# LABORATORY SAFETY MANUAL

**SCHOOL OF CHEMICAL AND BIOMEDICAL ENGINEERING**

**NANYANG TECHNOLOGICAL UNIVERSITY**

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# 1. GENERAL LABORATORY RULES

**Safety comes first:** Safe practices in the chemical laboratory are of great importance and they are everyone's responsibility. Some chemicals are toxic, flammable, explosive carcenogenous and thus one must acquire a basic knowledge and understanding of the chemical properties and equipments he/she is dealing with in the lab. One should realize the types of hazards that exist and the accidents and injuries that can result from ignorance or irresponsibility on the part of the student or a neighbor from bad planning, ignorance or simply by having indifferent attitude.

- Each student, prior to commencing laboratory work, must **Read and Accept** the Laboratory Rules. Each student must sign a declaration form stating that they will abide by these rules. Students will not be admitted in the laboratory without signing the declaration form.

- Refer to the Professional or Laboratory Officer in charge of the laboratory to sign the declaration form once you have read and accepted the Laboratory Rules.

- Please note that the division addresses the issue of laboratory safety very seriously. Students will not be allowed to conduct any experiment if they do not follow the Laboratory Rules.

### 1.1 Laboratory Rules

Observe the following rules whenever you make use of the laboratory and its facilities:

#### 1.1.1 Conduct

- User's work area should be kept clean and tidy.

- Do not eat, drink or smoke in the laboratory.

- Do not bring in friends who are not involved in the project.

- Do not play or listen to audio equipment (radio, walkman etc) while doing experiments.

- Do not use items which have been booked-out by other users.

- Report all accidents, breakages (major or minor) to the Lab Officer as soon as possible.

- Label all items clearly, including name, date and contents.

- Inform technologist and return all items promptly after completion of your project.

#### 1.1.2 Safety regulations

- **Wear safety glasses or goggles** at all times while in the laboratory. Take your contact lenses out prior to entering the laboratory.

- **Gloves** must be worn when performing experiments.

- **Caution** must be taken to prevent chemical contact with the skin or clothing.

- **Never** leave an experiment unattended. Inform the instructor or lab assistant if you must leave the lab.

- **Clean** up all chemical spills immediately.

- To avoid contamination of laboratory supplies, do not use personal equipment such as spatulas in shared chemicals and replace all lids after use.

- Be fully aware of what you do in the lab. Ask you instructor if in doubt.

- Use all electrical and heating equipment carefully to prevent shocks and burns.

- Become familiar with the location of safety equipment, such as eye wash, fire extinguisher, fire blanket, emergency shower.

- Never handle broken glassware with your bare hands; use a broom and a dust pan.

- After the experiment is completed, turn all equipment off, making sure it is properly stored, and clean your area.

- Wash your hands well at the end of the laboratory.

- **Report** all accidents to the instructor or lab assistant immediately.

### 1.2 Safety Facilities

The laboratory is equipped with various safety facilities. Students working in the lab must familiarize themselves with the location and proper use of these facilities.

- **Eye wash**: In the event of a chemical splash in the eye, the eye, with the eyelids widely open, should be washed immediately with copious amounts of water for at least 15 minutes. The casualty must seek medical attention immediately.
- **Shower**: If a chemical spill on the body, immediately flush the body with generous quantity of water for at least 15 minutes. All contaminated clothes should be removed.
- Fire extinguisher: Use $CO_2$ fire extinguisher to put small fires resulting from chemical incidents. Halohydrocarbons extinguishers should be used only when no chemicals are involved in the fire.
- **First aid boxes**: Use when necessary.
- **Fire blanket**: cover the affected are of the body to prevent the fire from spreading. Never try to blow out a fire; severe facial burns may result. Never use water to extinguish a laboratory fire.

### 1.3 Personal Attire

- Proper clothing must be worn in the laboratory and students must wear a lab coat in the lab. Lab coats can be bought from the division office. A lab coat is to help keep clothes protected and close to the body.

- Long, floppy and loose clothes can easily come into contact with chemicals. If your hair is long enough to interfere with you practical operation it should be tied back. Jewelry on your hand can be ruined if they come in contact with chemicals and therefore must be removed.

- Open toed shoes do not adequately protect you against chemical spills. No open footwear or high heeled shoes are allowed in the lab.

**1.4 Equipment and Glassware**

- Equipment should be assembled in the most secure and convenient manner. Consider the safe location of the equipments you use e.g. hot plate. Keep it away from the bench edge.

- Handle all laboratory glassware with care since they are usually fragile. Serious injuries may result if they are not properly handled.

- Apparatus that can roll should be placed between two immobile objects away from the edge of the bench.

- Chipped or broken glassware should never be used.

- After the experiment is completed, all glassware should be emptied, rinsed, cleaned and returned to your drawer.

**1.5 Personal Belonging**

Personal belonging must not be placed on working benches or floor of the laboratory. They should be kept in their designated place on the shelves.

# 2. BIOHAZARD SAFETY

## 2.1 Introduction

### 2.1.1 Definition of biohazardous materials and potential infectious materials

Biohazards are infectious agents or biologically derived infectious material, which presents or may present a risk to the well being of a person or the community. Examples include recombinant DNA; transgenic animals or plants, human, animal or plant pathogens; biological toxins; human blood and certain human body fluids; and human or monkey cell cultures.

### 2.1.2 Purpose

This manual sets out appropriate practices and guidelines for working safely with biohazardous materials. The purpose of the Biosafety Program is to protect faculty, staff and students from exposure to biohazardous materials, to guard against the release of biohazardous materials that may harm humans, animals or the environment, and to protect the integrity of experimental materials.

### 2.1.3 Responsibilities

Principal investigators, instructors and supervisors are primarily responsible for ensuring that the policies and guidelines established in this manual are strictly followed by all personnel under their jurisdiction. Individuals who work with biohazardous materials have a responsibility to follow the guidelines presented in this manual and to consult with their supervisors regarding the safe handling and proper disposal of specific biohazardous materials used in their work area.

## 2.2 General bio-laboratory safety regulations

- A long-sleeved lab coat and closed-toe shoes must be worn in the laboratory. Lab coats that have been worn in the laboratory are prohibited in conference rooms and washrooms. Lab coats should not be worn while eating.

- Protective safety glasses and goggles must be available and worn properly in the laboratory. Full-face shields should be worn to protect facial skin if necessary.

- Gloves should be worn for all procedures that might involve direct skin contact with toxins, blood, infectious materials, infected animals or hazardous chemicals. Gloves suspected to be contaminated must be removed immediately and placed in the appropriate waste container for disposal.

- Respirators are required to prevent the inhalation of infectious aerosols when dealing with them outside the safety cabinet.

- Mouth pipetting is prohibited in the laboratory.

- Eating, drinking, smoking, storing food or utensils, applying cosmetics and inserting or removing contact lenses are prohibited in the laboratory work area.

- Laboratory wastes shall be collected in segregated containers. All contaminated or infectious liquid or solid waste must be decontaminated (such as sterilized by autoclaving, or treated by a chemical disinfectant, or incinerated in a high temperature) before disposal or reuse.

- Work surfaces/floors etc. must be decontaminated after any spill of potentially hazardous substances.

- All spills, accidents and overt or potential exposures, including bites or scratches received from experimental animals**,** must be reported to your supervisor who will then report major exposures to the Departmental Safety Committee. Division policy requires that an incident/accident report must be completed and signed by the supervisor within 24 hours for all personal accidents or other incidents, and filed with the Division General Office.

- All individuals must follow the proper procedures for the transportation of biohazardous material.

- Hand-washing with antibacterial soap required when finishing work.

- Each Principal Investigator is responsible for ensuring that all visitors within their Laboratory are made aware of any necessary precautions that may affect them while they are visiting, and that all precautionary measures are taken to ensure their safety.

**2.3 Specific procedures for disposal and disinfection of biohazardous materials**

All biohazardous material from laboratories classified as Biohazard Level 1 must be disinfected prior to disposal. Biohazard Level 2 materials must be disinfected before removal from the lab if possible. If this is not possible, it must be transported in such a manner as to prevent contamination. Most material can simply be decontaminated or disinfected and subsequently handled as normal waste.

**Glassware**

- Contaminated Glassware can be decontaminated in a bath of 10% (v/v) household bleach for a minimum of 30 minutes, preferably overnight. Baths of household bleach should be changed every week. Chlorine based disinfectants will need to be changed less often. (NOTE: as little as 5% bleach for 30 minutes will inactivate all viruses and bacteria, but higher concentrations for longer times might be required for spores, and protozoan cysts. Contaminated Glassware can also be autoclaved, but must be transported to the autoclave in such a way as to prevent aerosol contamination of the hallways (i.e. with lids or tight covers such as parafilm over the mouths of jars and flasks).

- Contaminated pasteur pipettes are to be disposed of as SHARPS.

- Contaminated Glass Pipettes must be immersed in a bath of 10% bleach or suitable disinfectant within the laboratory before transfer to the glass washing area, where they will be further decontaminated and washed.

**Solid waste**

- Solid contaminated disposable waste (excluding glass), must be placed in an orange BIOHAZARDS bag. When full, bags must be closed, the name of contact person (the person

disposing of the waste, not the supervisor) and room number must be written on the outside. Do not overfill bags (1/2 to 3/4 full only)**.**

- At the autoclave, bags for decontamination must be placed in the available trays. Any bag that is punctured or leaking must be double or triple bagged if necessary before being transported out of the laboratory.

- Disinfected material that is no longer biohazardous must be placed in a regular garbage bag after ensuring that all biohazards warning labels are defaced.

**Cell culture**

- Do not dump any un-treated culture down the sink.

- Autoclave all leftover cultures, media before disposal. The addition of 10% Clorox for 2h also decontaminates waste.

**Other liquids**

- After decontamination, most liquids are suitable for sewer disposal. Liquid waste can be decontaminated in two ways: 1) in a 10% of household bleach for at least 30 minutes, after which waste can be disposed of down the drain. 2) by autoclaving at 121 °C for 20 min. When liquid waste is transported in the hallways, it should be placed in an unbreakable container with a tight lid to prevent contamination of hallways.

- Do not place any solid waste in the liquid containers to be sent for disposal.

**Sharps**

- All sharps must be placed in an approved sharps (hard shell) container and autoclaved prior to being sent for incineration.

- All materials defined as sharps and contaminated with infectious agents or human blood must be placed in the plastic sharps containers labeled with the BIOHAZARD symbol. This includes contaminated pasteur pipettes, all needles, all razor blades, scalpel blades, etc. Do not overfill containers. Full containers should be capped and labelled with a HAZARDOUS WASTE LABEL.

- Broken glass and pasteur pipettes that are not contaminated must be collected in a cardboard box which, when full, can be placed in the hall for pickup by the regular cleaning staff. The box must be labelled as broken glass. Chemically contaminated pipettes or glassware must be rinsed with water before disposal as glass waste.

- Sharps that are to be used more than once should never be left unguarded on bench tops.

**Transportation/shipment of biohazard materials**

- Any biohazardous materials transported between laboratories or buildings should be contained, as they would be in the laboratory, to prevent release of the materials into the environment.

- Transport containers should be labeled with the biohazard symbol and the identity of the material inside.

**Bioharzard spill clean-up**

- Spill kits must be available in the laboratory.

- Any potentially contaminated clothing must be removed and placed in a biohazard waste bag for autoclaving. If the spill is outside of a Biosafety Cabinet, the laboratory must be evacuated immediately.

- If the spill is outside of a laboratory, immediate clean-up is essential. If outdoors, personnel should remain upwind from the spill, if at all possible.

- If the spill is inside a centrifuge, the centrifuges should be closed as soon as the spill is noticed. Meanwhile, the rotor and its contents should be moved to a BSC, if possible.

- If the spill is contained inside a Biosafety Cabinet, the room need not be evacuated, however, the Biosafety Cabinet must remain running.

- Hands and any other contaminated skin must be washed thoroughly with soap and water.

- Everyone not needed for spill clean-up must be cautioned to stay away from the spill area. Signs may be posted if necessary.

- Any sharp contaminated objects must be removed from the spill area using mechanical means, never with hands. After all sharps are removed, disinfectant must be poured carefully around the edges of the edges of the spill, with care taken to avoid splashing. Paper towels can be used to absorb as much of the spilled material as possible. Working from the outside of the spill toward the center avoids spreading the contamination.

- After initial clean-up, the spill area must be flooded with disinfectant and left to soak for at least 20 minutes (adequate contact time is important to ensure complete decontamination).

- Disinfectant can be absorbed with paper towels. A final wipe-down should be done with clean paper towels soaked with disinfectant. Laboratory personnel should be sure to disinfect any equipment, walls or other areas likely to have been splashed by the spill.

- All contaminated waste must be disposed of properly.

**2.4 Fires**

All staff must be acquainted with the use and locations of fire extinguishers. If working with biohazardous materials when the fire alarm rings, cap all bottles of media, cells, etc., leave the laboratory closing the door behind you and follow the posted fire alarm procedure.

**2.5 Injuries**

If exposure to a potentially infectious material (cuts, needle sticks, punctures, scratches, animal bites, etc.) occurs, the injured area must be immediately disinfected, washed thoroughly with soap and water, and the cut then covered with a sterile bandage. Such injured persons should be taken

immediately to the Hospital during normal working hours or the Emergency Department after hours. All incidents must be reported to the senior investigator who will then report major exposures to the Department Safety Officer.

**2.6 Responsibilities**

ALL students who may come into contact with Biohazards must read and follow this safety manual.

# APPENDIX

## LABORATORY SAFETY NOTICE

**1. ALL students, prior to commencing work must ensure that they have read the Safety Manual and signed the acceptance form.**

**2. ALL students, prior to commencing work must fill in the risk rating form and obtain authorization from their supervisors, and submit to the Lab Officer in-charge.**

**3. ALL students MUST familiarize themselves with the emergency procedures in the laboratory. If in doubt ASK a Lab Officer or your Supervisor.**

**4. ALL students, prior to commencing work, must ensure that they obtain a long sleeved laboratory coat. This MUST be worn at ALL times when working in the laboratory.**

**5. ALL students must wear protective eyewear, gloves, aprons, etc when handling solvents, acids and other harmful chemicals. ALL such chemicals should be handled in the fume cupboard. Protective eyewear must also be worn when working with glassware under vacuum or pressure.**

**6. ALL chemicals when transported around the laboratory MUST be adequately supported and contained. All chemicals must be transported in closed containers.**

**7. No food and/or drink in the laboratory.**

**8. No wearing of sandals or uncovered shoes. No shorts and (ladies) wear pants, not skirts where possible.**

**9. DO NOT obstruct common passageways (with stools, equipment, etc.). They must be kept clear at ALL times.**

**10. Students are responsible for the cleanliness of the lab. Make sure that you have removed and cleaned ALL glassware at the end of the day – leave the work place TIDY.**

**Additional Note:** Proper disposal of the wastes from an experiment should be determined before the experiment is started. Volatile compounds should be properly labelled and stored in a hood until disposal. Solutions containing hazardous constituents should not be poured down a sink, but stored in well marked bottled for disposal. Hazardous constituents include such things as strongly acidic or basic solutions, concentrated solutions of hazardous metals or other inorganic compounds, and toxic organic compounds. If in doubt, ask your supervisor. It is the responsibility of the student to ensure timely disposal of stored waste solutions.

***Please refer to your Laboratory Officer regarding the use and disposal of any biological materials (e.g. microbial cultures).***

**These rules will be enforced on a DAILY basis by Lab Officers and staff. Non-conformance WILL result in penalties to the student and, if necessary, more serious disciplinary procedures.**

**Signed/Date:**
**Supervisor**

## DISPOSAL OF WASTE CHEMICALS

**The Laboratory Safety Notice states the following:**

**"Proper disposal of the wastes from an experiment should be determined before the experiment is started. Volatile compounds should be properly labeled and stored in a hood until disposal. Solutions containing hazardous constituents should not be poured down a sink, but stored in well-marked bottles for disposal. Hazardous constituents include such things as strongly acidic or basic solutions, concentrated solutions of hazardous metals or other inorganic compounds and toxic compounds. If in doubt, ask your supervisor. It is the responsibility of the student to ensure timely disposal of stored waste solutions."**

**Pleas Note:**

1. **Different waste bottles must be used for different types of waste generated – <u>DO NOT MIX WASTES IN THE SAME BOTTLE</u> (particularly organic wastes and acids).**

2. **Speak to your Lab Officers about obtaining waste bottles.**

3. **Each waste bottle must be labeled with: Your Name, Name of Supervisor, Date and Type of Waste**

4. **Waste bottles must be kept in a safe place at all times. Speak to your Lab Officers about putting the waste bottle in a fume cupboard.**

5. **Keep the bottle capped between use.**

6. **Do not overfill waste bottles. When finished, date the bottle. Waste must be cleared every month, regardless of volume.**

7. **Arrange with the Lab Officer to have the bottle removed promptly.**

8. **Refer to your Lab Officer for advice on the storage and disposal of biological materials. Note that the use of any biologically active materials (e.g. sewage, blood, microorganisms) must be discussed with your Supervisor prior to commencement of work and notified to the Lab Officer in Charge.**

**Note: Failure to comply with these requirements is a violation under the laboratory safety rules.**

# LABORATORY SAFETY, HOUSEKEEPING & CLEARANCE LOG SHEET
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1. This form is to be used by Professional and Lab Officers in charge of research laboratories in CBE in conjunction with the 'Laboratory Rules' issued to students.

2. All students working in the laboratories of CBE are required to read and sign the Safety, Housekeeping and Clearance Log Sheet indicating that they have read, understood and accepted the Laboratory Rules, and requirements therein.

3. Professional and Lab Officers are responsible for ensuring that students are:

- Provided with the Laboratory Rules prior to commencement of work in the laboratory
- Ensuring that the attached table is signed and dated by the student prior to the commencement of work
- Signing-off the student following completion of work with respect to laboratory safety and tidiness.

It is the responsibility of the Professional and Lab Officers to ensure that the table is kept fully up-to-date. Copies of the table will be reviewed as part of the regular laboratory safety audits.

Students should be given approximately three days to go through the requirements and sign the Log Sheet.

## LABORATORY SAFETY & CLEARANCE FORM FOR RESEARCH STUDENTS

This form is to be used by Laboratory Officers in charge of research laboratories in CBE. All students working in the laboratories of CBE are required to read and sign the list below indicating that they have read, understood and accepted the rules and conditions contained in the Departmental Safety Manual and Laboratory Safety Notice **prior** to commencement of work. Laboratory Officers must sign-off the student following completion of work with respect to safety and laboratory tidiness.

**Lab Officer:** **Laboratory:**

| STUDENT | PROJECT | SUPERVISOR | PROJECT START AND FINISH DATE | RISK RATING FORM/USE OF LAB FORM COMPLETED? | SAFETY & HOUSEKEEPING RULES ACCEPTANCE DATE* | LABORATORY DEPARTURE APPROVED?** |
|---|---|---|---|---|---|---|
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* By signing this acceptance, the student acknowledges that they have read, understood and accepted the rules and requirements of the safety manual and Laboratory Safety Notice prior to commencement of work in the laboratory. By signing this form the student accepts that he/she will be subject to disciplinary action in the vent that he/she breaches any safety regulation or is found to be behaving in such a manner to pose a safety risk to themselves or others. The student must also have received prior approval from the Supervisor for any out-of-hours work in the laboratory. Note the Safety Manual must <u>not</u> be removed from the laboratory.

** The Laboratory Officer must check that the student has cleared all chemicals, glassware and other materials and left their workspace in the laboratory in a safe, clean and tidy condition. Non-approval must be reported to the Student's supervisor and the Head of Safety Committee.

# APPLICATION FOR USE OF LABORATORY

Name of Applicant :..... Matric. No.....
Course and year of study: B.Eng. (2nd, 3rd, 4th)/M.Eng/M.Sc./Ph.D/RF, RE.
Location of Laboratory:.....
Laboratory Officer in charge:.....
Period of use (date): ..... from.....to.....
Time of use: .....from.....to.....

Chemical Risk Rating Forms for each chemical or mixture/preparation attached?*: YES ☐ NO ☐

Risk Rating: ☐ High ☐ Medium ☐ Low

..... .....
Date Signature of Applicant

..... .....
Date Signature of Laboratory Officer

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**Supervisors must ensure that:**

(i) The student has a valid reason to be working in the laboratory.

(ii) The student has signed the Safety & Housekeeping Rules Acceptance Form with the Laboratory Officer before commencing work.

(iii) **For safety reasons, undergraduates can use the laboratory after office hours only in the presence of a staff member for high and medium risk work.**

(iv) **Supervisor of post-graduate students: please select**

( ) High: Require 2 or more persons within sight of each other
( ) High: Able to work alone with these restrictions ..... or attached safe work procedure
( ) Medium: Require 2 or more persons within sight of each other
( ) Medium: Able to work alone with these restrictions ..... or attached safe work procedure
( ) Low or no hazardous chemicals are used: Able to work alone

(v) Risk evaluation form completed (Y/N?) The risk specified on this form should be the same as specified above

..... .....
Name of Supervisor Signature

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**(For official use only)**

Approved by:

Head of Safety Committee..... Head of Division.....

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**Note:**
Forms are to be submitted to Laboratory Officer for authorization by Member of Safety Committee
Laboratory Officers are required to keep an authorized copy of this form with the student record in their office.
With the authorized copy, applicants proceed to Division Office for access card configuration.
Applicants must sign "in" and "out" on the register of attendance kept by the Laboratory Officer each time the Student enters & leaves the laboratory after hours.

# CHEMICAL RISK RATING FORM

1. This form must be completed and attached to the form of application for use of laboratory after office hours.

2. Specify chemicals to be used. The following has to be completed for each chemical used.

   Based on the MSDS, CIRCLE the appropriate cells according to the European Economic Community directives (EC directives) or the National Fire Protection Association (NFPA) rating in the MSDS. MSDS must be obtained from the supplier or downloaded from the supplier/manufacturer's website. Generic MSDS can be used as a last resort.

3. Name of chemical or mixture/preparation: _____

**Hazardous potential in Health, Fire & Explosion**

| | | Hazard Rating | | |
|---|---|---|---|---|
| **Hazard** | **Criteria** | **High** | **Medium** | **Low** |
| **Fire** | **EC Directive** | **F+** | **F** | **F-** |
| | **NFPA** | **4** | **3** | **2 or lower** |
| **Toxic** | **EC Directive** | **T+** | **T** | **Xn** |
| | **NFPA** | **4** | **3** | **2 or lower** |
| **Reactivity** | **EC Directive** | **-** | **-** | **-** |
| | **NFPA** | **4** | **3** | **2 or lower** |

Risk Rating: High ☐ Medium ☐ Low ☐

Name :…… Matric. No……

Course and year of study: B.Eng. (2nd, 3rd, 4th)/M.Eng/M.Sc./Ph.D/RF, RE.

Location of Laboratory:……..…….

Signature :……

**Departmental Laboratory Safety Violation Form**

## First Violation

**Location and Date :_____**

**Safety Violation: _____**

**Student Involved:_____**

**Action Taken: _____**

**Student's Supervisor: _____**

**Student's Signature:_____**

**Lab Officer/Staff Signature: _____**

**CC: Student's Supervisor**

## Second Violation

**Location and Date:_____**

**Safety Violation: _____**

**Student Involved:_____**

**Action Taken: _____**

**Student's Supervisor: _____**

**Student's Signature:_____**

**Lab Officer/Staff Signature: _____**

**CC: Student's Record, Student's Supervisor, Safety Committee**