the general points in the Faculty of Science Safety Manual, Section 3: Office Safety, the following safe practices should be applied to SBS administration and office areas.

### **9.1 OOS Prevention**

- ensure that staff using keyboards have a reasonable workload and are aware of, and practise, exercises which reduce the risk of getting OOS
- ensure that staff use ergonomically sound furniture and have suitably designed work stations
- ensure that OOS safety data sheets are available to staff.

### **9.2 Office Design**

Ensure that office building design conforms to OHS regulations and statutory requirements concerning adequate floor space, ventilation and window lighting.

- Window openings should be placed to ensure cross ventilation. Windows should be equivalent to at least 10% of the floor area and half should be capable of opening.
- There must be no less than 12m<sup>3</sup> of clear air space per person.
- Lighting - refer to NZS6703 1984 code of practice for interior lighting design.

### **9.3 Ventilation**

Ensure adequate ventilation and fresh air so that people work in reasonably comfortable atmospheric conditions.

- Photocopiers should not be located in offices. Workers must be sited at least 4 metres from photocopiers.
- With reference to office conditions, monitor research on radiation emissions from VDUs, and ozone emission from toner, photocopies and other chemical materials in use in the office to ensure that staff are not exposed to undue hazards. Ozone gas is produced when photocopying. If it can be smelt, the concentration is too high.
- Ensure that all office equipment is inspected regularly to maintain the efficiency of filters.
- Copiers in use for more than 2 hours per day should not be sited in secretarial office or administration areas, to prevent staff from being exposed to any undue environmental hazard.
- Ensure that photocopy operating procedures are carried out safely.
  - i) The machine lid should be closed to avoid exposure to ultraviolet light.
  - ii) Windows should be open when extended runs are in progress to allow heat and ozone emissions to be vented away.
  - iii) Ensure that staff are adequately trained when handling hazardous substances, e.g. photocopier toner and keyboard cleaners.
  - iv) Ensure that material safety data sheets are available for toners and other chemical materials in use.
  - v) Ensure correct and safe handling procedures when dealing with heavier objects, e.g. boxes of photocopy paper.

# **PART TWO: ACCESS TO SBS FACILITIES - GUIDELINES**

## ***Section One: Introduction***

### **1.1 Purpose**

The University is responsible for providing safe working conditions and for seeing that all students and staff are given adequate instruction and safety equipment to enable them to do their work safely. The purpose of Part Two of this document is to ensure that procedures for access to the facilities within the School of Biological Sciences are in compliance with *The University of Auckland Policy on Access to University Facilities* and the *Faculty of Science Access to Facilities Guidelines* that have been formulated in response to section 2.4 of that policy. The School is committed to operating its facilities safely and in a prudent manner consistent with the University of Auckland's access policy. The purpose of Part Two of this manual is to set clear guidelines as to how to obtain access to an SBS facility and what level of access is appropriate for the work being performed.

### **1.2 Disclaimer**

The information in this manual is intended for all students and staff and particularly researchers working in the School of Biological Sciences. Personal safety depends on each individual acting responsibly. Much has been done to minimise hazards in the School, but the co-operation of staff and students in keeping the laboratories safe and tidy is vital. Please read this manual carefully. The information present here is not intended to be a complete guide on safety matters and any omission is not an excuse for unsafe practices. In all cases the individual supervisor is ultimately responsible for safe work practices and must insist upon the use of such proper procedures to eliminate unnecessary hazards.

## ***Section Two: Safety – General Information***

### **2.1 Getting Started.**

Before new graduate students, staff or visitors to the School are allowed to commence research work, the SBS Guide to Survival booklet and the SBS Safety Manual & After Hours Access Guidelines must be read and understood.

### **2.2 Awareness in research.**

Before starting work in any area the following should be known:

- The location of the main exit routes.
- The location of the nearest telephones, first aid kits, fire extinguishers and fire alarms.
- The location of the safety showers.
- What other work is being performed nearby and does it have any implications of any description, with your work.
- The location of Chemical Spills Cabinets.

These details are specified in Appendix 1 which is required to be signed off when the applicant is familiar with the location and operation of these safety related items, and a signed copy handed to the School Manager.

The health and safety aspects of all research work must be discussed with the research supervisor. Supervisors have the responsibility for emphasising any special hazards that the research might involve and describing precautions that must be taken. Such information is typically provided on Material Safety Data Sheets (MSDS) – it is the supervisor's



responsibility to provide such information to the research worker. The supervisor also has the responsibility of ensuring that the research does not produce a dangerous environment within the laboratory.

Recognising the nature of research, it would be prudent for all research workers to consider:

- Is the experiment conducted in a safe manner?
- Could the experiment be performed more safely?
- What action should be taken if the experiment develops in an unplanned way e.g. breakage, spillage, overheating etc.
- Are the materials necessary or are less dangerous substitutes available?
- Will there be any disposal or decontamination problems on completion?
- Are the other personnel working in the laboratory aware of the potential hazards associated with these experiments?

### ***Section Three: Definitions / General Information***

The definitions of all terminology and vocabulary used in Part Two of this document are consistent with those outlined in section 1.0 of the *University of Auckland Policy on Access to University Facilities*. Furthermore, in accordance with the requirements of section 2.4, these guidelines shall be Rules under the Disciplinary Statute 1998, which requires that the guideline:

- (a) state that it is a Rule; and
- (b) is the subject of notice as set out in section 4.0 in Part Two of this document.

SBS is responsible for providing safe working conditions and for seeing that all students and staff are given adequate instruction and safety equipment to enable them to do their work safely. These responsibilities for safety are formalised into a number of legal documents such as:

- (a) *The Hazardous Substances and New Organisms Act (2001)*
- (b) *Health and Safety in Employment Act (1992)*
- (c) *Education Amendment Act (1990).*

These Acts describe the legal obligations of The University.

### ***Section Four: SBS Guidelines and Protocols***

Part Two of this document outlines how access to SBS facilities is managed in a safe, non-hazardous fashion consistent with health and safety considerations. As such *Access to SBS Facilities – Guidelines* ensures the School complies with all relevant health and safety requirements. The purpose of this document is to describe clear rules as to when access to SBS facility is not permitted without an individual or general approval.

Compliance with all Health and Safety procedures is the first criteria behind the rules set by the School. Any staff member or student accessing SBS facilities after-hours or working alone must have approval to do so and must at all times abide by the rules for personal safety set out in Appendix 4, below.

## ***Section Five: Risk Definitions***

SBS does not currently conduct any experimental procedures considered to be high risk. Should this situation change, once the required safety assessment has been undertaken and any necessary training been given, specific approved access may be granted by the School Manager. The following table describes procedures, risk levels and the appropriate access approval level.

**Table 1: Risk Definitions & Types of Approval**

<b>Risk Level</b>	<b>Suggested type of approval</b>	<b>Notes</b>
<b><u>Low</u></b>	<p><b>General Approval</b> - would normally be given for this type of work.</p> <ul style="list-style-type: none"> <li>• work in an office environment,</li> <li>• using a computer outside a laboratory,</li> <li>• readings or observations from <b>low risk</b> experiments,</li> <li>• Use of instruments such as NMR, IR, UV, PCR,</li> <li>• work in seminar rooms, study areas, libraries, and information commons facilities,</li> <li>• lab work not involving hazardous substances, hazardous machinery, high work requiring use of lifting devices, ladders, scaffolding or "wet lab" work,</li> <li>• working alone where other suitably skilled and experienced support is immediately available and when performing tasks the Member has signed approval to perform,</li> <li>• interview or survey work with communities except high risk groups.</li> </ul>	<p>Office work hazards are generally low.</p> <p>Members should arrange a contact to advise safe return.</p> <p>It is advisable to have arrangements to ensure safety if working at night, such as parking near office or security escort to vehicle.</p> <p>What may in substance be low risk work, when undertaken in a laboratory may be deemed as a moderate or high hazard due to the surrounding hazards.</p> <p>Access for children, even accompanying Members, shall be deemed a "moderate" hazard.</p> <p>A General Approval is not appropriate for any person working alone or after hours. People faced with either or both of these situations must apply for an Individual Approval.</p>
<b><u>Moderate</u></b>	<p><b>Individual Approval</b> - may be given for this type of work to a competent Member who is:</p> <ul style="list-style-type: none"> <li>• undertaking low risk work in a moderate risk laboratory,</li> <li>• undertaking low risk work in a remote area.</li> </ul> <p>Examples of laboratory activities that would generally be considered low risk following an appropriate level of training would include DNA manipulation, protein and nucleic acid electrophoresis, column chromatography, operation of light and electron microscopes, operation of spectrometers and diffraction equipment, operation of bench top and floor centrifuges.</p>	<p>Some moderate risk activities require appropriate supervision e.g. Members undertaking work with hazardous substances, radiation, or operating workshop machines or when working alone. If a hazard cannot be safely handled by a lone Member, conditions must apply.</p> <p>Despite the wide variety of the laboratory work currently conducted in the School of Biological Sciences all work conducted is considered low or low-moderate risk.</p>
<b><u>High</u></b>	<p><b>Individual Approval</b> - would only be given to a Member provided the necessary hierarchy of controls is used and who is:</p> <ul style="list-style-type: none"> <li>• Working with, or near, infectious agents where there is a risk of exposure to the substance, taking into account the volume used.</li> <li>• Working with highly reactive chemicals, UN Class 4, or large volumes of flammable solvents (&gt;2.5L), highly toxic chemicals UN Class 6.1 (Packing Group 1), or large volumes of corrosive substances (&gt;200ml), or any toxic gas such as carbon monoxide.</li> <li>• Operating apparatus capable of inflicting serious injury.</li> <li>• Using apparatus that could result in explosion, implosion, or the release of high energy fragments or significant amounts of toxic or environmentally damaging hazardous material e.g. vacuum lines, rotary evaporators, solvent stills.</li> <li>• Working with exposed energized electrical or electronic systems with nominal voltages exceeding 50 V AC or 120 V ripple-free DC.</li> </ul> <p><b>NOTE:</b> These limits are for dry, indoor conditions and a more conservative approach should be taken in other conditions.</p>	<p>Members shall not undertake work or be granted access where the risk is identified as high without an Approval which is subject to conditions including supervision and hazard assessment.</p> <p>Every effort shall be made to reduce the level of risk.</p>

	<ul style="list-style-type: none"> <li>• Working with radio nuclides having activities that would normally require a license i.e. any activities greater than Level 0, as outlined in Appendix 2 of the <i>National Radiation Laboratory Code of Safe Practice</i> for the use of unsealed radioactive materials, NRL C1.</li> <li>• Working with micro-organisms of Risk Group 2 and higher, or which require the use of containment level 2 facility or higher.</li> </ul>	
<b>Extreme</b>	No after hour's approval. Every effort shall be made to reduce the level of risk.	No staff or student shall undertake extreme risk activities.
<b>Field Trips</b>	<p>Refer to the Field Trip "Off-Campus Research &amp; Teaching" document available in the Compliance &amp; Safety section of the SBS staff intranet site: - <a href="http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&amp;">http://web.auckland.ac.nz/uoa/science/sci-fac-intranet/sbs-intranet/sbs-intranet_home.cfm?redirected&amp;</a></p> <p>Working alone in the field or working on a large expanse of water</p>	<p>The unusual circumstances at SBS are such that staff and students may attend teaching &amp;/or research field trips that will carry various levels of risk depending on the particular nature of the field site, weather, tide etc.</p> <p>All staff and students intending to go on a field trip must complete an Off-Campus Research and Teaching document and have this approved by the School Manager prior to the field trip. Each field trip will be assessed for risk and the management of that risk before approval is granted.</p>

## **Section Six: Hours of Access:**

Access to all University of Auckland buildings is controlled by *The University of Auckland Policy on Access to University Facilities*. Under this policy, Normal Working Hours at SBS are between 6.00am and 7.00pm, Monday to Friday. To gain access to the Thomas Building a swipe card must be used for both ingress **and** egress. Swipe cards are issued by The University and an application form is included in the School's Induction package and is also available from Reception.

This document only considers the activities conducted in building 110 and access to building 110. The activities carried out in buildings 106, 114 at the city campus and 733 and 740 at the Tamaki campus are considered to be low risk and these buildings are therefore not considered in this document.

### **Building 110 Thomas Building:**

There are four levels of access to the Thomas Building.

**Level 1: General Access - Normal working Hours** – 6.00am to 7.00pm (or when opened by Security), Monday to Friday. During this time activities classified as low and moderate risk may be performed provided:

- i. the required safety assessments have been undertaken and any risks managed to an acceptable level,
- ii. the person performing the work has been adequately trained and formally approved as such by their supervisor,
- iii. signed General Access Approval has been obtained before an access card is issued,
- iv. certain specific physical areas may be excluded from the approval.
- v. all staff will have General Access.

**Level 2: Approved Access** – 6.00am to midnight, Monday to Sunday, (including public holidays and University closure days) requires a signed approval from the supervisor or PI before an access card is issued.

During this time, activities classified as low & moderate risk may be performed provided:

- i. the required safety assessments have been undertaken and any risks managed to an acceptable level,
- ii. the person performing the work has been adequately trained and formally approved as such by their supervisor. Some specific physical areas may be excluded.

Most staff and post graduate students will have Level 2 access.

**Level 3: Approved Access** - 24 hours a day, 7 days a week, Monday to Sunday, all year round. Job specific Level 3 approvals may be granted by the School Manager. Access will only be issued to designated individuals to perform specific tasks, with the written approval of the School Manager.

**Level 4: No Access Time:** 12.00am (midnight) until 6.00am every day.

**PLEASE NOTE THAT SWIPE CARDS MUST NOT BE USED TO ADMIT UN-AUTHORISED PERSONNEL INTO ANY SBS BUILDING.**

**Access to SBS Facilities outside of Normal Working Hours is considered After Hours and rules govern what activities, based on their level of risk, can be performed during these times.** Should you wish to be in School premises after hours, approval to perform specific tasks at specific times must be sought from supervisors or PIs and the School Manager (for Level 3 Access). Such approval may be granted on a case by case basis once a safety assessment has been undertaken and any risks managed to an acceptable level. The person performing the work must have been adequately trained and formally approved as such by their supervisor or PI.

### ***Section Seven: Access for Contractors and Subcontractors***

Where possible, contractors and subcontractors that are on site in the School should be contracted through Property Services and approval for access to the facility will be dealt with by Property Services. Any after hours access required by the School for contractors and subcontractors which is not managed by Property Services will be approved and signed off by the School Manager. This includes all Contracts for Service.

### ***Section Eight: Personal Responsibility***

Access to SBS facilities is a privilege and not a right. Not all hazards can be reasonably foreseen and each staff member and student shall access all facilities at their own undertaking and on condition that they accept individual responsibility to avoid hazardous or dangerous situations.

These guidelines will be reviewed by the School Manager before Easter every year.

### ***Section Nine: Hazard Assessment***

Before any approval is granted, a Hazard Assessment must be undertaken either on a personal basis or as a group assessment as outlined on the Approval Form below. All staff members and students seeking after hour's access must be notified of the School's rules and regulations, safety expectations and risk assessment analyses.

The notification mentioned in 4.0 above, will form part of the conditions of the approval and will contain:

- a) Identification of all foreseeable hazards arising from working alone.
- b) Assessment of the risk(s) of each hazard.
- c) Implementation of practicable and/or reasonable steps to control the hazard to an acceptable level.
- d) Identification of risk level for each hazard or task process (ref Table 1, below), to determine:
  - i. The level of supervision required,
  - ii. The type of approval required,
  - iii. If the task is to be undertaken by students or staff or should be restricted to staff only,
  - iv. Whether it is practicable to grant an approval albeit with conditions,
  - v. The conditions which must apply before an approval is granted.

The hazard assessment must be undertaken before access is approved.

## ***Section Ten: Competency Assessment***

For moderate and high risk activities, the supervisor (if applicable) must provide a competency assessment for the staff member or student seeking after hours access. This assessment will validate the competency and confirm the training, skill, and experience to undertake working alone after hours. This competency assessment is done on the Approval Forms below (Appendices 1, 2 & 3) and must address any known issues of disability, health related matters and any other factors having a possible impact on the member's competency in performing the task.

## ***Section Eleven: Approval for After Hours Access***

This School will issue Approval Forms outlining access to the designated area, a relevant hazard assessment, and a competency assessment. Departmental safety guidelines, emergency procedures, training expectations and a table explaining risk assessment levels will also be distributed to all relevant staff members and post graduate students. Persons who are found to be undertaking inappropriate procedures or experiments after hours or who are present in the No Access period (12am-6am) without official approval will have their after hours access removed.

The Approval Form includes:

- a) An expiry date for all fixed term and casual staff and for all students.
- b) Procedure, equipment, areas that can be accessed / used by that person.
- c) Tasks that can be undertaken.
- d) For moderate to high risk activities, detail of controls required by the hazard assessment.
- e) Other relevant conditions.

## ***Section Twelve: Review of Approvals***

A Review of the Approval is required when there is a change in the workplace or activities being undertaken.

### **12.1 How to apply for an approval**

Approval Forms are readily available at Reception and can also be found on the Schools website. The forms must be completed by the relevant staff member or student.

### **12.2 Who signs approvals?**

All General Access Approvals must be signed by the supervisor or PI (when applicable). Individual Access Approval Forms, both Level 2 and Level 3 must be signed by the supervisor or PI (when applicable) and the School Manager.

### **12.3 Recording approvals**

Copies of all approvals are kept by the School Manager and are updated at least annually. New approval forms are required on an annual basis.

## ***Section Thirteen: Security***

Security should be informed if any staff members or students need to be in SBS outside the hours of access generally assigned for that member. Normal security precautions should prevail at all times, particularly while accessing facilities after hours.

**UniSafe (University Security)** – the prime function of UniSafe is to provide a safe and secure environment for University students and staff as well as the protection of university assets. UniSafe has an office located in Building No 201, 11 Wynyard Street and provides a 24 hours a day, 7 days a week control room staffed by operators. Telephone contact is 85000 or 966 in an emergency.

**Identification Cards** – All staff and students are issued with a University Identification Card which must be carried at all times, and presented, if required, to UniSafe (University Security) staff on demand. Lost or stolen cards should be reported immediately to the ID card centre on ext. 87885.

**Security of Building** – Under normal circumstances, doors to laboratories, offices etc should be locked whenever possible and when not in use. If staff leave an office, even for a short period of time, it is recommended that the door be locked. Many thefts that occur are on the spur of the moment where an office door is left open. Research workers should securely lock away equipment likely to be attractive to thieves and not in immediate use, and it is advisable not to leave purses, wallets & cell phones out on desks or benches. All incidences of theft or vandalism or strangers snooping around rooms in the building should be immediately reported to UniSafe (Security) on ext. 85000.

If you are concerned about your personal safety at any time, contact UniSafe (Security) on ext. 85000 or ring 966 in an emergency.

#### ***Section Fourteen: Contacts***

Fire, Ambulance, Police..... 1-111  
Doctor (Student Health).....87681  
UniSafe .....85000, 966 or 08003737550

#### ***Section Fifteen: Faculty Contacts***

David Jenkins (Hazards and Containment Manager) .....83789 / 86714  
Linda Thompson (Faculty Manager) .....87767

#### ***Section Sixteen: University Contacts***

Ian O’Keefe (Health & Wellness Manager) .....89645



## Appendix 1: Safety Guidelines Acknowledgement Form

I have received a copy of the *School of Biological Sciences Safety Manual & After Hours Access Guidelines*, University of Auckland. I have read and understood the *School of Biological Sciences Safety Manual & After Hours Access Guidelines* and accept responsibility for obeying the safety rules therein and exercising good judgement in following the SBS codes of practice.

I know the location and operation of my nearest: (tick)

- Telephone ..... ☐
- Fire Alarm..... ☐
- Fire Exit ..... ☐
- Hose Reels and fire extinguishers..... ☐
- First Aid box and list (current) ..... ☐
- Sand bucket and spill kits ..... ☐
- Emergency shower and eye wash ..... ☐

I understand and will perform the following tasks as required: (tick)

- Adhere to the SBS After Hours Access Guidelines..... ☐
- Safely dispose of chemicals I will be using..... ☐
- Safely dispose of biological material I will be using..... ☐
- Report accidents and incidents ..... ☐
- Comply with relevant MSDS & SMOU safety information..... ☐

**Position** within the School (Please tick one only)

- Student:** - BSc ☐ Hons ☐ BTech ☐ MSc ☐ PhD ☐
- Staff:** - Post-doctoral researcher ☐ Visitor ☐ General Staff ☐
- Academic Staff ☐ Co-locator ☐

**Name** (Block capitals):.....

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

**Room Number of laboratory:**.....

**Supervisors / PIs Name(s):**.....

**Supervisors / PIs Signature(s):** ..... **Date:** .....

**PLEASE RETURN A COPY OF THIS COMPLETED SHEET TO THE SCHOOL  
MANAGER**

## Appendix 2: Access to SBS Facilities – General Access Approval Form

To maximise access to First Aid, Emergency and Security services, work should be conducted during the hours of **Level 1: General Access** whenever possible.

<b>Name of Department:</b>	<b>School of Biological Sciences</b>
<b>Building (Number):</b>	Thomas Building (110)
<b>Level 1: General Access - Normal Working Hours when only "Low &amp; Moderate Risk" work can be undertaken.</b>	<b>6.00am – 7.00pm Monday to Friday</b> ( <i>excluding</i> weekends, statutory/public holidays, and University closure days e.g. Christmas/New Year period). For details on Low & Moderate Risk work see Table 1 (above) <i>Definitions &amp; Types of Approval</i> . <b>Signed approval from Supervisor or PI is required.</b>

### Conditions of Approval:

Approval for work to be conducted **After Hours** requires the holding of a signed copy of this form and that the following procedures are followed:

- Completion of Safety Guidelines Acknowledgement Form (Appendix 1, above).
- Completion of adequate training for any potentially hazardous operations that are specific to your laboratory and/or research.
- The School of Biological Sciences Safety Rules (Appendix 4, below) must be adhered to.

Staff/student name \_\_\_\_\_ (block capitals) ID #: \_\_\_\_\_ is permitted General Access to the Thomas Building 110, from \_\_\_\_\_ (date) until Easter, 201\_\_.

I also require access to: a) floor 5 ☐ b) zebrafish facility ☐

1. I have read the information stated above and will abide by the SBS Policy on Access to SBS facilities.
2. I have read and understood the SBS Safety Manual version \_\_\_\_.
3. I will only undertake low risk work during the period approved by this form.
4. I will not work at SBS after midnight and before 6:00am.

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

**Staff** ☐ **Student** ☐ **Room Number(s) of laboratory:** .....

**Supervisors / PIs Name(s):** .....

**Supervisors / PIs Signature(s):** ..... **Date:** .....

Please note that from the time this Approval is communicated to you, this Approval and the conditions in it are deemed a Rule as defined in the University Disciplinary Statute 1998.

**PLEASE RETURN A COPY OF THIS COMPLETED & SIGNED SHEET TO THE SCHOOL MANAGER**

### Appendix 3: Access to SBS Facilities - Approval Form for Access Out of General Access Hours

<b>Name of Department:</b>	<b>School of Biological Sciences</b>
<b>Building (Number):</b>	Thomas Building (110)
<b><u>Level 2: Approved Access:</u> - After Hours period when only "Low" &amp; approved "Moderate" Risk work may be undertaken.</b>	6.00am to midnight Monday to Sunday, including public and University holidays. For details on Low & Moderate Risk work see Table 1 (above) <i>Definitions &amp; Types of Approval.</i>  <b>Signed approval from Supervisor or PI and the School Manager are required.</b>
<b><u>Level 3: Approved Access:</u> - complete all year-round access.</b>	24 hours a day, 7 days a week, Monday to Sunday, all year round. Job-specific approvals may be granted by the School Manager.  <b>Signed approval from Supervisor or PI and the School Manager are required.</b>
<b><u>Total Closure Time.</u></b>	Midnight to 6.00am, every day. Job-specific approvals may be granted by the School Manager.

#### **Conditions of Approval:**

To maximise access to First Aid, Emergency and Security services, work should be conducted during the hours of **General Access** whenever possible.

Approval for work to be conducted **After Hours** requires the holding of a signed copy of this form and that the following procedures are followed:

- Completion of Safety Guidelines Acknowledgement Form (Appendix 1, above).
- You have obtained an adequate level of training for any potentially hazardous operations that are specific to your laboratory and/or research.
- You have demonstrated an adequate understanding of the laboratory procedures you are required to perform and your Supervisor / PI has signed acknowledgement of your performance.
- School of Biological Sciences Safety rules (Appendix 4, below) must be adhered to.

During **After Hours** periods:

- You will use your access card and have it and your University ID available on your person at all times.
- You will take care to be safe entering and leaving the building and avoid personal hazards.
- You will also ensure you are able to communicate with Security/UniSafe in an emergency and that you are familiar with the location and operation of First Aid kits, fire extinguishers, fire safety exits, and fire alarm procedures.

**Note:** An individual's approval for working outside of Normal Operating Hours can be withdrawn at any time by the School Manager.

Staff/student name \_\_\_\_\_ (block capitals), is permitted **Level 2** ☐, or **Level 3** ☐ **Approved Access** to the Thomas Building 110, from (date) \_\_\_\_\_ until Easter, 201\_\_.

<b>The following experiments &amp; procedures may be performed during this period:</b>         	<u><b>Initials</b></u>
<b>I have read the appropriate literature, MSDS's and have discussed this/these procedure/procedures with my supervisor.</b>	<u><b>Initial</b></u>
<b>I am aware of any known hazards and the appropriate safety guidelines associated with this/these procedure/procedures.</b>	<u><b>Initial</b></u>
<b>I have been fully trained in this/these procedure/procedures I am authorised to carry out this/these procedure/procedures.</b>	<u><b>Initial</b></u>
<b>I am using the appropriate chemicals and the procedure is clearly labelled. If the procedure is potentially hazardous I have informed others about the safety implications.</b>	<u><b>Initial</b></u>
<b>I am using the appropriate equipment (including personal protection) and this equipment is all in good working order.</b>	<u><b>Initial</b></u>
<b>I have carefully considered any changes to the procedure that I might be making and how they might affect safety? (new equipment, larger scale, new location)</b>	<u><b>Initial</b></u>
<b>I know where the safety equipment (fire extinguishers, First Aid etc) is located and what to do and who to contact if this procedure becomes dangerous or causes injury.</b>	<u><b>Initial</b></u>

I have read the information stated above and will abide by the *Access to SBS Facilities -Guidelines*.

**Name:** (Block capitals): .....

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

**Staff** ☐ **Student** ☐ **ID Number:** .....

**Room Number(s) of Laboratory:** .....

**Supervisors / PIs Name(s):** .....

**Supervisors / PIs Signature(s):** ..... **Date:** .....

**School Managers Signature:** ..... **Date:** .....

Please note that from the time this Approval is communicated to you, this Approval and the conditions in it are deemed a Rule as defined in the University Disciplinary Statute 1998.

**PLEASE RETURN A COPY OF THIS COMPLETED & SIGNED SHEET TO THE SCHOOL MANAGER**

## Appendix 4: School of Biological Sciences Safety Rules – Summary

- In the case of serious accidents dial 1-111 and if time permits also communicate the problem to UniSafe (Security) on ext. 85000 or 966.
- Staff and post graduate students (including BSc (Hons) and 4th year BTech students) must have an “**Access to SBS Facilities General Access Approval Form**” signed by their supervisor/PI to carry out any experimental work in the laboratories **during** Normal Working Hours (6.00am - 7.00pm, Monday to Friday, excluding weekends, statutory/public holidays and University closure days) and may only use laboratories in which they have been given specific authority to work.
- Staff and post graduate students (including BSc (Hons) and 4th year BTech students) must have an “**Access to SBS Facilities Individual Access Approval Form**” signed by the School Manager to carry out any experimental work in the laboratories **outside** Normal Working Hours (i.e. 7.00pm – midnight, Monday to Friday, including weekends, statutory/public holidays and University closure days) and may only use laboratories in which they have been given specific authority to work. Supervisors / PIs and Laboratory Managers are required to examine the proposed work and assure themselves that all rules concerning safety are met.
- Students and staff must wear protective eyewear and appropriate lab coats in laboratories and workshops.
- Appropriate full-cover footwear must be worn in all laboratories and workshops. The whole foot must be protected and non-skid soles are recommended.
- Smoking is prohibited anywhere on The University of Auckland campus.
- Eating and drinking in laboratories is prohibited. Eating and drinking in the reading/computer rooms located between the research laboratories is allowed.
- Work with hazardous or toxic materials must not be undertaken without proper precautions. Consult your supervisor or PI to clarify exactly what procedures you are able to perform and how to perform them.
- No unauthorised preparations of any substances are to be attempted.
- All accidents must be reported immediately to the School Manager using the Accident/Incident Report form. This is particularly important when the circumstances leading to the accident are likely to recur. Acquaint yourself with the location and contents of the first aid equipment provided at several sites throughout the School.
- Undergraduate students, except 4th year BTech and BSc (Hons) students are not permitted to work in laboratories outside their scheduled laboratory hours without a signed Approval from the School Manager.
- At no time of the day or night are students or staff allowed to carry out research laboratory work unless a second person is within audible distance **and** a named person on the Laboratory Manager or nominated person-in-charge list is present in or near the laboratory.
- Corridor doors and windows must be kept closed outside normal working hours.
- Only authorised persons are permitted to carry out electrical wiring on equipment or extension cords.
- Always seek help if you are in doubt or you have concerns.
- Child visitors to the School must remain under adult supervision at ALL times, and are strictly forbidden from laboratories and workshops.

## Appendix 5: First Aiders in SBS - buildings 106, 110, & 118



Building/Level	Name	Extension	Room No.
<b>THOMAS BUILDING - 110</b>			
<b>Level 1 (basement)</b>	Mary Sewell	83758	130
	Angela Little	88483	141
<b>Level 2</b>	Sandra Anderson	87214	244
	Amy Zhu	87119	228
	<b>Emergency First Aid Bags</b>	<i>Reception &amp; Finance Office (Rm 259 &amp; 260)</i>	
<b>Level 3</b>	Yimin Dong	88986	348
	Anna Lau	87785	334
	<b>Emergency First Aid Bag</b>	<i>Lewis Lab (Rm 348)</i>	
<b>Level 4</b>	Richard Bailey	87045	440
	Garth Cooper	87239	450
	Jo Dodd	88412	402
	<b>Emergency First Aid Bag</b>	<i>Christie/Brittain Lab (Rm 402)</i>	
<b>Level 5</b>	Anthony Phillips	82037	545
	Lynda Whiting	85763	504
	Ben Loveday	85714	538
<b>BIOLOGY BUILDING - 106</b>			
<b>Basement</b>	Yvette Wharton	86697	BB 014A
<b>Level 1</b>	David Seldon	87853	BB 111B
	<b>Emergency First Aid Bag</b>	<i>Student Resource Centre</i>	
<b>Level 2</b>	Hong Liu	88370	BB207
<b>Level 3</b>	Janet McQuillan	87631	BB 308
<b>LIPPINCOTT COTTAGE - 118</b>			
	Sue Skelly	89189	GO1
	<b>Emergency First Aid Bag</b>	<i>Sue Skelly's Office</i>	

## Appendix 6: Fire Wardens in SBS - buildings 106, 110, & 118

Building/Level	Name	Extension	Room No.
<b>THOMAS BUILDING - 110</b>			
<b>Level 1 (basement)</b>	Adrian Turner	85986	158
	Rabendra Singh	85098	117
	<b>Bruce Anderson</b>	<b>87244</b>	<b>112</b>
	<b>(Deputy Warden)</b>		
<b>Level 2</b>	Steven Heoe	88232	258
	Martin Middleditch	87612	285A
	Tony Hickey	87623	292
<b>Level 3</b>	Yimin Dong	88986	348B
	Keith Richards	87287	318
	Soon Lee	87338	318
<b>Level 4</b>	Carol Wang	87235	401
	David Palmer	87238	432
	Peter Lai	85533	403
<b>Level 5</b>	Michael Sue	87246	524
	<b>Amorita Volschenk</b>	<b>85740</b>	<b>545</b>
	<b>(Building Warden)</b>		
<b>BIOLOGY BUILDING - 106</b>			
<b>Basement</b>	Yvette Wharton	86697	BB 014A
<b>Level 1</b>	Libby Hitchings	88703	BB 104
	Mandy Harper	87794	BB 101
<b>Level 3</b>	Sue Jordan	87631	BB 308
	<b>Janet McQuillan</b>	<b>87631</b>	<b>BB 308</b>
	<b>(Building Warden)</b>		
<b>LIPPINCOTT COTTAGE – 118</b>			
	Peter Cattin	87978	LC103
	<b>(Building Warden)</b>		

## Appendix 7: Location of First Aid Kits in SBS - buildings 106, 110, & 118

Building/Level/Room	Area	Person Responsible	Extension	Kit Type
<b>THOMAS BUILDING - 110</b>				
<b>Level 1</b> 108(x2)	Teaching Lab Kit A	Victor Borges	85869	Wall box
	Teaching Lab Kit B	Victor Borges	85869	Wall box
102	Teaching Lab Prep Area	Victor Borges	85869	Wall box.
114	Workshop, mechanical.	Bruce Anderson	87244	Green metal box
117	Workshop, electrical.	Rabendra Singh	85098	Wall box.
141	Marine Lab	Angela Little	88483	Wall box.
150	Histology	Vivian Ward	87202	Small blue box
158H	Microscopy/EM.	Adrian Turner	85986	Wall box.
<b>Level 2</b> 209C	Sick Bay	Angela Little	88483	Wall box-wooden.
228(1)	Molecular Ecology and Evolution	Vibha Thakur	84588	Wall box
228(2)	N. Birch Lab	Victor Borges	85869	Small blue box
228(3)	K. Scott Lab	Amy Zhu	87119	Green wall box
228(3)	C. Evans Lab	Amy Zhu	87119	White 'Alpine' box
244	EEB Lab	Sandra Anderson	87214	Wall box
259	Finance Office.	Steven Heoe	88232	Black emergency bag
260	Reception	Patricia Yip	87279	Black emergency bag
285	Proteomix Lab	Martin Middleditch	87612	Green NZ Safety wall box
291	Affymetrix Lab	Liam Williams	87653	Green NZ Safety box
<b>Level 3</b> 301	G. Cooper Lab	Marion Blumenstein	87243	Wall box
301(1)	G. Cooper/Reference Lab	Shay O'Neill	87289	Small green box
301A	Prep. Area	Yimin Dong	87520	Blue box (in storeroom)
304	P. Harris Lab	Michael Sue	88204	Wall box (not on wall)
318	Plant Mol. Biol. Lab.	Keith Richards	87287	Green NZ Safety box
330	Goddard/Villas-Boas Lab	Nicole Anfang	82777	Green NZ Safety box
334	Turner Lab	Anna Lau	87785	Yellow box
334	Turner Lab (field kit)	Anna Lau	87785	Small green lid box
338(3)	Plant Vir/Pearson Lab	Anna Lau	87785	White wall box
348	Lewis Lab (field kit)	Yimin Dong	88986	Small clear box
348	Lewis Lab	Yimin Dong	88986	Green NZ Safety box
348	Lewis Lab	Yimin Dong	88986	Black emergency bag
<b>Level 4</b> 401	Taylor/Kingston Lab	Carol Wang	87235	Blue box
402	Christie Lab/Brittain	Jo Dodd	88412	Complete F/A clear box
402	Christie Lab/Brittain	Jo Dodd	88412	Black emergency bag
420	Mitra Lab	Kien Ly	87593	Small NZ Safety box
424	AgResearch	Shaun Lott	87074	Small NZ Safety box
432	Bender Mass Spec	David Palmer	87238	Blue lidded box
440	G. Cooper Lab	Cynthia Tse	87394	White box
435A	G. Cooper Lab	Richard Bailey	87045	Small green box
454	Structural Biol/S. Lott Lab	Peter Mayne	87913	Small NZ Safety box
461	Prep Area	Shah Akbar	85984	Red lid box
464	R. Dunbar Lab	Vaughan Feisst	83887	Green box
480	T. Baker Lab	Peter Mayne	87913	Green lid box with Complete F/A sticker
<b>Level 5</b> 560	Animal Houses	Amorita Volschenk	85740	Complete F/A clear box



	558 565	Rat Room Glasshouse Prep Area	Lynda Whiting Michael Sue	87097 85726	NZ Safety box NZ Safety box
<b>Biology Building 106 Basement</b>	14A 220 220	Teaching Lab Office Preparation Area Field Course Kits	Yvette Wharton Technician in charge Technician in charge	86697 87218 86058	5P Kit 5 Person box Red pouch kit 1 Red pouch kit 2 Red pouch kit 3
<b>Level 1</b>	107	Resource Centre	Tessa Holloway	87297	Black emergency bag
<b>Level 2</b>	201 205 207	East Lab West Lab Preparation Area	Technician in charge Technician in charge Technician in charge	87298	Wall box Wall box Wall box
<b>Level 3</b>	301 307 308	Stage 1 East Lab Stage 1 West Lab Preparation Area - East	Janet McQuillan Janet McQuillan Janet McQuillan	87631 87631 87631	Wall box room 301 Wall box room 307 Wall box
<b>Vans</b>		Van 1 Van 2 Van 3 Van 4		87218	Soft Field Kit Soft Field Kit Soft Field Kit Soft Field Kit
<b>Lippincott Cottage - 110</b>		Lippincott Cottage	Sue Skelly	89189	Black emergency bag