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1. INTRODUCTION

The preparation of a "Chemical Hygiene Plan" (CHP) has been mandated by OSHA as an extension of regulations governing worker protection. The original regulations were best suited to industrial situations, where workers are exposed to large amounts of a small variety of substances. In laboratories, there tends to be a wide variety of substances, and different hazards are involved. Implementation of the CHP is the responsibility of the Chemical Hygiene Officer (CHO), with the advice of the Safety Committee. The CHO for Williams College is Dr. Anne Skinner of the Chemistry Department, office Bronfman 327, phone 2285/ 2323, or 458-9071 (home).

In the regulations, a "laboratory" is defined as a place where manipulations are carried out on laboratory scale (usually implying quantities manipulable by one person), where multiple procedures and chemicals are involved, and where the procedures are not part of a production process. Further, the range of procedures requires only what might be considered "normal" protective equipment (goggles, fire extinguishers, etc.).

These regulations are designed to apply to employees, including work-study students. There is no mechanism specifically covering students working in the lab as part of a research project, where no compensation is involved. Nor does it cover those who enter a lab only briefly, such as secretaries delivering a message. However, Williams College is free to define "employee" more broadly than OSHA, with respect to application of safety procedures, and it is only common sense to protect everyone to the maximum extent feasible. Certainly all workers, whether paid or not, should receive training in the materials and techniques in use in a given lab. Training is to be done by the supervisor. The CHO can provide assistance such as copies of this legislation, copies of substance lists (carcinogens, poisons, teratogens), and suggestions for training materials. Notes of training sessions, giving the name of the person(s) trained and the date, should be sent to Dr. Skinner.

In general, the standards of compliance are "performance" based; that is, if it can be shown that exposure is minimal, the government does not care how the level got that low. There are some existing health standards (Permissible Exposure Limits) which still apply, and all laboratory supervisors must be aware of certain substances for which eye and/or skin contact is prohibited.

The Chemical Hygiene Plan does not supersede the Hazard Communication Program set up in 1989. The latter is intended to ensure that employees are informed about their rights to know about risks they may encounter. The former is intended to ensure that they are trained how to reduce these risks by appropriate procedures in the laboratory. Copies of both documents should be available in the lab.

In what follows, general procedures that should be in use campus-wide have been outlined. All laboratories may have to supplement this information with written lab-specific materials that detail, for example, which substances must be used in a fume hood, and what protective equipment is appropriate for a given activity. Overall, the governing principle under this Chemical Hygiene Plan is that everyone should be alert to unsafe conditions, and should either correct them or alert others.

2. STANDARD OPERATING PROCEDURES

a. Procurement, distribution and storage of chemicals

Each department must have clearly defined procedures for the ordering of chemicals. Records of substances ordered must be kept, and MSDS's copied and distributed to the lab supervisor, to the departmental file, and to the central safety office. All procurement and receiving personnel should receive training in interpreting DOT labels, and in handling of hazardous substances.

The method of distributing chemicals from receiving areas to stockrooms, and from stockrooms to laboratories must reflect the potential danger posed by the specific substance. Secondary containment of chemicals should be used to protect against breakage. Acids must be transported in shock-proof buckets; other dangerous liquids (flammables, carcinogens) should also be carried in protective containers.

Storage of chemicals should take into consideration hazard classes. In particular, flammable substances must be segregated from other materials. Access to extremely hazardous materials (toxics, carcinogens) should be restricted. Other hazard classes may also have to have separate areas. The Chemical Hygiene Officer will advise on particular cases.

b. Generally applicable work practices

Every worker should know the safety rules and procedures that apply to the particular laboratory. This should include training in the use of Material Safety Data Sheets, with emphasis on routes of potential exposure and target organs. Workers should know how to recognize signs of overexposure. They should also know the location of and how to use any emergency equipment. Training should state specifically that exposed eyes and/or skin should be washed for at least 15 minutes. The appropriate personal protective equipment should be available, and its use required. Confine long hair and loose clothing while in the lab. Wash hands before leaving.

Be certain all chemicals are correctly and clearly labeled. Keep warning signs up-to-date and easily readable. Use equipment only for its designated purpose.

There should be no eating, drinking or smoking in any lab, or area where chemicals are stored. Do not pipet chemicals by mouth, or start a siphon by sucking on the tube.

No one should work alone in the laboratory outside of normal working hours without special arrangement. No one should work alone with chemicals of acute toxicity at any time. If operations must be left unattended, provisions should be made, where possible, for periodic inspection. The effect of potential disruptions such as electricity failure should be known. There should be provisions for containment in case of breakage. There must be signs on the door alerting security personnel to the fact that the equipment is running, and if possible laboratory lights should be left on.

All experiments that pose a hazard by virtue of the chemicals involved should be, where possible, tried first with less-hazardous substances, to determine the integrity of the equipment and procedures.

c. Personal protective equipment

All laboratory workers must have adequate eye protection. The choice of safety glasses, safety goggles or face shields should be made by the supervisor. For hygenic reasons, protective eyewear should not be shared. The use of contact lenses should be restricted.

Exposure of skin to chemicals should be minimized. The use of gloves in handling solvents and hazardous substances is recommended. Shoes, not sandals, must be worn in labs. If shorts are worn, a lab apron (or lab coat) should be used.

Fume hoods must be used for manipulations involving any volatile chemical with an 8 hr. TWA (time weighted average) exposure limit less than 50 ppm. Hoods must be tested at least once a year, and labelled as to correct opening levels. Fire extinguishers and emergency showers are also tested annually. Eyewash baths will be flushed at least every 6 months as part of regular inspections of laboratory-scale operations.

d. Housekeeping

All laboratories must have on the door a general card noting the types of hazards to be found inside, and the name(s) of contacts in case of emergencies. Certain hazards, such as the presence of radioactive material, require further signs.

Within the laboratory, chemicals and stored reaction mixtures should be labeled as to hazards. Equipment presenting a particular hazard (high voltage; laser light) should be appropriately labeled.

Work areas should be kept clean. Clean up spills immediately, and deposit waste in the appropriate receptacle. Do not block access to exits, emergency equipment, or equipment controls.

Keep equipment properly maintained. Safety equipment, such as guards, must be inspected before any equipment is used.

e. Emergency procedures

Every laboratory must post on the door the name and phone number of the person to be contacted in an emergency. In addition, emergency telephone numbers (fire, Security, medical help) must be posted prominently in each lab. Every lab should have a system for internal reporting of accidents, to prevent re-occurence, even where such an accident does not result in injury. Copies of accident reports should be sent to the CHO. Injury to personnel should be reported promptly on the appropriate form to Payroll, with a copy to Personnel.

Each laboratory must have a plan for emergency evacuation. Evacuation routes must be posed and kept clear. Practice emergency evacuations.

f. Waste disposal

Each laboratory worker should be aware of the waste characteristics of materials in use. The following criteria apply for various categories.

i. Substances that are water-soluble, not highly toxic (or malodorous), and have a pH between 3 and 11 may be disposed of down the sink. This includes **small** quantities of heavy metals. When in doubt, check with the Chemical Hygiene Officer.

ii. Solid chemical wastes that cannot be dissolved in water (or that are toxic) should be stored in labeled containers in the lab. Whenever needed, these containers can be collected and transferred to the central hazardous waste storage shed, for ultimate collection and disposal. Empty bottles should be washed, and the labels removed; they can then be recycled.

iii. Liquid chemical wastes not suitable for disposal down the sink should be collected in **carefully labeled** hazardous waste containers. It is important to segregate halogenated and non-halogenated solvents, and to segregate strong acids and bases. **Never put cyanide-containing wastes into a container that might also contain acids!.** Again, these **labeled** containers can be collected and transferred to the central shed; do not allow hazardous waste to accumulate in the lab. **Non-labeled containers will not be accepted for disposal.**

iv. Special care must be taken with certain classes of compounds. As well as the cyanides noted above, strong carcinogens, mutagens, and other very toxic substances should be segregated from other classes of waste. Solvents which may form explosive peroxides on standing should be identified and segregated also.

In addition to these general principles, the EPA has specific regulations on the handling of waste. Williams College's protocol to ensure EPA compliance is attached as Appendix A.

3. MEDICAL CONSULTATION AND EXAMINATIONS

Williams College will provide medical attention and follow-up examinations to any employee who develops symptoms of overexposure, or who may have been exposed to a hazardous substance in excess of the PEL (Permissible Exposure Limit) either in the laboratory or as a result of a spill or leak in another workplace location. In an emergency, the employee should seek immediate assistance from the College Health Center. Otherwise the employee would normally be expected to call the Personnel Office, which would arrange for treatment.. Any medical services will be performed by a licensed physician or under his/her direct supervision, without cost to the employee (including lost pay), and at a reasonable time and place. The College will provide the physician with information on the identity and extent of exposure. The physician will provide the College with the results of any examination and tests, and any recommendation for follow-up. The employee will also be informed of the results.

4. SPECIAL PROBLEMS

a. Introduction

For most laboratories at Williams College, the preceding sections provide all neccessary information for compliance with the OSHA Laboratory Standard. Labs affected by one or more of the following restrictions will need to supplement this Chemical Hygiene Plan with a detailed protocol enabling them to comply with the appropriate practices.

b. Potentially acutely hazardous procedures

Because of the potential dangers posed to the college community as a whole, certain procedures may require prior permission of the Safety Committee (analogous to the current situation with users of radioisotopes). No specific procedures have been designated by the legislation; rather, it is up to the College to decide what are appropriate concerns. The preamble to the legislation, which indicates the thinking of the regulators, lists two situations as possible examples: "...operations involving highly toxic noncarcinogenic material or highly volatile toxic material..." As the College responds to these, and other suggestions, the Chemical Hygiene Plan will be revised accordingly. At present two such hazardous procedures have been identified on campus. Any experimentation involving the use of human blood or other potentially infectious material (as defined by the OSHA Bloodborne Pathogens Standard) must have approval from the Safety Committee before work can be done. Also, the federal government requires registration of certain 'select agents', as defined in the Public Health Security and Bioterrorism Preparedness and Responses Act of 2002 (list in Appendix B). To enable Williams College to comply with this regulation, all researchers using any of these substances must inform this committee before bringing such material on campus.

c. Particularly hazardous substances

There are three classes of "Particularly hazardous substances". In all cases, work with such a substance must be confined to a designated area (this can be a particular bench, or hood, within a lab; it need not be physically restricted from other work areas), and use of containment devices must be specified. The procedures for waste removal and decontamination must also be specified in the supplemental material to this document, and are subject to review.

The first class is "Select Carcinogens". These are substances a) regulated by OSHA as a carcinogen; b) classified by NTP (National Toxicology Program) as "known to be a carcinogen", or "reasonably anticipated to be carcinogen"; or c) classified as IARC Group 1 ("carcinogenic to humans") or Group 2A ("limited human evidence") or 2B ("sufficient animal evidence; inadequate human data"), provided that the classification under a), b) or c) (for groups 2A and 2B) is based on one or more of the following conditions: inhalation exposure 6-7 hours/day, 5 days/week, for a significant portion of lifetime at doses less than 10 mg./cu. m.; repeated skin application of less than 300 mg/kg body weight/day; and/or oral doses of less than 50 mg/kg body weight/day. In other words, the intent is to identify substances which are likely to be carcinogens under conditions of long-term working usage. Ethyl alcohol, for example, is considered a carcinogen, but the level of potency is below the specified conditions. Information as to whether a particular substance meets one or more of these criteria is generally found on the MSDS, although by no means all of the substances noted as "Carcinogen" on the MSDS are "Select Carcinogens". Copies of the IARC list are available from Dr. Skinner.

The second class is "Reproductive Toxins". These are substances which affect reproductive capabilities, including mutations and teratogenesis (i.e. either damage to the chromosomes or to the developing fetus).

The third class is substances of "high acute toxicity". No definition of this class as a whole is given, but some examples, from which an idea of the criteria can be gained, are hydrogen cyanide,

hydrogen sulfide and nitrogen dioxide. A suggested compilation is the DOT Class A Poison list, found in 49CFR172.101.

APPENDIX A

LABORATORY HAZARDOUS WASTE REGULATIONS

What is hazardous waste?

There are three significant liquid hazardous waste streams at Williams. Two of them are organic solvents, subdivided into halogenated and non-halogenated. The third comes from aqueous solutions containing toxic materials such as heavy metal ions or cyanides. Other potential sources of hazardous waste include solid organic compounds, inorganic compounds containing heavy metals, and concentrated acids or bases.

How does the lab handle hazardous waste?

1. Every lab has a 'Satellite Accumulation Area' where wastes are combined and stored temporarily. Containers in this area must be **marked** with a label saying 'Hazardous Material' and further information such as 'Halogenated Solvents', or 'Cyanides'. A description of the hazard characteristics should also be on the label. For non-halogenated and halogenated solvent waste this is 'ignitable'. Halogenated solvent waste also should read 'toxic'. Heavy metal and other aqueous waste streams should be labelled 'toxic', and, if appropriate, 'corrosive'. **Suitable containers can be found in the basement stockroom in MSC or in MSC G30.** Please do **not** simply reuse empty reagent bottles without putting Hazardous Material labels on them.

2. In addition to the generic label, a detailed list of the contents of each container must be maintained, using the full chemical names of the materials, not chemical formulas or abbreviations. A preprinted list of solvents in use in the lab is acceptable. This list must be kept with the container. The date on the sheet is that when the container is **filled** because that is technically the starting date for accumulation.

3. The satellite area should be clearly marked with tape and experiments should not be performed in the area. Containers should be in secondary containment in case of spills or leaks.

4. Containers must be closed at all times except when waste is actually being added to them.

5. Any container up to 55 gallons in size can be used to accumulate wastes within the lab. Please use as large a container as can be accommodated, at least 1 gallon, in order to minimize trips to MSC G30A. When a container is full, it must be transferred promptly (within 3 working days) to MSC G30A, the waste handling area. Whoever brings the container to the waste room must log it in, showing date brought in and lab from which the container came. Plan on picking up a fresh container for the lab whenever one is dropped off.

6. Solid waste from spill cleanup should be brought to MSC G30A within 3 days as well and logged in.

7. The College's waste is picked up twice yearly, generally in January and July. All waste, including outdated chemicals, should be brought to MSC G30A.

A calendar is posted in every lab. Once a week the satellite area should be inspected and the calendar signed. The easiest way to do this might be for the first person in the lab on Monday morning to check

that the waste is not leaking and **sign** the calendar with their **full name**. **These calendars must be kept in the lab for three years.**

APPENDIX B
SELECT AGENTS

Viruses

Crimean-Congo Haemorrhagic fever virus
Ebola viruses
Cercopithecine herpesvirus 1 (Herpes B virus)
Lassa fever virus
Marburg virus
Monkeypox virus
South American Haemorrhagic fever viruses (Junin, Machupo, Sabia, Flexal, Guanarito)
Tick-borne encephalitis comples (flavi) viruses
Variola major virus (smallpox virus) and variola minor virus (Alastrim)
Eastern Equine Encephalitis virus
Nipah and Hendra Complex viruses
Rift Valley fever virus
Venezuelan Equine Encephalitis virus

Bacteria

Rickettsia prowazekii
Rickettsia rickettsii
Yersinia pestis
Bacillus anthracis
Brucella abortus
Brucella melitensis
Brucella suis
Burkholderia mallei (formerly *Pseudomonas mallei*)
Burkholderia Pseudomallei (formerly *Pseudomonas Pseudomallei*)
Botulinum neurotoxin producing species of *Clostridium*
Coxiella burnetii
Francisella tularensis

Fungi

Coccidioides posadasii
Coccidioides immitis

Toxins

Abrin
Conotoxins
Diacetoxyscirpenol

Ricin
Saxitoxin
Tetrodotoxin
Shigatoxin and Shiga-like ribosome inactivating proteins
Botulinum neurotoxins
Clostridium perfringens epsilon toxin
Staphyloccoccal enterotoxins
T-2 toxin

Genetic Elements, Recombinant Nucleic Acids and Recombinant Organisms derived, naturally or synthetically, from select agents.