CHEMICAL HYGIENE PLAN

Chemical Hygiene Plan

For: _____

The Chemical Hygiene Plan for this lab includes the following information:

General Chemical Hygiene Practices
Laboratory Policies & Procedures
Standard Operating Procedures for Hazardous Tasks
Chemical Inventory
Lab Safety Training Records

This plan has been reviewed and approved by:

Principal Investigator	Department Chemical Hygiene Officer
_____ ___/___/___	_____ ___/___/___
Signature	Signature
_____	_____
Printed name	Printed name

Chemical Hygiene Plan (revised March 2018)

INTRODUCTION

The University of Alaska Southeast (UAS) encourages and supports all programs which promote the safety, health, and well-being of UAS faculty, staff, students, participants in UAS-sponsored programs, and visitors. It is the goal of UAS to provide a safe working environment and to reduce injuries and illnesses to the lowest possible level. In keeping with this commitment, this Chemical Hygiene Plan (CHP) was developed as part of the Laboratory Safety program.

The CHP provides information to laboratory personnel with regard to protecting themselves from potential hazards associated with the use of chemicals. Compliance with the provisions of the CHP is mandatory for all employees working in campus laboratories due to requirements of the Occupational Safety and Health Administration (OSHA) standard on "Hazardous Chemicals in Laboratories" (Code of Federal Regulations 29 CFR 1910.1450). While these regulations pertain specifically to employees, UAS maintains that everyone working with hazardous chemicals in a campus laboratory must comply with the provisions of the CHP.

A variety of hazardous chemicals are used in research and teaching laboratories at UAS. Chemicals may cause injury or property damage if they are explosive, toxic, flammable, corrosive, or reactive. The degree of personal risk associated with the use of these chemicals depends on how these substances are handled and stored, as well as on the specific reactions and processes in which the chemicals are used.

The objective of this CHP is to provide uniform requirements for safe use of potentially hazardous substances in UAS laboratories. The CHP must be adapted by individual laboratories to reflect the unique tasks performed in those labs and to outline the methods of mitigating the risks associated with those tasks.

INDIVIDUAL CHEMICAL HYGIENE RESPONSIBILITIES

The responsibility for maintaining a safe laboratory environment lies with the Principal Investigator (PI) for the lab. Every individual in the lab is expected to conduct all operations and procedures involving chemicals in a safe and prudent manner.

Principal Investigator

The PI has responsibility for implementation of the CHP in his/her laboratory. The PI shall:

1. complete all required safety training, including those related to lab safety
2. ensure that workers are trained and follow the CHP outlined in this document
3. ensure that the necessary protective and emergency equipment is available and in working order
4. ensure that appropriate training has been provided
5. ensure that periodic laboratory inspections are performed (refer to Appendix 2)

6. know current legal requirements concerning regulated substances
7. review and evaluate the effectiveness of the laboratory Standard Operating Procedures (SOPs) at least annually and update as necessary

Laboratory Employees

Laboratory employees are responsible for:

1. completing required safety training, including those related to lab safety
2. planning and conducting each operation in accordance with practices and procedures established in this CHP
3. using equipment only for its designed purpose
4. being familiar with emergency procedures, including knowledge of the location and use of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency
5. knowing the types of protective equipment available and using the proper type for each procedure
6. being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible

Chemical Hygiene Officer

A Chemical Hygiene Officer (CHO) is an employee designated by a department who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the CHP for the individual labs within the department. The CHO is designated by the Dean, Director, or Department Head.

The CHO shall:

1. assist PIs and other laboratory employees with development and implementation of standard operating procedures and practices, including providing consultation and information
2. keep abreast of legal requirements concerning regulated substances and communicate any changes to PIs and laboratory employees
3. seek ways to improve the overall chemical hygiene program

TRAINING

PIs shall ensure that information and training are provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. Refresher information and training on the laboratory CHP shall be conducted at least annually and documented.

All laboratory personnel shall be informed of:

1. The requirements of the OSHA Standard, "Occupational Exposure to Hazardous Chemicals in Laboratories", 29 CFR 1910.1450

(https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10106&p_table=STANDARDS)
2. The contents and availability of this CHP
3. The permissible Exposure Limits (PELs) for OSHA regulated substances or recommended exposure limits where there is no applicable OSHA standard
4. Methods and observations that may be used to detect the presence or release of a hazardous chemical; e.g., exposure monitoring conducted by the UAS Health and Safety Office, visual appearance or odor of hazardous chemicals when being released, etc.
5. The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and PPE to be used
6. Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory
7. The location of reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Safety Data Sheets (SDSs)

Employee training shall include:
1. UAS Laboratory Safety training
2. UAS Hazardous Waste Management training

Additional training modules are available, including, Formaldehyde, Methylene Chloride, Chloroform, Phenol, Hydrofluoric Acid, Laboratory Sharps Safety, Biosafety Cabinets, and Radiation Safety. These are required for all employees working with these hazards.

CIRCUMSTANCES REQUIRING PRIOR APPROVAL

Employees must obtain prior approval to proceed with a laboratory task from the PI when:
1. Radioactive materials will be used.
2. Recombinant DNA or biological material of Biosafety Level 2 or greater will be used.
3. It is likely that exposure limit concentrations could be exceeded or that other harm is likely.
4. There is failure of any equipment used in the process, especially of safeguards such as chemical fume hoods.
5. Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.

LABORATORY-SPECIFIC STANDARD OPERATING PROCEDURES (SOPs)

You must include your own laboratory specific SOPs in your CHP.

Examples of procedures for which SOPs are needed include:

- Operation of laboratory equipment such as: lasers, atomic absorption spectrometers, muffle furnaces, freeze-dryers, electrophoresis equipment, etc.
- Operations posing a special hazard, such as: using perchloric acid, working with pyrophorics, conducting electrophoresis, performing distillations and/or extractions, handling infectious agents, etc.
- Operations that use a chemical that is listed in the lab's chemical inventory as needing an SOP.
- Neutralizing non-contaminated acid wastes.
- Specific procedures for operations that are to be conducted in fume hoods.
- Transporting hazardous chemicals

SOPs are step-by-step instructions for conducting the procedure, and should include:

1. Training requirements for lab personnel
    a) Documents should record the name of the trainer, the topics covered, and the date of the training
2. Information on the specific hazards posed by the chemicals and/or equipment used in the procedure
3. Information on the personal protective equipment (PPE) needed during the procedure, including specific information on glove type
4. A step-by-step description of the process
5. First aid measures
6. Waste disposal instructions

A template to use for writing SOPs can be found in Appendix 1.

PERSONAL PROTECTIVE EQUIPMENT (PPE) AND APPAREL

Carefully inspect all PPE prior to use. Do not use defective equipment.

<u>Eye Protection</u>

Eye protection (safety glasses, chemical-resistant goggles, or face shield) shall be worn at all times in laboratories where chemicals are being used. This includes visitors.

1. All eye protection must meet American National Standards Institute (ANSI) 87.1Z – 2010.
2. Ordinary prescription glasses are not considered safety glasses.
3. Safety glasses should be worn over prescription glasses or prescription safety glasses must be provided to employees who must wear corrective lenses.

4. Contact lenses may be worn as long as additional appropriate eye protection outlined above is used.
5. Additional information regarding the use of contacts in a chemical environment is outlined in the National Institute of Occupational Safety and Health Publication Number 2005–139 (http://www.cdc.gov/niosh/docs/2005-139/pdfs/2005-139.pdf)
6. If chemical-resistant goggles are required, it may be necessary to wear contact lenses, as these goggles will not seal around the face if glasses are worn.

Gloves

When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of material known to be resistant to permeation by the substance shall be worn. No one glove can protect against all hazards.

1. Cloth gloves, while not appropriate for use around liquids, can protect against light abrasive materials and moderate temperature changes.
2. Synthetic or rubber gloves protect against corrosives, solvents, and poisons.
    a) Some solvents permeate the commonly-used nitrile gloves very quickly. Consult the SDS or glove manufacturer's glove selection charts for more information.
3. Leather gloves, often used for tasks like welding, protect against sparks, heat, and rough abrasives.

Clothing

1. A full-body-length rubber, plastic, or neoprene apron appropriate for the material being handled should be worn if there is risk of splash or spill when working with large volumes of chemicals.
2. Low-heeled shoes with fully covered uppers shall be worn at all times in the laboratory. Shoes or sandals with open toes or shoes with mesh covered uppers shall not be worn.
3. Long pants and long sleeves should be worn when working with or around chemicals.
4. Long hair should be held in place behind the head.
5. Loose clothing, especially loose trouser legs and sleeves, should not be worn in the laboratory.

Fume hoods and Respirators

1. Fume hoods must be used whenever possible.
2. A proper respirator must be worn whenever exposure by inhalation is likely to exceed the action level or the PEL and a fume hood is not available.
    a) NOTE: Prior to wearing a respirator, employees must be medically evaluated, trained, and fit-tested prior to using a respirator.

LABORATORY SAFETY RULES AND REGULATIONS

General Rules for laboratory work with chemicals

1. Regular (day-time) work schedules should be followed unless a deviation is authorized by the laboratory supervisor or PI. Employees should avoid working alone after hours
    a. Arrangements should be made between individuals working in separate laboratories outside of regular working hours to crosscheck each other periodically
    b. Procedures known to be hazardous should not be undertaken by an employee who is alone in the laboratory
    c. Prominent signs should be posted in laboratories that show the contact information for the PI , Facilities and Emergency Services so that those working alone can quickly inform and get help.
2. Unauthorized experiments shall not be performed
3. Plan and review safety procedures before beginning any operation
4. Follow standard operating procedures at all times
5. Always review the SDS and container label before using a chemical
6. Wear appropriate PPE at all times
7. Use appropriate ventilation when working with hazardous chemicals
8. Pipetting should never be done by mouth. Use mechanical devices, such as pipet bulbs, pipet wheels, electric pipettors, or Pipetman® devices
9. Wash hands with soap and water immediately after working with any laboratory chemicals, even if gloves have been worn
10. Do not use solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals.
11. Eating, drinking, gum chewing, applying cosmetics, and taking medicine in laboratories where hazardous chemicals are used or stored is strictly prohibited
12. Smoking is prohibited in all UAS facilities
13. Food, beverages, cups, and other drinking and eating utensils shall not be stored in areas where hazardous chemicals are handled or stored
14. Laboratory refrigerators, ice chests, cold rooms, and ovens shall not be used for food storage or preparation
15. Eating and office areas must be clearly separated from laboratory and chemical storage areas
16. Maintain situational awareness
17. Make others aware of any special hazards associated with your work
18. Notify the PI of any chemical sensitivities or allergies so that protective measures or alternatives can be identified.
19. Report all injuries, accidents, incidents, and near misses to the laboratory supervisor, PI, CHO, and the UAS Health and Safety Manager, 796-6077.
20. Unauthorized persons and dogs are not allowed in the laboratory

21. Report unsafe conditions to the PI, laboratory supervisor, or CHO.
22. Properly dispose of chemical wastes
23. Contact the laboratory supervisor, PI, CHO, or UAS Health and Safety Manager (796-6077) with all safety questions or concerns.

Housekeeping

1. Proper housekeeping includes appropriate labeling and storage of chemicals, safe and regular cleaning of the facility, and proper arrangement of laboratory equipment.
2. All work areas, especially laboratory bench tops, should be kept clear of clutter.
3. All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.

EMERGENCY EQUIPMENT

Know the location and proper use of safety equipment. Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers shall never be blocked or obstructed.

Emergency eyewashes and showers

OSHA (29 CFR1910.151) states:

> *"Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use."*

The ANSI standard Z358.1 recommends that:

1. The safety shower and eyewash be within 10 seconds or 55 feet of the work area for quick drenching or flushing of the eyes and body.
2. The equipment must be installed on the same level as the hazard (i.e. accessing the equipment should not require going up or down stairs or ramps).
3. The path of travel from the hazard to the equipment should be free of obstructions and as straight as possible.
4. Eyewash stations and showers will be tested annually by Facility Services to determine proper pressure and flow rates.
5. It is the responsibility of the laboratory personnel, CHO or designated employee to test emergency equipment weekly to ensure the delivery of clear, tepid, debris-free water. These weekly tests must be documented in a written log.

Fire Extinguishers

Unless the laboratory is a high fire hazard area, fire extinguishers are not allowed. UAS's policy is to have employees and students exit the building in the event of a fire, not to remain behind to attempt to fight the fire. However, we recognize that individuals who are properly trained and equipped may be able to put out a small fire in a piece of

equipment, thus reducing the amount of property damage to the equipment and surrounding lab.

CHEMICAL MANAGEMENT

Chemical Procurement:

1. Information on proper handling, storage, and disposal should be provided to those who will be involved, before a chemical is received.
2. Only containers with proper labels identifying the chemical and its hazard should be accepted. Beginning in 2016, all container labels must be compliant with the Globally Harmonized System (GHS).
3. Shipments with breakage or leakage should be refused, or opened in a chemical fume hood.
4. Only the minimum amount of the chemical needed to perform the planned work should be ordered.
5. Purchases of high-risk chemicals should be reviewed and approved by the CHO, with the assistance of UAS Health and Safety if necessary.
6. Proper protective equipment and handling and storage procedures should be in place before receiving a shipment.
7. Chemical shipments should be dated upon receipt and the stock should be rotated.

Chemical Storage:

1. Chemicals should be separated and stored according to hazard category and compatibility.
    a) Consult SDS and label information for storage requirements.
2. Maintain existing labels on incoming containers of chemicals and other materials.
3. Peroxide formers should be dated upon receipt, again dated upon opening, and stored away from heat and light with tight-fitting, nonmetal lids.
4. Label all containers of hazardous chemicals (including transfer vessels, beakers, flasks, and process equipment) with the chemical name and hazard warnings.
5. Open shelves used for chemical storage should be secured to the wall and have 3/4-inch lips.
6. Secondary containment (tubs, bins) should be used for liquids.
7. Consult the SDS and keep incompatibles separate during transport, storage, use, and disposal.
8. Oxidizers, reducing agents, and flammables should be stored separately to prevent contact in the event of an accident.
9. Chemicals should not be stored in the chemical fume hood, on the floor, in areas of egress, on the benchtop (except for small amounts of working solutions), near heat sources, or in direct sunlight.
10. Laboratory-grade, flammable-rated refrigerators and freezers should be used to store sealed chemical containers of flammable liquids that require cool storage.
11. Highly hazardous chemicals should be stored in a well-ventilated and secure area designated for that purpose.

12. Flammable chemicals should be stored in a spark-free environment and in approved flammable-liquid containers and storage cabinets. Grounding and bonding should be used to prevent static charge buildups when dispensing solvents.
13. Storage of flammable substances shall be limited to quantities specified in Appendix 8.
14. Chemical storage and handling rooms should be controlled-access areas. They should have proper ventilation, appropriate signage, diked floors, and fire suppression systems.

Chemical Handling:

1. A risk assessment should be conducted prior to beginning work with any hazardous chemical for the first time. Contact the UAS Health and Safety for assistance at 796-6077.
2. Read all SDS and label information before using a chemical for the first time, or if it has been awhile since using the chemical.
3. Trained laboratory workers should ensure that proper engineering controls (ventilation) and PPE are in place.

Chemical Inventory:

Prudent management of chemicals in any laboratory is greatly facilitated by keeping an accurate, up-to-date chemical inventory.

1. A current copy of the inventory must be kept in the CHP book in the laboratory
2. Chemicals that are no longer needed or are waste should be properly stored until picked up by UAS Health and Safety.

Transporting Chemicals:

1. Use secondary containment, such as bins and buckets, when transporting chemicals
2. Use a break-resistant transport container when transporting chemicals outside of the laboratory or between stockrooms and laboratories.
3. Avoid transporting chemicals through high-traffic areas.
4. Never transport chemicals in your personal vehicle or in a departmental vehicle. Call UAS Health and Safety for assistance at 796-6077.

Transferring Chemicals:

1. Use adequate ventilation (such as a fume hood) when transferring even a small amount of a particularly hazardous chemical.
2. Using drums for storage of chemicals is not appropriate for laboratories.
3. Transfer flammable liquids from 5 gallon containers (or less) to smaller containers only in a laboratory fume hood or an approved flammable liquid storage room.

Shipping Chemicals:

Outgoing chemical shipments must meet all applicable Department of Transportation (DOT) regulations.

1. Contact UAS Health and Safety Office at 796-6077 before shipping ANY chemical, unless you have current training as a hazmat shipper.

COMPRESSED GAS SAFETY

Compressed gases present a number of chemical, physical, and health hazards. Improper handling and use can cause structural damage, severe injury, and possibly death.

1. Cylinders that are knocked over or dropped can be very dangerous. If a valve is knocked off, the cylinder can become a lethal projectile.
2. Accidental releases may result in an oxygen-depleted atmosphere or adverse health effects.

The following guidelines will help ensure safe handling, use, and storage of compressed gas cylinders.

<u>Receiving and Storage:</u>

1. Be sure to arrange a return agreement with suppliers prior to purchase since disposal of compressed gas cylinders is difficult and very expensive.
2. Cylinders should not be accepted unless the cylinder contents are clearly labeled.
3. Color code only should not be accepted, since it does not constitute adequate labeling.
4. Do not accept cylinders which are damaged or do not have a valve protection cap.
5. All gas cylinders shall be secured in an upright position in racks, holders, or clamping devices, with straps or chains placed at 1/3 and 2/3 the tank height. Chains are preferable, as they will not burn during a fire and will continue to secure the cylinder.
6. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the shoulder area so that labels are readily visible.
7. Never place oxygen cylinders near highly combustible materials, especially oil and grease, near stocks of carbide and acetylene or other fuel gas cylinders, nor near any other substance likely to cause or accelerate a fire.
    a) Systems and components used for other gases and purposes must never be used for oxygen or interconnected with oxygen.
    b) Signs should be conspicuously posted in areas where flammable compressed gases are stored, identifying the gases and the appropriate precautions to be taken.
8. Cylinders should have current hydrostatic test date (normally less than 5 years old for steel and 3 years old for aluminum) engraved on the cylinder. Cylinders should be returned to the supplier for servicing prior to the expiration date.
9. Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.
10. Do not store cylinders in exit corridors or hallways.

Handling and Use:

1. Only Compressed Gas Association fittings and components are permitted for use with gas cylinders.
2. Only use regulators approved for the type of gas in the cylinder.
3. Do not use adapters to interchange regulators.
4. Be careful when threading a regulator onto a cylinder. They can become stuck, causing the gas to be released from the cylinder. This may result in oxygen-depletion of the room, or in the development of a flammable atmosphere in the room.
5. Open cylinder valves slowly and face away from the valve when opening it. Ensure that others are not facing the valve when you open it.
6. Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.
7. Transferring gases from one cylinder to another, refilling cylinders, or mixing gases in a cylinder in the laboratory is prohibited.
8. All cylinders are to be considered full unless properly identified as empty by the user. Empty cylinders must be returned to the supplier and not accumulated.
9. Compressed gases must not be used to clean your skin or clothing.
10. Never heat cylinders to raise their internal pressure.
11. Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.
12. Always leave at least 30 psi minimum pressure in all "empty" cylinders. Do not leave an empty cylinder attached to a pressurized system.

LABORATORY VENTILATION

General laboratory ventilation is normally designed to provide a minimum of eight air changes per hour. This flow is not necessarily sufficient to prevent accumulation of chemical vapors in the lab.

Laboratory work shall be conducted in a fume hood, glove box, or similar device when:

1. Procedures call for work with toxic substances which are volatile; i.e., evaporate at normal temperature and pressure.
2. There is a possibility the action level or PEL will be exceeded.

The way the hood is used will determine the degree of protection it will provide. Each employee is responsible for implementing the following work practices when using a hood.

1. Continually monitor air being drawn into the hood. Many hoods have electronic monitors and will alarm if the air flow drops below the safe value. If no monitor is present, air flow can be checked by attaching a light-weight strip of paper, such as a Kim wipe, to the bottom of the sash. The paper should flutter inwards.
2. Operate the hood at a sash position that will provide splash protection for the user; e.g. 10-12 inch opening for hoods with vertical sliding (up and down) sashes and the sashes closed as much as possible for continuous air flow hoods

with horizontal sliding (left and right) sashes. This helps to ensure optimum protection when conducting operations in the hood.
3. Avoid using the hood for storage of bottles and equipment, especially along the back wall of the hood.
4. Any apparatus that must be housed within the hood should fit completely inside the hood. Elevate the apparatus on blocks (at least 2 inches off the bench top) to allow air to flow freely around and beneath the item.
5. Manipulations within the hood should be performed at least 6 inches inside the face of the hood or as far towards the back of the hood as possible. This minimizes the possibility of contaminants escaping from the hood due to turbulent air flow.
6. Minimize air turbulence across the face of the hood from fans, window air conditioning units, or excessive movement around the hood face.
7. Avoid walking past a fume hood when it is being used.
8. Avoid excessive arm movements when working inside a fume hood.
9. Exhaust hoods do not provide adequate protection for all operations involving toxic materials. A higher level of containment should be used for procedures where exposure to even small amounts of the chemical can be serious. If you are in doubt about the level of containment needed for your operation, ask your PI, Lab Supervisor, CHO, or the UAS Health and Safety Office.

Fume hoods should be evaluated annually to verify that adequate airflow is maintained through the hood face. Check for a current sticker on the side of the fume hood or other local exhaust equipment.

1. The date should not be over a year old. If it is, call the UAS Health and Safety Office at 796-6077 to schedule a face velocity test.
2. Face velocities should be between 80 and 120 feet per minute (fpm).
3. Contact the UAS Health and Safety Office at 796-6077 if you suspect the hood is not working properly.

In the event of a fume hood failure or low-flow alarm, discontinue all fume hood operations and, **only if it is safe to do so**, place lids on open containers, lower the hood sash and secure reactions that may be generating hazardous emissions.

1. Contact Facilities Services at 796-6496 to report the alarm after following the steps listed above.
2. After work hours, call 1-866-999-1822 for an operator that can call the Facilities Services staff 24 hours.
3. If the danger level is imminent, leave the lab immediately and call 911.

EMERGENCY PROCEDURES FOR ACCIDENTS AND SPILLS

Spill Clean-up Procedures:

1. Spill response information should be included in the SOP for the procedure in which the chemical is being used. It is your responsibility to be familiar with spill response for all chemicals that you use.

2. If you do not feel comfortable cleaning up any spill, call the UAS Health and Safety Office at 796-6077 for assistance during business hours. After hours, call 1-866-999-1822.
3. Call 911 in the event of an emergency or if anyone is in danger.
4. Attend to anyone who may have been contaminated during the spill, or injured.
5. Notify occupants in the immediate area about the spill.
6. Evacuate all nonessential personnel from the spill area.
7. If the spilled material is flammable, turn off all ignition and heat sources; this includes magnetic stir plates.
8. Ensure that the fume hood is on.
9. Confine or contain the spill to a small area using dikes or spill pads.
10. Avoid breathing vapors of the spilled material. If medically qualified and trained as required in the Respiratory Protection Program, use a respirator if necessary.
11. Obtain cleanup supplies. Wear suitable PPE, including appropriate gloves, lab coat, and chemically-resistant safety goggles. Ensure that PPE is resistant to the spilled material.
12. Use appropriate kit and materials to neutralize and absorb inorganic acids and bases.

EXPOSURE MONITORING

Exposure assessments and monitoring shall be conducted through the UAS Health and Safety Office (796-6077).

Initial Monitoring:
Exposure monitoring shall be performed when there is reason to believe that exposures are in excess of the action level or the PEL. Substances which require monitoring under these conditions are listed in OSHA Regulations, 29 CFR 1910 Subpart Z (https://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1910)

Periodic Monitoring:
If initial monitoring reveals that exposures are in excess of the action level or PEL, the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

Termination of Monitoring:
Monitoring may be terminated in accordance with the relevant standard.

Employee Notification:
Employees will be notified in writing by the Health and Safety Office within 15 working days after receiving any monitoring results. Documentation of exposure monitoring shall be kept and maintained as part of each employee's personnel record.

MEDICAL CONSULTATIONS AND EXAMINATIONS

Employees shall be provided an opportunity to receive medical attention, including any related follow-up examinations, at UAS's expense, under the following circumstances:

1. An individual develops signs or symptoms associated with exposure to hazardous chemicals in the laboratory.
2. Exposure monitoring reveals an exposure level routinely above the action level or PEL for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
3. An accident such as a spill, leak, equipment failure, or explosion results in possible over-exposure to hazardous chemicals.

The UAS Health and Safety Office is responsible for establishing and maintaining an accurate record of any medical consultations and examinations provided to an employee.

HEALTH HAZARDS

Criteria for determining whether a chemical is classified as a health hazard are detailed in Appendix A to 29 CFR 1910.1200.

Acute Toxicity refers to those adverse effects occurring following oral or dermal administration of a single dose of a substance or multiple doses given within 24 hours, or an inhalation exposure of 4 hours.

Skin Corrosion/Irritation

1. Corrosion is irreversible damage to the skin.
2. Irritation is reversible damage to the skin.

Serious Eye Damage/Irritation

1. Eye damage refers to tissue damage of the eye or serious decay of vision.
2. Eye irritation refers to changes to the eye that are reversible within 21 days of the exposure

Respiratory or Skin Sensitization

1. Respiratory Sensitization refers to a chemical that will lead to hypersensitivity of the airways following inhalation
2. Skin sensitization refers to a chemical that will lead to an allergic response following skin contact.

Germ Cell Mutagenicity is defined as a permanent change in the amount or structure of the genetic material in a cell.

Carcinogenicity: a substance or mixture which will induce cancer or increase its incidence. There are 3 categories for carcinogens:

1A: substances which are known to have carcinogenic potential for humans

1B: substances which are presumed to have carcinogenic potential for humans
1C: substances which are suspected human carcinogens

A list of chemicals that are classified as carcinogens by the National Toxicity Program is given in Appendix 6, as are the thirteen chemicals listed by OSHA as carcinogens.

Reproductive Toxicity:
Reproductive toxicity includes adverse effects on sexual function in adult males and females, as well as adverse effects on development of the offspring. There are 2 categories for reproductive toxicants:

1: Known or presumed human reproductive toxicant
2: Suspected human reproductive toxicant

Specific Target Organ Toxicity, Single Exposure: refers to a specific, non-lethal target organ toxicity arising from a single exposure to a chemical.

Specific Target Organ Toxicity, Repeated or Prolonged Exposure: refers to specific target organ toxicity arising from repeated exposure to a substance or mixture.

Aspiration Hazard: refers to the entry of a liquid or solid into the trachea and lower respiratory system.

Simple asphyxiant:
A simple asphyxiant (as defined in 29 CFR 1910.1200(c)) is a substance or mixture that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those who are exposed, leading to unconsciousness and death.

PHYSICAL HAZARDS

Criteria for determining whether a chemical is classified as a physical hazard are detailed in Appendix B to 29 CFR 1910.1200.

Explosive: is a solid or liquid chemical which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

Flammable Gas: refers to a gas having a flammable range with air at 20°C (68°F) and a standard pressure of 101.3 kPa (14.7 psi).

Flammable Aerosols: refers to any non-refillable receptacle containing a gas compressed, liquefied or dissolved under pressure and fitted with a release device allowing the contents to be sprayed as a gas, foam, paste, powder, or liquid.

Oxidizing Gases: refers to any gas which may, usually by providing oxygen, cause or contribute to the combustion of other material above and beyond what air does.

Gases Under Pressure: refers to gases which are contained in a receptacle at a pressure of 200 kPa (29 psi) or more, or which are liquefied or liquefied and refrigerated.

Flammable Liquids: refers to liquids having a flash point of not more than 93°C (199.4°F). Flash point refers to the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air.

Flammable Solids: refers to a solid which is readily combustible solid or which may cause or contribute to fire through friction.

Self-Reactive Chemicals: refers to thermally unstable liquid or solid chemicals liable to undergo a strongly exothermic decomposition even without oxygen. Excludes explosives, organic peroxides, and oxidizing liquids or solids.

Pyrophoric Liquids: refers to a liquid which is liable to ignite within five minutes after coming into contact with air.

Pyrophoric Solids: refers to a solid which is liable to ignite within five minutes after coming into contact with air.

Self-Heating Chemicals: refers to a large amount of a solid or liquid chemical (excluding pyrophoric liquids or solids) which, by reaction with air and without an energy supply, is able to self-heat with hours or days.

Chemicals Emitting Flammable Gases when in Contact with Water

Oxidizing Liquids: refers to a liquid which, generally by yielding oxygen, cause or contribute to the combustion of other materials.

Oxidizing Solids: refers to a solid which, generally by yielding oxygen, cause or contribute to the combustion of other materials.

Organic Peroxides: refers to a liquid or solid that is a derivative of hydrogen peroxide.

1. Organic peroxides are thermally unstable chemicals and may undergo exothermic self-accelerating decomposition.
2. They are liable to explosive decomposition, burn rapidly, be sensitive to impact or friction and react dangerously with other substances.

Corrosive to Metals: refers to a chemical that can materially damage, or even destroy, metals.

Appendix 1

LABORATORY-SPECIFIC STANDARD OPERATING PROCEDURES

[*Name of procedure*]

Location(s): *list room number(s) and building(s) here*

Chemical(s): *list chemical(s) here*

Specific Hazards:

List specific hazards for each chemical here (by chemical). This information is in the SDS.

1. Purchasing:

Include this verbiage if chemicals or hazardous materials are being purchased for use in this SOP. If not, just write "N/A".

All purchases of these materials must have approval from _____ before ordering. The user is responsible to ensure that a current Safety Data Sheet (SDS) is obtained unless a current one is already available within the laboratory. Quantities of this material will be limited to the smallest amount necessary to complete the experiments.

2. Storage:

Include this verbiage if chemicals or hazardous materials are being used as part of this SOP. If not, just write "N/A".

Materials will be stored according to compatibility and label recommendations in the designated _____storage area. Storage areas will be regularly inspected by lab personnel to ensure safety. Periodic inventory reductions will be scheduled.

3. Authorized personnel:

Include this verbiage if the use of this procedure should be limited in any way. If not, just write "N/A".

Use will be limited to the following personnel (check all that apply):

Principal Investigator ___ Graduate students__ Technical staff __

Post-doctoral employees___ Undergraduates ___ Other (_____) ____

4. Training requirements:

The user must demonstrate competency and familiarity regarding the safe handling and use of these materials prior to using them. Training shall include the following:

Review of this SOP

Other examples: UAS Laboratory Safety training

UAS Hazardous Waste Management training

5. Use location:

This procedure will be done in *[BUILDING AND ROOM HERE]*. *Also specify any other specific location, such as fume hood or biosafety cabinet.*

6. Personal protective equipment (PPE):

All personnel are required to wear the following personal protective equipment (PPE) whenever conducting this procedure:

Examples: Lab coat

Safety goggles or safety glasses

Gloves: [must specify glove type, and thickness if necessary; may also include warnings against other types of gloves that are not recommended for that chemical]

7. Spill equipment: *List spill response equipment here, including neutralizer, universal pads, etc.*

8. Procedure:

Materials needed:

Number list of materials needed for procedure, including pipets, tips, beakers, hot plates, chemicals, etc.

Procedure Notes:

Provide any notes for the procedure. This will mostly be scientific or technical in nature, but may include any specific warnings about serious safety hazards. May not have this section in some SOPs.

Procedure Steps:

Numbered list of steps in procedure, beginning with "don PPE" and "gather materials".

1. Don PPE.
2. Gather materials.
3. *Continue here.*

9. Waste disposal and clean up:

If no wastes are generated, just write "It is not anticipated that any wastes will be generated during this procedure." Otherwise, include this:

The authorized person using this material is responsible for the safe collection, preparation and proper disposal of waste unless otherwise stated below. Waste shall be disposed of as soon as possible and in accordance with all laboratory and University procedures.

Then, write specific instructions for liquid and solid wastes:

Specific instructions:

1. Liquid wastes
    a. Obtain a *[specify type if relevant]* bottle and label with "*[concentration and name of waste that will be generated]*". *Note, this should be specified for EACH bottle of waste if more than one type of waste will be generated.*
    b. *Further instructions here, if necessary (e.g., using a funnel, carefully decant the supernatant into the waste bottle and recap waste bottle.)*
    c. Store liquid wastes in secondary containment until the bottles are full or they are no longer needed (all samples have been prepared). Store in *[list appropriate area here]*. DO NOT store in a fume hood.
2. Solid wastes
    a. *Specific instructions here, including labeling of bag and storage of bag.*
3. Contact the UAS Health and Safety Office (796-6077) for hazardous waste disposal assistance.

10. Decontamination:

Instructions for decontaminating items (Example: Triple-rinse any non-disposable items with water.)

11. Exposures: Emergency procedures to be followed (from SDS):

Eye contact for any or all chemicals used in these procedures

Symptoms:

List symptoms for each chemical from MSDS.

First aid:

Describe first aid measures for each chemical as they are given in the SDS.

Call a physician. During business hours, call the UAS Health and Safety Office (796-6077) to report an exposure.

Skin contact for any or all chemicals used in these procedures

Symptoms:

List symptoms for each chemical from MSDS.

First aid:

Describe first aid measures for each chemical as they are given in the MSDS.

Call a physician if necessary. Call the UAS Health and Safety Office (796-6077) immediately to report the exposure.

Ingestion for any or all chemicals used in these procedures

Symptoms:

List symptoms for each chemical from MSDS.

First aid:

Describe first aid measures for each chemical as they are given in the MSDS.

Call a physician immediately. Call the UAS Health and Safety Office (796-6077) immediately to report the exposure.

Inhalation

Symptoms:

List symptoms for each chemical from MSDS.

First aid:

Describe first aid measures for each chemical as they are given in the MSDS.

Call a physician immediately. Call the UAS Health and Safety Office (796-6077) immediately to report the exposure.

12. Spills:

May adjust this area to fit particular chemical(s) and circumstances. Here is an example:

In case of a spill outside of the fume hood: evacuate the area. Immediately call the UAS Health and Safety Office (796-6077) or 911 (if serious injury or exposure has occurred) to report the spill and request cleanup assistance.

In case of a spill inside the fume hood:

Do not turn the fume hood off until area is cleaned. Continue to wear gloves, lab coat, and chemical safety goggles. Absorb the spill with gray absorbent pads. Wash the area with water.

Place all pads in plastic bag. Place gloves in bag. Call the UAS Health and Safety Office (796-6077) immediately to report the spill and to request waste pickup. Wash hands and forearms thoroughly after cleaning up the area.

13. Other important information:

N/A

Prepared by: *Name(s) here*

Date: *Date here*

Reviewed/Revised: _____

Appendix 2

RESEARCH LABORATORY SELF-AUDIT CHECKLIST

A. Training

Name	Lab Safety	Haz Waste Mngmt	CHP	Employee Safety	Haz Com	Materials Handling	Benzene	Biosafety Cabinet	Chloroform	Formaldehyde	Methylene chloride	Phenol	Sharps Safety					
1.																		
2.																		
3.																		
4.																		
5.																		
6.																		
7.																		
8.																		
9.																		
10.																		

Required training: Lab Safety, Hazardous Waste Management, Chemical Hygiene Plan, Hazard Communication, Materials Handling, Employee Safety, Fire Extinguisher Awareness (to be developed). Other trainings may be required, depending on lab operations (e.g., Chloroform, Sharps, Formaldehyde). Key: --: training not required; X: training completed; blank: training not completed.

B. Administrative

__Yes __No __N/A Are SDS available in the lab?
__Yes __No __N/A Is there a current Chemical Hygiene Plan (CHP) in the lab?
__Yes __No __N/A Are SDS and the CHP readily accessible and obviously used?
__Yes __No __N/A Are SOPs included in the CHP?
__Yes __No __N/A Is the chemical inventory current (updated within 12 months)?

C. General Safety Concerns

__Yes __No __N/A Are rooms, cabinets, designated areas containing such materials as regulated hazardous substances, radioactive materials, and biohazardous materials, posted with the appropriate warning signs?
__Yes __No __N/A Are all exits and aisles to the outside free from any obstructions?

D. Seismic Safety/Fire Safety

__Yes __No __N/A Is overhead storage minimized and restrained?
__Yes __No __N/A Is overhead storage kept 24” below ceiling?

E. Personal Protective Equipment

__Yes __No __N/A Is the appropriate personal protective equipment required for the lab available?
___ Safety Glasses ___ Goggles ___ Face Shields ___ Gloves
___ Lab Coats/aprons
__Yes __No __N/A If the lab is considered a high-hazard fire area, is an appropriate extinguisher available?
__Yes __No __N/A In high-hazard fire areas, are lab personnel current on fire extinguisher training?

F. Laboratory Equipment

__Yes __No __N/A Is the eyewash readily accessible and free from any obstructions?
__Yes __No __N/A Is the eyewash operated weekly and documented?
__Yes __No __N/A Is the emergency shower readily accessible and free from any obstructions?
__Yes __No __N/A Is the emergency shower operated weekly and documented?
__Yes __No __N/A Has the fumehood been tested within the last year?
__Yes __No __N/A Is storage within the fumehood minimized?
__Yes __No __N/A Is equipment inside the fume hood elevated to permit airflow underneath it?
__Yes __No __N/A Are the biological safety cabinets certified annually?
__Yes __No __N/A Is non-ionizing radiation equipment such as lasers, microwaves, and ultraviolet light sources properly posted and shielded?
__Yes __No __N/A Are vacuum systems that are capable of imploding protected with cages or barriers; are smaller vacuum systems taped?
__Yes __No __N/A Glass dewars are wrapped or shielded?
__Yes __No __N/A Are proper gloves and safety glasses available for use with liquid nitrogen?
__Yes __No __N/A Vacuum pump belt guard is in place?
__Yes __No __N/A Are two-pronged appliances not located within a five foot radius or directly located above a sink or flammable materials?

G. Refrigerators

__Yes __No __N/A Are food and beverages kept out of work areas and out of laboratory refrigerators?
__Yes __No __N/A Is the proper type of refrigerator used i.e., explosion-proof for flammable liquids?
__Yes __No __N/A Are laboratory refrigerators and freezers are marked to prohibit the storage of food or drink?
__Yes __No __N/A The refrigerator/freezer is free of chemical spills or contamination; all containers are labeled, and tightly closed?

H. Compressed Gases

__Yes __No __N/A Are all cylinders properly secured in an upright position?
__Yes __No __N/A Are protective caps in place when the cylinder is not in use?
__Yes __No __N/A Are incompatible cylinders stored separately?
__Yes __No __N/A Are cylinders secured with two straps or chains?
__Yes __No __N/A Are the regulators, connections and supply lines in good condition? Are shatter-resistant supply lines utilized (no hard plastic)?
__Yes __No __N/A Are flash arresters on flammable gas supplies for atomic absorption instruments, in-house propane gas lines, hydrogen and oxy-acetylene torch lines? **I. Hazardous Materials/Wastes**
__Yes __No __N/A Are all chemical and waste containers properly labeled with the chemical name(s) and hazard of the material(s)?
__Yes __No __N/A Are the proper containers obtained and used for storing hazardous waste?
__Yes __No __N/A Are all chemicals color-coded to identify proper storage location?
__Yes __No __N/A Are all chemicals and wastes stored according to hazard classification and compatibility?
__Yes __No __N/A Are all containers of potential peroxide-forming chemicals dated upon receipt and utilized or disposed of within one year?
__Yes __No __N/A Are flammable liquids stored in flammable liquid storage cabinets or in closed metal safety cans whenever possible?
__Yes __No __N/A Are flammable cabinets free of corrosion, spills, and damage?
__Yes __No __N/A Are corrosive cabinets free of corrosion, spills, and damage?
__Yes __No __N/A Is storage of corrosive chemicals above eye level avoided?
__Yes __No __N/A Are all containers kept tightly closed except when adding or removing waste?
__Yes __No __N/A Are liquid waste containers kept in secondary containment tubs?
__Yes __No __N/A Are all "sharps" collected in puncture and leak resistant containers?
__Yes __No __N/A Is broken glass collected in puncture-resistant containers, marked with the words "Broken Glass

Appendix 3

LABORATORY SAFETY TRAINING RECORD

Lab Name

Print this form and keep it with your Chemical Hygiene Plan. This is to certify that the individuals listed below have received Lab Safety training as indicated:

NAME (please print)	Job Title	Indicate training given by date received						
		UAS Lab Safety Training	UAS Hazardous Waste Training	UAS Chemical Hygiene Plan training	Hazard Communi-cation GHS			

Use blank columns to document additional, lab-specific training, such as formaldehyde, methylene chloride, hydrofluoric acid, etc. Add additional pages as necessary.

Appendix 4

CHECKLIST FOR VACATING LABS

PI name: _____ Person(s) completing checklist: _____

Building: _____ Room #: _____ Date lab is to be vacated:_____

When vacating a lab space, please complete this checklist and return to your Chemical Hygiene Officer (CHO). As a courtesy to the next person moving into the lab, outgoing PIs are responsible for ensuring that the following checklist is completed. If you have questions, call the UAS Health and Safety Office at 796-6077 for assistance or if your department does not have a CHO.

- ☐ **Chemicals:** All chemicals and chemical wastes must be removed from the lab.
  - Contact your CHO regarding the following:
    - For assistance in moving chemicals to a new lab space
    - To surplus unwanted chemicals
    - For assistance in arranging for chemical and other hazardous waste to be removed from the lab
  - Contact your CHO if your lab needs to be decontaminated (e.g. if you used ethidium bromide or other toxic chemicals in the lab).

- ☐ **Equipment:** All unwanted equipment (including glassware and other lab supplies) must be removed from the lab. Freestanding chemical storage cabinets (e.g. flammables and corrosives) may remain, as long as they are empty and clean.

- ☐ **Hoods:** Fume hood work surfaces must be free of chemical spills and any paper liners should be removed and disposed of appropriately (e.g. in trash or in chemical waste if contaminated with hazardous chemicals such as ethidium bromide).

- ☐ **Radioactive materials areas:**
  - All labs where radioactive materials were used must be swiped to ensure that the lab is free of radioactive contamination. Please contact the UAS Health and Safety Office prior to moving anything out of the lab, as all potentially contaminated surfaces/items must be tested.
  - If the lab is destined to become an unrestricted space, it must be decommissioned. Please contact the UAS Health and Safety Office for further assistance.

- ☐ **General lab cleanliness:**
  - All lab bench tops, sinks, and shelves should be washed down with soap and water so that they are free of dust and dirt.
  - All trash should be removed from the lab, and floors should be swept and/or mopped.
  - All tape should be removed from walls, doors, drawers, and cabinets.
  - All posters should be removed from walls and doors.

Following completion of this checklist, the lab will be inspected by your CHO, the UAS Health and Safety Office, or departmental head prior to being turned over to either a new occupant or to Facilities Services for renovations and/or painting. The lab will not be released until all of the guidelines listed above have been met. Please ask for assistance if necessary.

For office use only:

Inspected by: _____ Date: _____

Pass: Y N

Notes:

Appendix 5

HAZARDOUS MATERIALS DISPOSAL PROCEDURES

Hazardous materials are defined as those materials that are: flammable, corrosive, air or water reactive or toxic (see **Definitions of Hazardous Materials** below). The UAS Health and Safety Office can provide assistance removing hazardous materials, used and unused, from UAS facilities. Materials removed from laboratories are recycled, made available to others on campus, or disposed of at an EPA-approved facility.

PROCEDURES FOR PROPERLY COLLECTING, STORING, HANDLING AND TRANSPORTING HAZARDOUS MATERIALS:

- Keep all hazardous materials in appropriate closed containers with airtight lids.
- Do not store hazardous materials in a fume hood.
- Keep all hazardous material containers closed at all times except when adding or removing the material.
- Do not mix incompatible chemicals (i.e. oxidizers with flammables).
- Do not mix hazardous materials with non-hazardous materials. It greatly increases waste disposal costs.
- Accurately label all containers with full chemical names, hazards and exact content as well as date of purchase. It is imperative to avoid producing containers whose contents are unknown. Disposal of such materials is very expensive.

PACKAGING REQUIREMENTS FOR ALL HAZARDOUS MATERIALS

- The outside of the containers must be clean and free of chemical contamination.
- Use appropriate containers. All glass containers must be securely packaged to prevent breakage during transport.
- All containers of liquids must have screw lids and must not leak when inverted. Corks, cotton plugs, tape, or parafilm are not acceptable lids for containers of hazardous materials.
- If possible, use the same container for disposal of used material that held the new material originally.
- Metal cans are not acceptable for accumulating hazardous solvents - except for waste oil.
- Loose solid materials must be placed in a sealed container or in a cardboard box lined with two polyethylene bags.
- Containers storing hazardous materials must be kept closed, except when adding or removing contents.

DEFINITIONS OF HAZARDOUS MATERIALS

Hazardous materials are those that "could cause injury or death; or damage or pollute land, air, or water." Hazardous wastes are defined as substances that are ignitable (flammable), corrosive, toxic, explosive, or reactive, (react with air, water, or acids or bases). Specific definitions are found in the Code of Federal Regulations: 40CFR part 261. These are summarized below.

Ignitable: This category contains materials that are easily combustible or flammable. This includes liquids that have a flash point less than 60C (140F), and non-liquids that are capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical change and when ignited burn so vigorously and persistently that they create a hazard, and any ignitable compressed gas described in 40 CFR 173.300. Examples are solvents and spent solvents (acetone, benzene, ethyl acetate, ethyl ether, methanol, methyl isobutyl ketone, xylene); ignitable paint waste (some paint removers, brush cleaners, and stripping agents; epoxy resins and adhesives (epoxies, rubber cements and marine glues); inks containing flammable solvents, and some degreasers. For additional information see 40 CFR 261.21.

Corrosive: This category includes acids and bases or mixtures having a pH less than or equal to 2 or greater than or equal to 12.5, and materials that burn the skin or dissolve metals. Examples are strong mineral acids (chromic, sulfuric, hydrochloric, or nitric) strong alkalis (potassium hydroxide), rust removers, and acid or alkaline cleaning fluids. This category also includes solids that when mixed with water form solutions that are strongly acidic or basic (ferric chloride, sodium hydroxide). For additional information see 40 CFR 261.22

Reactive: This category includes materials that are unstable or undergo rapid or violent chemical reaction when exposed to air, water or other material, generate toxic gases or vapors when mixed with water or when exposed to pH conditions between 2 and 12.5 (as in the case with cyanide or sulfide containing materials), forms potentially explosive mixtures with water, are capable of detonation or explosive reaction when heated or subjected to shock. Examples are acetyl chloride, chromic acid, cyanides, hypochlorides, organic peroxides, perchlorates, permanganates, sulfides, some plating materials and bleaches. For additional information see 40 CFR 261.23

Toxic: This category includes heavy metal compounds such as: arsenic, barium, cadmium, chromium, lead, mercury, silver, selenium, etc. Pesticides such as, Aldrin, arsenic pentoxide, arsenic trioxide, cacodylic acid, chlordane, copper cyanides, DDT, Dieldrin, dimethylcarbamoyl chloride, Endrin, Lindane, pentachlorophenol, strychnine, etc.

Pathogenic, Infectious, and Etiologic agents: Includes any material that can directly cause an infectious disease in humans or animals, including viable microorganisms, toxins, and viruses. Infectious waste includes wastes that may contain bloodborne

pathogens such as hepatitis B virus or Human Immunodeficiency Virus). For more information on infectious agents, contact the UAS Health and Safety Office at 796-6077.

Sharps: Sharps are defined as any non-contaminated sharp object that can penetrate the skin, including, but not limited to: broken capillary tubes and pipettes, blades from power tools, glass microscope slides and cover plates, and hypodermic and non-hypodermic needles.

There may be other hazardous substances that are not described here. It is your responsibility to determine if the materials you use are hazardous to human health or the environment. If you have any doubt contact the UAS Health and Safety Office for assistance.

You can find information about your material by looking at the Safety Data Sheet, available from the manufacturer. Safety Data Sheets for infectious agents are available from Health Canada at: http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/index-eng.php, You should have Safety Data Sheets accessible for all substances utilized in the lab.

Appendix 6

SELECT CARCINOGENS

The following standards apply to substances that are classified as carcinogens or potential carcinogens by the National Toxicity Program (NTP) and listed in OSHA's "13 Carcinogens" (29 CFR 1910.1003). The applicable OSHA standard for the substance is listed next to the substance name.

2-Acetylaminofluorene	29 CFR 1910.1014
Acrylonitrile	§ 1910.1045
4-Aminodiphenyl	§ 1910.1011
Inorganic Arsenic	§ 1910.1018
Asbestos	§ 1910.1001
Benzene	§ 1910.1028
Benzidine	§ 1910.1010
bis-Chloromethyl ether	§ 1910.1008
1,3-Butadiene	§ 1910.1051
Cadmium	§ 1910.1027
Chromium (VI)	§ 1910.1026
Coke oven emissions	§ 1910.1029
1,2-dibromo-3-chloropropane	§ 1910.1044
3,3'-Dichlorobenzidine (and its salts)	§ 1910.1007
4-Dimethylaminoazobenzene	§ 1910.1015
Ethylene oxide	§ 1910.1047
Ethyleneimine	§ 1910.1012
Formaldehyde	§ 1910.1048
Methyl chloromethyl ether	§ 1910.1006
Methylene chloride	§ 1910.1052
Methylenedianiline	§ 1910.1050
alpha-Naphthylamine	§ 1910.1004
beta-Naphthylamine	§ 1910.1009
N-Nitrosodimethylamine	§ 1910.1016
beta-Propiolactone	§ 1910.1013
Vinyl chloride	§ 1910.1017

The following is a PARTIAL list of known or potential carcinogens:

Chemical Name	CAS Number	Category*
2-Acetylaminofluorene	53-96-3	NTPRAHC OSHA 13
Acrylonitrile	107-13-1	IARC 2B;NTPRAHC
Actinomycin D	50-76-0	IARC 3
Adriamycin	23214-928	IARC 2A;NTPRAHC
Aflatoxins	1402-68-2	IARC 1;NTPKHC
2-Aminoanthraquinone	117-79-3	IARC 3; NTPRAHC
o-Aminoazotoluene	97-56-3	IARC 2B
4-Aminobiphenyl (4-aminodiphenyl)	92-67-1	IARC 1;NTPKHC, OSHA 13
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	712-68-5	IARC 2Bs
Amitrole	61-82-5	IARC 2B;NTPRAHC
Ortho-Anisidine	90-04-0	IARC 2B;NTPRAHC
O-Anisidine hydrochloride	134-29-2	NTPRAHC
Aramite®	140-57-8	IARC 2B;NTPRAHC
Arsenic	7440-38-2	IARC 1;NTPKHC
Arsenic compounds	7440-38-2	NTPKHC
Arsenic pentoxide	1303-28-2	IARC 1
Arsenic trioxide	1327-53-3	IARC 1;NTPKHC
Arsenic, inorganic compounds	7440-38-2	IARC 1;NTPKHC
Asbestos (all forms)		IARC 1;NTPKHC
Auramine	492-80-8	IARC 2B
Azaserine	115-02-6	IARC 2B
Azathioprine	446-86-6	IARC 1;NTPKHC
Benzene	71-43-2	IARC 1;NTPKHC
Benzidine	92-87-5	IARC 1;NTPKHC, OSHA 13
Benzo(a)pyrene	50-32-8	IARC 1
Benzo(b)fluoranthene	205-99-2	IARC 2B
Benzotrichloride	98-07-7	NTPRAHC
Benzyl violet	1694-09-3	IARC 2B
Beryllium and compounds	7440-41-7	IARC 1;NTPKHC
Bis-(chloromethyl) ether	542-88-1	IARC 1;NTPKHC, OSHA 13
Bis-chloroethyl nitrosourea	154-93-8	IARC 2A;NTPRAHC
1,4-Butanediol dimethane-sulphonate	55-98-1	IARC 1;NTPKHC
beta-Butyrolactone	3068-88-0	IARC 2B
Cadmium and compounds	7440-43-9	IARC 1;NTPKHC
Carbon tetrachloride	56-23-5	IARC 2B;NTPRAHC
Chlorambucil	305-03-3	IARC 1;NTPKHC
Chloramphenicol	56-75-7	IARC 2A
Alpha-Chlorinated toluenes		IARC 2A
1-(2-Chloroethyl)-3-cyclo-hexyl-1-nitrosourea	13010-47-4	IARC 2A;NTPRAHC
4-Chloro-*o*-phenylenediamine	95-83-0	IARC 2B;NTPRAHC
Chromium hexavalent compounds	1333-82-0	IARC 1;NTPKHC
Cisplatin	15663-27-1	IARC 2A
Citrus red no. 2	6358-53-8	IARC 2B
Creosote(s)	8001-58-9	IARC 2A
para-Cresidine	120-71-8	IARC 2B;NTPRAHC
Cupferron	135-20-6	NTPRAHC
Cycasin	14901-08-7	IARC 2B;
Cyclophosphamide	50-18-0	IARC 1;NTPKHC
Dacarbazine	4342-03-4	IARC 2B;NTPRAHC
Daunomycin	20830-81-3	IARC 2B

Chemical Name	CAS Number	Category*
DDT	50-29-3	IARC 2B;NTPRAHC
N,N'-Diacetylbenzidine	613-35-4	IARC 2B
2,4-Diaminoanisole sulfate	39156-41-7	IARC 2B;NTPRAHC
4,4'-Diaminodiphenyl ether	101-80-4	IARC 2B
2,4-Diaminotoluene	95-80-7	IARC 2B;NTPRAHC
Dibenz(a,h)acridine	226-36-8	IARC 2B;NTPRAHC
Dibenz[a,j]acridine	224-42-0	IARC 2A;NTPRAHC
Dibenz[a,h]anthracene	53-70-3	IARC 2A;NTPRAHC
Dibenzo(a,e)pyrene	192-65-4	IARC 3
Dibenzo[a,h]pyrene	189-64-0	IARC 2B;NTPRAHC
Dibenzo([a,i]pyrene	189-55-9	IARC 2B;NTPRAHC
Dibenzo[q,i]pyrene	189-55-9	IARC 2B;NTPRAHC
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	IARC 2B;NTPRAHC
3,3'-Dichlorobenzidine	91-94-1	IARC 2B;NTPRAHC, OSHA 13
3,3'-Dichloro-4,4'-diaminodiphenyl ether	28434-86-8	IARC 2B
Diethyl sulfate	64-67-5	IARC 2A;NTPRAHC
Diethylstilbestrol	56-53-1	IARC 1;NTPKHC
Dihydrosafrole	94-58-6	IARC 2B
3,3'-Dimethoxybenzidine	119-90-4	IARC 2B;NTPRAHC
trans-2((Dimethylamino)methylimino)5-(2-(5-nitro-2-furyl)vinyl)-1,3,4-oxadiazole	25962-77-0	IARC 2B
1,1-Dimethylhydrazine (UDMH)	57-14-7	IARC 2B;NTPRAHC
Dimethyl sulfate	77-78-1	IARC 2A;NTPRAHC
Para-Dimethylaminoazobenzene	60-11-7	IARC 2B;NTPRAHC, OSHA 13
Dimethylcarbamoyl chloride	79-44-7	IARC 2A;NTPRAHC
1,4-Dioxane	123-91-1	IARC 2B;NTPRAHC
Estrone	53-16-7	IARC 1;NTPKHC
Ethyl methanesulfonate (EMS)	62-50-0	IARC 2B
Ethylene dibromide (EDB)	106-93-4	IARC 2A;NTPRAHC
Ethylenethiourea	96-45-7	IARC 3;NTPRAHC
Ethyleneimine	15-15-64	OSHA 13
Formaldehyde	50-00-0	IARC 1;NTPKHC
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole	3570-75-0	IARC 2B
Glycidylaldehyde	765-34-4	IARC 2B
Hexachlorobenzene	118-74-1	IARC 2B;NTPRAHC
Hexamethylphosphoramide	680-31-9	IARC 2B;NTPRAHC
Hydrazine, sulfate (1:1)	10034-93-2	NTPRAHC
Lasiocarpine	303-34-4	IARC 2B
Lead acetate	301-04-2	NTPRAHC
Lead chromate(VI) oxide	18454-12-1	IARC 2B;NTPKHC
Lindane, and mixed isomers	58-89-9	NTPRAHC
Melphalan	148-82-3	IARC 1;NTPKHC
Merphalan	531-76-0	IARC 2B
Mestranol	72-33-3	IARC 2B;NTPKHC
Methyl chloromethyl ether	107-30-2	OSHA 13
4,4'-Methylenebis-(2-chloroaniline)	101-14-4	IARC 1;NTPRAHC
4,4'-Methylene bis(N,N-dimethyl)benzeneamine	101-61-1	NTPRAHC
4,4'-Methylene bis (2-methylaniline	838-88-0	IARC 2B
Methylenedianiline	101-77-9	IARC 2B;NTPRAHC
Methylenedianiline dihydro-chloride	13552-44-8	NTPRAHC

Chemical Name	CAS Number	Category*
Methyl iodide	74-88-4	IARC 3;
Methyl methanesulfonate (MMS)	66-27-3	IARC 2A
Methylnitroanthraquinone	129-15-7	IARC 2B
Methylnitronitrosoguanidine	70-25-7	IARC 2A
Methylazoxymethanol acetate	592-62-1	IARC 2B
Methylthiouracil	56-04-2	IARC 2B
Metronidazole	443-48-1	IARC 2B;NTPRAHC
Michler's ketone	90-94-8	IARC 2B;NTPRAHC
Mirex	2385-85-5	IARC 2B;NTPRAHC
Mitomycin C	50-07-7	IARC 2B
Monocrotaline	315-22-0	IARC 2B
Mustard gas (Sulfur mustard)	505-60-2	IARC 1;NTPKHC
1-Naphthylamine (alpha-naphthylamine)	134-32-7	IARC 3;OSHA 13
2-Naphthylamine (beta-Naphthylamine)	91-59-8	IARC 1;NTPKHC, OSHA 13
5-Nitroacenaphthene	602-87-9	IARC 2B
4-Nitrobiphenyl	92-93-3	IARC 3;OSHA 13
5-Nitro-*ortho*-anisidine	99-59-2	IARC 3;NTPRAHC
N-Nitrosodimethylamine	62-75-9	IARC 2A;OSHA 13
beta-Propiolactone	57-57-8	IARC 2B;OSHA 13

*Notes on categories:

IARC International Agency for Research on Cancer

Group 1 The agent (mixture) is carcinogenic to humans. The exposure circumstances entail exposures that are carcinogenic to humans.

Group 2A The agent (mixture) is *probably* carcinogenic to humans. The exposure circumstance entails exposures that are probably carcinogenic to humans.

Group 2B The agent (mixture) is *possibly* carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans.

Group 3 The agent (mixture or exposure circumstances) is unclassifiable as to carcinogenicity in humans.

Group 4 The agent (mixture, exposure circumstance) is probably not carcinogenic to humans.

NTP National Toxicology Program

RAHC Reasonably Anticipated To Be Human Carcinogen

KHC Known To Be Human Carcinogen

OSHA - Occupational Safety and Health Administration

13 OSHA Regulated carcinogens

Appendix 7

LABORATORY EMERGENCY PROCEDURES DURING POWER OUTAGES

It is important to remember that some equipment cannot be turned off and certain other pieces of equipment do not shut themselves off when there is a power outage. Plan specific procedures for your laboratory while adhering to the following:

- Fully close chemical fume hood sashes. No work is allowed in fume hoods during a power outage.
- Ensure that all chemical containers are secured with caps, parafilm, etc. and returned to their proper storage location.
- All non-essential electrical devices should be turned off, especially computers, printers, and other devices with sensitive circuitry (including autoclaves and laminar flow hoods).
- Keep the doors of refrigerators and freezers closed.
- Ensure that no flammable chemicals are stored in domestic refrigerators and freezers. When the power returns to these appliances, a reaction may be ignited by the refrigerator light or other electrical source.
- Check to ensure that lasers, radio frequency generators, etc. have been turned off.
- Turn off all gas cylinders at the tank valves.
- If a low flow of an inert gas is being used to blanket a reactive compound or mixture, it may be appropriate to leave the flow of gas on. The decision to do this should be part of the written Standard Operating Procedure specific for each lab in Appendix 1.
- Check all cryogenic vacuum traps (N_2, CO_2 and solvent). The evaporation of trapped materials may cause dangerous conditions.
- Check all pressure, temperature, air, or moisture sensitive materials and equipment. This includes vacuum work, distillations, glove boxes used for airless or moistureless reactions, etc.

Appendix 8

INTERNATIONAL BUILDING AND FIRE CODE FOR STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

CLASS	IA	IB	IC	II	IIIA
FLASH POINT	<73°F	<73°F	73° – 100°F	100° - 140°F	140°-200°F
BOILING POINT	<100°F	> 100°F			
FLAMMABILITY POTENTIAL	Extremely High	Very High	High	Moderate	Moderate
EXAMPLES OF COMMONLY USED MATERIALS	acetaldehyde ethyl ether pentane	acetone ethanol butylamine gasoline methanol isopropanol	amyl acetate butanol chlorobenzene turpentine xylene	formaldehyde hydrazine	aniline glycol glycerine kerosene nitrobenzene
NFPA 704 HAZARD RATINGS*	4	4	3	2	2
MAXIMUM CONTAINER SIZE					
Glass	1 pint** (500 ml)	1 quart** (1 liter)	1 gallon (4 liters)	1 gallon (4 liters)	1 gallon (4 liters)
Metal--other than DOT drums or approved plastic	1 gallon	2 gallons	2 gallons	2 gallons	2 gallons
Safety cans	2 gallons	2 gallons	2 gallons	2 gallons	2 gallons
DOT metal drums	N/A	5 gallons	5 gallons	60 gallons	2 gallons
Polyethylene (DOT Spec. 34 or as authorized by DOT Exemption	1 gallon	2 gallons	2 gallons	2 gallons	2 gallons

*National Fire Protection Association. NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials for Emergency Response*, provides planning guidance to fire departments for safe tactical procedures in emergency operations. The Hazard Identification System is not intended to identify the nonemergency health hazards of chemicals.

** Exception: Class IA and Class IB flammable liquids may be stored in glass containers of not more than one-gallon capacity if the required liquid purity (e.g., ACS analytical reagent grade or higher) would be affected by storage in metal containers or if the liquid would cause excessive corrosion of the metal container.

STORAGE REQUIREMENTS

1. Flammable and/or combustible liquids stored in the open in a laboratory work area or inside any building shall be kept to the minimum necessary for the work being done.
2. Maximum quantity permitted in labs and other areas of use is limited to a total of 10 gallons, all classifications combined, outside of a flammable storage cabinet or approved flammable storage room. Please refer to the table above.
3. Quantities stored in flammable storage cabinets shall be limited to 60 gallons of class I, II or III liquids and the total of all liquids shall not exceed 120 gallons. Please refer to the table above for maximum allowable container size for each class. Not more than three cabinets shall be located in the same room.
4. Quantities exceeding the above must be stored in an approved flammable storage room meeting the requirements of the Uniform Building and Fire Codes.
5. Flammable and combustible liquids shall not be stored near exit doorways, stairways, in exit corridors, or in a location that would impede egress from the building.
6. Flammable aerosols and unstable liquids shall be treated as class I-A liquids. Please refer to the table above.
7. Materials which will react with water or other liquids to produce a hazard shall be segregated from flammable and/or combustible liquids.

HANDLING AND DISPENSING

1. Class I liquids shall not be transferred from one vessel to another in any exit passageway.
2. Transfer of flammable liquids from 5 gallon containers (or less) to smaller containers shall be done in a laboratory fume hood or in an approved flammable liquid storage room.