CHEMICAL HYGIENE PLAN
2009-2010

Purpose
Federal Occupational Safety & Health Administration (OSHA) regulations require employers who operate laboratories, where personnel may be exposed to various health and physical hazards, to develop and implement a written Chemical Hygiene Plan (CHP) to minimize the risks of such exposures. This plan is intended to provide the Hamilton College community with the guidance necessary to comply with OSHA requirements.

Authority
These procedures are based upon requirements of federal law, generally recognized best EHS management practices, and/or criteria established by the National Institute of Occupational Safety and Health (NIOSH).

Objectives
- To protect the health and welfare of Hamilton College employees, and the greater Hamilton College community;
- To provide employees with the necessary information and guidance concerning laboratory activities, by addressing the unique exposure conditions under which laboratory work is performed;
- To protect laboratory workers from adverse health effects that may result from their work in laboratories, regardless of what substances are used; and
- To comply with Title 29, Part 1910.1450 of the Code of Federal Regulations (CFR), otherwise known as the Laboratory Safety Standard (LSS)—click HERE to go directly to the standard.

Applicability
This plan applies to all Hamilton College employees, including faculty, staff and administrators, work-study students and research personnel, where the following laboratory conditions exist:
- Chemical manipulations are carried out on a "laboratory-scale".
- Multiple chemical procedures or chemicals are used.
- The procedures involved are not part of a production process, nor in any way simulate a production process.
- "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Exemptions
While students in an academic laboratory are not technically considered laboratory employees, the rules/requirements/procedures outlined herein shall be an integral part of the academic learning and research environment at Hamilton to provide for the protection of all laboratory personnel.

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SECTION 1
RESPONSIBILITIES

1. Director of Environmental Protection, Safety & Sustainability (EPS&S)

The Director of EPS&S shall:

- Routinely review the CHP and make modifications as required;
- Provide technical assistance to Departmental Chemical Hygiene Officers, laboratory supervisors and workers concerning appropriate storage, handling and disposal of hazardous chemicals;
- Provide general laboratory safety training for Chemical Hygiene Officers, laboratory supervisors, faculty members and lab workers as needed;
- Conduct exposure assessments and laboratory audits as needed;
- Provide technical assistance concerning personal protective equipment and laboratory safety equipment; and
- Maintain a comprehensive MSDS library across all laboratory units at the college.

2. Science Stockroom & Facility Coordinator

The Science Stockroom & Facility Coordinator shall:

- Assist Science faculty and DCHO's with the timely procurement, storage and dispensing of necessary chemical and/or dry goods materials to support ongoing teaching/research activities;
- Secure all chemical supplies within the confines of the stockroom until they have been dispensed or delivered to an authorized user;
- Work with the Director of EPS&S and the DCHO's to routinely survey facility lab activities;
- Work with the Physical Plant to address facility deficiencies as needed.

3. Department Chairpersons

Each science department chairperson shall:

- Support the implementation of the CHP throughout his/her department;
- Assist the departmental Chemical Hygiene Officer in maintaining awareness and compliance with the CHP; and
- Provide for departmental health and safety equipment as needed.

4. Departmental Chemical Hygiene Officers

The Departmental Chemical Hygiene Officers (DCHOs) shall:

- Ensure that the elements of the CHP are implemented into their respective departments;
- Coordinate all technical matters concerning the appropriate storage, handling and disposal of hazardous chemicals, with the assistance of the Director of EPS&S;
- Provide and/or coordinate all department-specific laboratory safety training for those individuals utilizing laboratory facilities within their department;
- Coordinate all technical matters concerning personal protective equipment and laboratory safety equipment within their department, with the assistance of the Director of EPS&S;
- Conduct internal inspections of the laboratories within their department, with the assistance of laboratory supervisors and faculty members; and
- Maintain a department-specific MSDS library for all chemicals utilized in their laboratories.

5. Laboratory Supervisors

A laboratory supervisor is anyone authorizing and overseeing any type of laboratory work, including faculty, administrators, and staff. No one is exempt from the appropriate safety precautions. Lab supervisors must serve as good role models for their technical staff and students by observing all safety

rules and recommendations, wearing protective equipment, and being enthusiastic about safety.
Laboratory supervisors are primarily responsible for the implementation of the CHP, and shall:

- Inform and train all lab workers concerning chemical safety as required by this Chemical Hygiene Plan;
- Ensure that untrained workers (or students) are not permitted to work unsupervised with hazardous chemicals or certain pieces of equipment;
- Implement and enforce rules and standards concerning health and safety for laboratories under the supervisor's/faculty member's jurisdiction;
- Ensure the availability, and enforce the use, of the appropriate personal protective equipment;
- Remain cognizant of chemicals stored and used in labs, and their associated hazards;
- Conduct internal inspections of their laboratories with the departmental Chemical Hygiene Officer to identify and address health and safety concerns; and
- Request the allocation of funds for health and safety improvements as needed or identified.

6. Laboratory Workers

Laboratory workers, including any work-study or research students employed by the college, shall:

- Follow all health and safety standards and rules;
- Report all hazardous conditions to laboratory supervisors;
- Wear or use any prescribed personal protective equipment;
- Report any job-related injuries or illnesses to the laboratory supervisor;
- Refrain from the operation of any equipment or instrumentation without proper instruction and/or authorization;
- Remain aware of the hazards of the chemicals in the lab and how to handle hazardous chemicals safely; and
- Request information and training when unsure how to handle a hazardous chemical, or safely utilize laboratory instrumentation.

SECTION 2
STANDARD OPERATING PROCEDURES

Universal lab safety SOP's are those generated to establish a minimum set of guidelines required for Hamilton College Science laboratories. Departmental SOP's are those generated at the departmental level to specifically implement Universal SOP's, usually in the context of a Department EH&S Handbook, or to address other hazards exclusive to that department.

1. Universal Laboratory Safety SOP's

General Considerations

- Respect and understand the safety and health hazards associated with the chemicals and equipment in your laboratory at all times.
- Adhere to the prescribed laboratory equipment instructions at all times, and use equipment only for its desired purpose.
- Know the chemical and physical hazards associated with the chemicals in use before using.
- Become thoroughly acquainted with the location and use of safety equipment such as safety showers, fire blankets, eyewash fountains, fire extinguisher, and emergency exits.
- Know the safety rules and procedures that apply to the work being done, and determine the potential hazards and precautions before undertaking any operation.
- Be alert to any unsafe conditions and work practices, and if present, call attention to them immediately, such that appropriate action can be taken to remedy the condition or practice.
- Horseplay, practical jokes, or other behavior which might confuse, startle, or distract other workers in the laboratory is forbidden.
- Be certain all chemicals are correctly and clearly labeled, and post warning signs when unusual hazards, such as radiation, laser, use of carcinogens, or highly toxic chemicals exist.

Personal Protective Equipment (PPE)

As a general rule, individual lab supervisors (i.e. authorized employees as defined below) are responsible for making the appropriate hazard determination on a lab-by-lab or experiment-by-experiment basis, so as to determine the type, variety and assortment of PPE that lab users must wear while engaged in lab work. Appendix M below may help to facilitate that process. Other general considerations are as follows:

- General attire—high heeled, open-top or flip-flop shoes, or shorts, mini-skirts and tank tops, should be generally discouraged in all lab environments, and are forbidden in labs actively engaging in wet chemistry. Long/loose hair should be constrained, and any dangling or loose jewelry should be removed.
- Eye protection—suitable eye protection using ANSI approved safety glasses or goggles is required at all times for personnel working with hazardous chemicals or equipment, or as otherwise required by laboratory supervisors and/or their departments. While safety glasses may be acceptable for use during minor chemical manipulations or during observational activities, safety goggles are the eye protection devices of choice when personnel use corrosive or other more toxic/poisonous materials, or are exposed to actual chemical splash hazards. Face shields should be worn in addition to approved safety glasses or goggles when conducting experiments which may result in violent chemical reactions or splashes, which might also affect the face/neck.
- Hand protection—the proper selection of suitable hand protection must take into account the properties of the chemical being used, the nature and severity of the potential exposure, the duration of protection required, the physical performance required, and the length of the glove required. See the glove selection charts in Appendix L for additional information.

- Lab coats/splash aprons—in situations where incidental drips/drops/splashes of various hazardous chemicals represent a potential hazard to exposed skin along the arms as well as an individual's personal clothing, the additional protections afforded by lab coats are required. Chemical splash aprons should be used in addition to lab coats whenever regular/routine splash hazards exist.

Other Safety/Emergency Equipment

- Teaching labs using wet chemistry will have the following:
    - An ABC dry chemical fire extinguisher, fire blanket, stocked first aid kit, emergency shower and eyewash/drench hose, spill kit, emergency call box, emergency gas valve shut offs, and emergency power shut offs..
- Research and prep labs using wet chemistry will have the following:
    - A stocked first aid kit, emergency shower and eyewash/drench hose, and spill kit.
- Other labs with physical/equipment hazards only will have the type and variety of safety equipment/devices necessary to safeguard the workstation, i.e. adequate ventilation for mechanical grinding equipment, required curtains/signage to control laser beams, etc.

Safe Work Practices

- Personal hygiene—hands should be washed frequently during the use of laboratory facilities, before leaving the lab, after contact with any hazardous material, and before eating, drinking or smoking.
- Glove use/etiquette—protective gloves worn inside the laboratory should not be worn outside of it so as to minimize the cross-contamination of objects expected to be "clean" (i.e. door handles, telephones, etc.). For similar reasons, personnel should routinely remove contaminated gloves in the lab if they must contact items that will be removed from it (i.e. lab notebooks, laptops, etc.).
- Chemical transportation—when moving/transporting chemical (or like biological) materials from the main Science Stockroom to individual labs, or from one lab to another using main hallways or elevators, personnel should make use of carts or totes to minimize the chance of a spill.
- Foodstuffs—do not prepare, store or consume foodstuffs or beverages inside laboratories or otherwise undesignated areas, and do not store consumable foodstuffs or beverages inside lab refrigerators.
- Pipetting—mouth pipetting or otherwise using the mouth to siphon is strictly prohibited.
- Cosmetics—cosmetics should not be applied within laboratories.

Housekeeping

- Laboratory work areas should be maintained in a clean and neat manner at all times.
- Work areas should be kept clean and free from obstructions, and aisle ways should be kept free of chairs, boxes, equipment, and waste receptacles.
- Lab benches and floors should be cleaned regularly and kept free of clutter.
- Access to emergency equipment, exits, control panels, etc. must be kept clear at all times.
- Spilled chemicals shall be cleaned up immediately and disposed of properly.

Fume Hood Usage

- Just like any lab workstation, hoods must be maintained in a clean and neat manner.
- The use of ventilated hood benchtop space to store chemicals (>10 containers) is inadvisable as hoods used for these purpose are less effective engineering controls for personnel safety.
- Hood sashes are to be closed except when personnel are actively using the hood.
- Electrical cords are not to be used under the sash—they should make use of the side penetrations to the hood.

Unattended Operations

Reactions that are left to run unattended overnight or at other times are inherently dangerous, and can be problematic in the event of electric/gas/water service interruptions. Unattended operations should be:

- Checked at some predetermined regular interval.
- Established such that vital equipment (power stirrers, hot plates, heating mantles, and water condensers) will not run unattended without fail-safe provisions.
- Set up with the appropriate signs posted, indicating that a laboratory operation is in progress.
- If continuous running water is needed, precautions should be taken to ensure that hoses are adequately clamped, and that only those hoods that have been modified with notched cup sinks and caulked edges (to minimize the effects of leaking water upon other labs or the facility itself) are used.

Laboratory Use Procedures

- Pertinent Definitions:
    - Authorized personnel—faculty and/or administrators with supervisory or management control over activities in a lab (i.e. a faculty members or administrators in their assigned research/teaching/prep lab);
    - Qualified personnel—faculty/administrators/staff given rights to work in certain lab areas that they do not primarily manage (i.e. a faculty member using another faculty member's research/teaching lab)—this could include limited supervisory responsibilities;
    - Restricted personnel—students who execute work under the supervision of an authorized or qualified individual, and who are either paid in some capacity (work-study, teaching assistants, research students), or who are performing senior-thesis lab activities—in either case, these students may be given additional privileges to access lab areas based upon criteria established by authorized/qualified personnel who can attest to the student's capabilities to work safely and responsibly in a lab setting;
    - Students—any student conducting lab work in a capacity where they are not paid, or they are not conducting senior thesis lab activities.
- Most labs (based upon the presence of hazardous chemicals, dangerous equipment, and certain animals) are inherently dangerous by their very nature, and as such, working alone is inadvisable and strongly discouraged. Authorized personnel and their Departments shall use their EHS Handbooks to define which labs, if any, are not a wholly hazardous work setting by their set up and use (i.e. teaching labs with limited, isolated, or no inherent hazards).
- College labs are only to be used for sanctioned or recognized experiments in the furtherance of teaching/research activities, and are not to be used for any activity outside of the purview of the college (privately funded or production-type work).
- All authorized, qualified and restricted personnel must be trained in accordance with this Chemical Hygiene Plan before they may work in a lab, or supervise other personnel in the lab where applicable.
- Authorized and qualified personnel may work in a lab alone and unsupervised as long as they have been properly trained. Qualified personnel are restricted from engaging in lab activities that are not approved by the lab's principal authorized personnel, who is/are ultimately responsible for all activities in his/her lab.
- Restricted personnel (during normal working hours) may work with hazardous chemicals, dangerous equipment or certain animals as long as they do so under the supervisory direction of authorized personnel. "Supervisory direction by authorized personnel" means that the faculty member or administrator (or in some cases qualified personnel acting in a supervisory capacity on behalf of the authorized individual) is either in the lab directly overseeing the lab work, or he/she is within a reasonable distance of the lab work (like in a nearby lab or an office on the same floor). In the event authorized/qualified personnel are not able to perform such direct supervisory functions, restricted

personnel must either no longer engage in hazardous lab work, or the supervisory functions may be assigned to other authorized personnel. For this to be permissible, the following must occur:
    - The authorized/qualified personnel must be knowledgeable with the activity/task they are being asked to supervise;
    - They must be on-site, willing to assist, and acknowledge the additional supervisory responsibilities; and
    - The supervisory change must be communicated to the restricted personnel.
- Restricted personnel may work unsupervised (outside of normal working hours) in a lab setting only if they are engaging in observational or other non-hazardous activities which do not involve the use/handling of hazardous chemicals, dangerous equipment, and certain animals. It is expressly up to the authorized supervisor to determine the approved non-hazardous activities. Additionally, restricted personnel working in such a capacity (again, outside of normal working hours) must work under the buddy-system, or by another means that will achieve the same goal (using certain camera technologies, frequent contact with Campus Safety, building monitor, etc.).
- Students (in addition to any other visitors or unapproved personnel not directly affiliated with the college) are forbidden from working alone and/or unsupervised in a hazardous lab setting.

Chemical Storage
- Chemical storage in teaching/research/prep labs should be minimized to the greatest extent possible, and should be sufficient to supply the labs for on-going or up-coming experimentation or demonstration only (see Appendix A below).
- The storage of flammable or corrosive chemicals in teaching/research/prep labs should never surpass the capacities provided by staged lab cabinetry and hoods, and no more than 5 gallons of flammable liquids "in use" may be located outside of a hood or cabinet at any time.
- Chemical storage in bulk supplies, or the storage of chemical species which are used on a very infrequent/intermittent basis, should make use of the main Science Stockroom.
- The Science Stockroom serves as a place to store consumable chemicals and goods, and segregates chemicals by both hazard class and accessibility:
    - Flammable/combustible liquids (except ethanol), water reactives, flammable solids—full faculty access;
    - Common organics/inorganics, corrosives, oxidizers—full faculty access;
    - Gases (flammable, non-flammable, inert, empty cylinders)—full faculty access;
    - Special hazards (acutely toxic/hazardous chemicals, refrigerated/frozen chemicals, syringes)—restricted area, limited access only.

Peroxide-Forming Chemicals
- Certain chemicals are known to produce dangerous peroxides upon exposure to air or light. These may detonate with extreme violence when concentrated by evaporation or distillation, when combined with other compounds, or when disturbed by unusual heat, shock or friction.
- Examples of peroxide-forming chemicals include those identified in Appendix B below.
- Containers of peroxide-forming chemicals shall be dated upon receipt and opening, and disposed of in accordance with Appendix B and/or before its expiration date.
- Alternatively, peroxide-forming chemicals may be periodically tested with peroxide testing strips, to determine their usability status.

Compressed Gases/Cylinders
Cylinders of compressed gas present a wide variety of chemical and physical hazard, dependent upon species, application and ventilation (or lack thereof). Consider the following:

- Freestanding compressed gas cylinders must be strapped or chained securely to a wall or bench top, and capped when in storage or not in active use.
- Flammable compressed gases must be stored away from heat, oxygen, and ignition sources when not in use.
- Lecture-size compressed gases are strongly discouraged because they are very cost-prohibitive when being disposed of. When they are required, they must be secured in a fashion that prevents dropping, i.e. by using a lecture bottle stand, and shall be segregated during storage into the following categories:
    - Toxic gases;
    - Flammable gases; and
    - Oxidizing and inert gases.
- The appropriate regulator will be used, and cylinders should not be bled completely empty.
- Identification labels must never be removed from compressed gas cylinders.
- Compressed gas cylinders will be transported using carts specifically designed for this purpose, and can be borrowed from the Science Stockroom.

Cryogenic Materials

Cryogenic materials are defined as a liquid with a normal boiling point below -150°C (-240°F). The most common cryogen used is liquid nitrogen, but other commonly available cryogens include helium, hydrogen, argon, and oxygen. Cryogens present many hazards dependent upon the species and application, as follows:

- Extreme cold hazard: Cryogenic liquids and their vapors can rapidly freeze human tissue. Brief exposures that would not affect skin on the face or hands can damage delicate eye tissue. Unprotected skin can stick to metal that is cooled by cryogenic liquids and can tear when pulled away. Cryogenic liquids can cause common materials such as rubber/plastics to become brittle and break under stress.
- Asphyxiation hazard: All cryogenic liquids produce large volumes of gas when they vaporize. For example, one volume of liquid nitrogen vaporizes to 694 volumes of nitrogen gas at 20°C (68°F), which can displace oxygen below the normal 21% level. When there is an insufficient amount of oxygen in air, symptoms of asphyxia will develop, and death can occur very quickly. As most cryogenic liquids are odorless, colorless, and tasteless when vaporized into the gaseous state, the release of too great of volume of a cryogenic liquid to the air is life-threatening. Those using or dispensing cryogenic liquids must be trained to understand the built-in warning properties of cryogen cylinders as they routinely "boil-off", resulting in ice buildup around cylinder controls. If a cryogen cylinder is "boiling-off" and creating a highly visible fog, leave the area immediately and sound an emergency alarm.
- Explosion Due to Rapid Expansion: Cryogenic liquids cannot be indefinitely maintained in the liquid state. If they are vaporized in a sealed container, they can produce enormous pressures that could rupture the container. For this reason, pressure relief devices are utilized on equipment and storage containers.
- Safe work methods to follow when working with cryogenic liquids include the following:
    - *Wear suitable clothing:* Close-toed shoes, long pants (without cuffs), and long sleeved shirts are the recommended attire when handling cryogens.
    - *Leave the jewelry at home:* No metal jewelry (rings, watches, bracelets, etc.) should be worn on hands or wrists while transferring cryogenic liquids.
    - *Wear suitable PPE:* Since the eyes are very sensitive to extreme cold, the recommended PPE for handling cryogens includes a full-face shield over safety glasses. Loose-fitting (so that they can be easily removed, if need be) thermal insulated or leather gloves shall also be worn.
    - *Use appropriate storage containers:* Cryogenic liquids must be handled, stored, and used only in containers or systems designed to handle such materials.

- *Transfer liquids carefully:* Transfer operations involving cryogenic containers must be done slowly (to minimize boiling and splashing), while wearing the proper PPE. Care must be taken to avoid contact with non-insulated pipes and system components.
- *Use tongs:* Use tongs to immerse and remove objects from cryogenic liquids, as objects that are pliable at room temperature (e.g., rubber or plastics) are easily broken because they turn brittle at low temperatures.

Nanoparticles

Nanoparticles are particles that have at least one dimension between 1-100 nanometers, are typically classified based on their morphology (e.g., fullerenes, nanotubes, nanowires, and quantum dots), and can be spheres, rods, tubes, or other geometric shapes. In research, nanoparticles may be bound to surfaces or substrates, put into solution or suspension, attached to a polymer, or handled as a dry powder. At present, very limited information is available on the toxicity of many nanoparticles. It is believed that some engineered nanoparticles may present health effects following exposure because of the unique properties associated with the particles which make them able to penetrate deep into lungs and to translocate to other organs. Because of this limited data, it is prudent to assume that nanoparticles may be toxic and to avoid exposure when working with them in the laboratory. The four common routes of exposure to consider when working with these materials are skin absorption, ingestion, inhalation, and injection. Safe work methods to follow when working with nanoparticles include the following:

- Pre-planning: All personnel participating in lab work with nanoscale materials should be briefed on the potential hazards and handling techniques for nanoparticles, and review the applicable MSDS information.
- Wear appropriate PPE/lab attire: Double gloving with nitrile gloves is recommended; safety glasses or safety goggles and a lab coat shall be worn; closed-toed shoes, long pants and tops that provide good coverage shall be worn..
- Use good chemical hygiene practices: Eating and drinking are not allowed in labs where chemicals and nanoparticles are used.
- Minimize airborne release of engineered nanoparticles to the environment: Nanoparticles are to be handled in solutions, or attached to substrates so that dry material is not released. Where this is not possible, nanoscale materials should be handled with engineering controls such as a HEPA-filtered local capture hood or glove box. If neither is available, work should be performed inside a laboratory fume hood.
- Practice good laboratory housekeeping: Areas where nanoparticles are prepared and/or administered should be cleaned and decontaminated immediately following each task. Bench tops, fume hood surfaces, and equipment should be routinely cleaned. The use of bench paper is recommended for preventing the contamination of work surfaces.
- Dispose of sharps properly: Needles used for nanoparticle injection shall be disposed of in approved sharps containers immediately following use.
- Attend to spills immediately: Laboratory personnel must don appropriate PPE prior to attempting to manage any spill involving hazardous agents. Small spills (less than 5 mg or 5 mL of nanoparticle-containing material) should be wet-wiped with towels that are dampened with soapy water. Affected surfaces should be wet-wiped three times, with a clean, damp towel used for each wipe-down. All materials utilized in the clean-up must be disposed of as hazardous waste. Alternatively, the contaminated area can be vacuumed with a HEPA-filtered vacuum. For assistance in cleaning up larger spills, contact Brian Hansen (x4647) or Mary Collis (x4914).
- Manage waste properly: Dispose of and transport waste nanoparticles in solution according to the hazardous waste procedures for the solvent. All waste engineered nanoparticles shall be treated as unwanted hazardous toxic material unless the material is known to be non-hazardous.

Use of Radioactive Materials and Radiation-Generating Equipment

- All employees using radiation sources are expected to be familiar with the radiation safety requirements set forth in the Hamilton College Radiation Safety Manual and to conduct their operations according to them and the College EHS program.

Radioisotopes

- Use of radioactive materials in the department is defined by the terms and conditions specified in the New York State Department of Health License No. 589 issued to Hamilton College. The Hamilton College Radiation Safety Manual should be consulted for details of the Radiation Safety Program.
- Prior to initiating work with radioactive materials, and prior to purchasing radioactive materials, an application must be submitted to the College Radiation Safety Officer (RSO) for review and approval by the College Radiation Safety Committee.
- Students, including student employees, may not use radioactive materials except under direct supervision of a faculty member who is an "authorized user" of radioactive materials.
- Other employees (technicians), sponsored by and with written permission of a faculty "authorized user" to whom they have demonstrated competence to work with radioactive materials, may use radioactive materials only after application is submitted in writing to, and approved by, the Radiation Safety Committee. This application must be initiated by the supervising authorized user.
- Use of radioactive materials is restricted to SC Rooms 2055 and 2056, or as otherwise indicated on the College's license. Areas where radioactive materials are stored or used must be marked by the magenta tri-foil on yellow background.

Radiation-Generating Equipment

- All radiation-generating equipment must be registered with the New York State Department of Health, and signage indicating the presence of a radiation hazard must be placed directly on the equipment itself. Prior to initiating work with radiation-generating equipment and prior to purchasing radiation-generating equipment, an application must be submitted to the College Radiation Safety Officer (RSO) for review and approval by the College Radiation Safety Committee.
- Use of this equipment is determined by the faculty member who has direct control of the equipment. Use of the equipment by students, student employees or other personnel is permitted only by permission of the equipment supervisor and after appropriate training.

Hazard Communication

- All labs that contain hazardous chemicals and/or dangerous equipment will have the appropriate facility signage external to the room so as to communicate inherent risks to all building employees, students, visitors and emergency personnel.
- All Science departments and the Science Stockroom must maintain chemical product inventories that are specific to the lab/room where the chemicals are in use or stored.
- Chemical safety information will be made available to every employee and student using hazardous chemicals via access to both MSDS sheets and to the Chemwatch database.
- Lab supervisors requiring/authorizing lab personnel to use Particularly Hazardous Substances (or other acutely toxic/dangerous/carcinogenic chemicals) shall take any additional chemical-specific training measures to ensure those personnel are instructed appropriately, as outlined in Section 6 and Appendix G & H below.
- Container labels on incoming hazardous chemicals will not be defaced, and bulk chemicals dispensed into containers 100 mL or greater for distribution will be appropriately marked with a Hazcom label. Containers smaller than 100 mL, or any vials, beakers, test tubes, beakers, etc., that hold chemicals for ongoing experimentation will be otherwise marked so as to clearly identify the container's contents.

Waste Stream Management

Laboratory supervisors are responsible for knowing whether or not the waste streams they generate are regulated, or for making that determination with the assistance of the Director of EPS&S **before** the wastes are generated. The quick procedures below should be used as a reference—for further guidance, consult the Waste Management & Minimization Plan.

Hazardous Waste

- Hazardous wastes are the result of discarded or inherently waste-like by-products of certain characteristically or listed chemical wastes.
- Hazardous waste must be collected in a suitable container that is no greater than 4 Liters in volume, and shall be kept closed except when being filled.
- Hazardous waste containers must be labeled with the appropriate "Hazardous Waste" label, which identifies the chemical contents and concentration (if known) by name, not chemical symbol, in addition to the hazard class, i.e. ignitable, corrosive, oxidizer, etc.
- Labs that routinely generate hazardous waste must have a designated satellite accumulation area (SAA) where containers of hazardous waste are temporarily stored, so as to both isolate and segregate the wastes from other usable hazardous lab chemicals.
- Laboratories may not store more than 55 gallons of hazardous waste, or 1 liter/kilogram of acute hazardous waste, in a SAA at any time. As a good management practice, labs should notify the Director of EPS&S on a regular basis to see that full containers of hazardous waste are routinely moved to the 180 Day Hazardous Waste Storage Facility in room G090 of the Science Building.
- Hazardous waste containers moved to the 180 Day Facility will either be consolidated with other like wastes, or full dated for storage, and will be shipped out within 180 days.
- Under no circumstances shall hazardous wastes be drain disposed, allowed to evaporate in a lab hood, or be treated or otherwise utilized in a methodology constituting disposal.

Biohazardous Waste

- All sharps (syringes, hypodermic needles, scalpel/razor blades) regardless of contamination, and certain types of contaminated glassware (cover slips, Pasteur pipettes) must be collected in rigid containers with the proper labeling/coloring. Once full, the container must be delivered to the Science Stockroom, to be transferred to the Biohazardous Waste Storage Facility in room G091 of the Science Building for shipment off-site.
- Lab supervisors generating solid/semi-solid biohazardous waste must know in advance of generation whether the agents/cell lines in use are classified as BSL-1 or BSL-2.
- All lab generated BSL-1 and BSL-2 solid/semi-solid biohazardous wastes will be collected and stored primarily in an unlabeled, autoclavable bag, which is then to be stored in a rigid plastic container with the biohazard label/color.
- When a bag of BSL-1 solid/semi-solid waste is full, the lab supervisor is responsible for ensuring it is delivered to the Biology department's autoclave for sterilization. Following sterilization (in accordance with the autoclave SOP found in the Waste Management & Minimization Plan), the treated waste may be transferred to **a gray garbage bag and disposed of as trash.**
- When a bag of BSL-2 solid/semi-solid waste is full, the lab supervisor is again responsible for ensuring it is delivered to the Biology department's autoclave for sterilization. Following sterilization, the waste is no longer regulated biohazardous waste. Nonetheless, since the college is still forbidden from disposing of this waste as solid waste/trash, it must be transferred to a gray garbage bag, and delivered to the Science Stockroom. The waste will then be logged into the Biohazardous Waste Storage Facility (Room G091)for shipment off-site.

- Liquid BSL-1 waste may be discharged to the sanitary sewer without prior treatment. Liquid BSL-2 waste must be autoclaved **or** chemically disinfected before disposal into the sanitary sewer.
- BSL-3/4 materials are prohibited.
- Animal carcasses are only considered to be biohazardous waste if they have been contaminated with infectious substances. If carcasses have been exposed to infectious substances, they must be delivered to the Science Stockroom, and then to the Biohazardous Waste Storage Facility for shipment off-site. If carcasses have not been exposed to infectious substances, lab supervisors must place them in cold storage in the Animal Care Facility, where they will be shipped off-site as unregulated animal waste by the Science Coordinator.

Other Wastes

- *Glassware*—All intact and broken glassware, i.e. pipettes, vials, test tubes, beakers, etc., that are uncontaminated in accordance with the hazardous/biohazardous waste requirements, that are capable of causing puncture injuries to custodial personnel must be discarded in the appropriate closable cardboard boxes.
- *Vacuum Pump Oil*—Vacuum pump oil should be maintained free from chemical contamination, and so when spent, will be shipped out as non-regulated chemical waste. If vacuum pump oil becomes chemically contaminated, lab supervisors must communicate this to the Director of EP&S, who will make a hazardous waste determination on the oil.
- *Batteries*—While standard alkaline batteries may be discarded as trash when expired, other battery types (lithium-ion, nickel-cadmium/metal hydride, sealed lead, lead-acid) must be collected by the Director of EPS&S as universal waste through the Science Stockroom.
- *Empty Chemical Containers*—Most chemical containers emptied by normal means (pipetting, pouring, aspirating, etc.) are considered legally empty and may be disposed of as glassware trash as long as there is less than 3% of the original volume of chemical in the container. Chemical containers that once held a P-listed chemical must be handled through the Science Stockroom for special considerations.
- *Bar Coded Containers*—All bar coded chemical containers must be recycled in the staged blue bins in all labs for reinventorying through the Science Stockroom.

2. Departmental EHS Handbooks

The implementation of the Universal SOP's noted above, along with the development of SOP's for department-specific chemical or physical hazards, shall be facilitated through the use of Departmental EHS Handbooks. Each academic Science department should use the Universal SOP's in this Chemical Hygiene Plan as the minimum lab requirements, and develop and use their handbooks for more specificity or rigidity as they see fit. Further, a completed Departmental EHS handbook will provide the baseline for lab-specific training that supervisors must provide to new students employees (restricted personnel) when starting their assignment. Examples of department-specific chemical or physical hazards that require SOP's include, but are not limited to, the following:

- The use of PHS substances—SOP requirements may be satisfied by the generation of a Use Approval Form—see Appendix G, H & I;
- Lasers;
- Autoclaves;
- Analytical equipment, like gas chromatographs/mass spectrometers, high pressure liquid chromatographs, and trans/scanning electron microscopy;
- Mechanical grinders/crushers; and
- Any other process identified by the lab supervisor or Departmental Chemical Hygiene Officer as requiring a SOP (see Appendix C).

SECTION 3
CONTROLLING CHEMICAL EXPOSURES

The basic routes for a chemical to enter the body in a laboratory setting are through inhalation, skin and eye contact, ingestion, and injection. The prevention of entry by one of these routes can be accomplished by adherence to the general or specific SOP's noted above, and by control mechanisms such as engineering controls, personal protective equipment, and administrative controls.

1. Inhalation Hazards

Inhalation of chemicals is the most common route of entry a chemical can take to enter the body. To avoid significant inhalation exposure, engineering controls such as substituting a less volatile or toxic chemical, or substituting a liquid or solid chemical for a gaseous one, is the best means of control. If substitution is not practical, ventilation should be used to lessen the chance of overexposure. The use of well-functioning local exhaust ventilation equipment, such as ventilation hoods, biological safety cabinets, and vented glove boxes, are primary examples of suitable engineering controls that will minimize inhalation exposure to hazardous chemicals. Dilution ventilation may be used to reduce exposure to non-hazardous nuisance odors. For extremely toxic chemicals, such as those classified as poison gases by the State or Federal Department of Transportation (i.e. arsine, phosgene), the use of closed systems, vented gas cabinets, failsafe scrubbing, detection or other stricter controls may be required.

If both substitution and engineering controls are unavailable, the use of personal protective equipment may be required to reduce inhalation exposures. Respiratory protection, from dust masks to a self-contained breathing apparatus, may be utilized to this end. If laboratory employees wear respirators, requirements of the OSHA Respirator Standard (1910.134) must be met. This Standard requires training in the proper use of respirators, medical prequalification to ensure the user is capable of wearing a respirator, and fit testing to ensure that the respirator fits properly. A lab worker or his/her supervisor must contact the Office of EPS&S in the event that respiratory protection is necessary to control exposures to hazardous chemicals.

Finally, administrative controls can be utilized to reduce the risk of overexposure to hazardous chemicals. Some examples of administrative controls include:

- Minimizing the exposure time for individual employees;
- Reducing the quantities/volumes of chemicals used in experiments to as little as practical, or using micro-scale experiments; and
- Restricting access to areas where particularly hazardous experiments are on-going, and placing appropriate signage as a warning to others.

2. Skin and Eye Hazards

To reduce the risk of a chemical entering the body via skin and eye contact, engineering controls include substitution and appropriate ventilation as described above. The more obvious means of preventing skin and eye contact is the wearing of personal protective equipment (PPE) such as eye protection, face shields, gloves, appropriate shoes, lab aprons, lab coats, and other protective equipment as appropriate to the hazard. Suitable eye protection (glasses or goggles) is a determination based upon the likelihood of splash hazards (as noted above). Further, since the chemical resistivity of the different types of protective equipment (most importantly hand protection) varies significantly, the lab supervisor should consult the

MSDS or other appropriate references (like Appendix L below) to determine the type of personal protective equipment required.

Administrative controls to reduce skin/eye contact include:

- Enforcement of policies pertaining to skin and eye protection; and
- Discarding or repair of cracked or broken glassware.

3. Ingestion Hazards

Ingestion of chemicals is another route of entry for chemicals to gain access into the body. A laboratory worker can easily ingest chemicals into the body via contaminated hands if they are not washed prior to eating or smoking, or by sticking part of the hand or a writing tool that has been in contaminated hands into the mouth. Some controls for preventing this route of exposure include engineering controls (i.e. use glove box), personal protective equipment such as the wearing of gloves, and administrative controls such as restricting mouth pipetting, encouraging good personal hygiene and designating a well-marked non-chemical area where eating, drinking and the application of cosmetics is permitted.

4. Injection Hazards

Exposure to chemicals by injection is a final route of entry for chemicals to gain access into the body. Injection exposure can inadvertently occur through injury from metal or glass contaminated with chemicals, or from needle-sticks associated with the handling of syringes. Attention to detail and adherence to general standard operating procedures will provide control against accidental injection exposure. Sharps containers shall be used to collect all used needles and syringes, and separate collection containers shall be used to collect broken glass. Syringes and needles that are intended for reuse should be stored in sturdy plastic containers as an engineering control to avoid needle-sticks.

SECTION 4
VENTILATION HOOD ENGINEERING CONTROLS

1. Laboratory Ventilation Fume Hoods

The laboratory ventilation fume hood is the primary engineering control for protecting lab personnel from exposure to hazardous chemicals. The hood itself is one component of the system that consists of a working chamber, an exhaust system, proper hood location, make-up air to the hood, a hood monitoring system, hood operating parameters, routine performance surveys, and system maintenance.

***Note**—other hood types that do not directly exhaust contaminated air to the outside (i.e. bio-safety cabinets, HEPA equipped down-draft tables), protect hood users by removing and filtering airborne contamination from the space, and the air is recirculated to the general laboratory atmosphere. Be sure to **NOT** use hazardous chemicals in these types of hoods, and follow manufacturer specific guidelines regarding use parameters and requirements.

2. Ventilation Hood Air Flow

Air flow patterns are affected by many factors, including traffic patterns, room make-up air, doorways, room size, hood location, work practices, objects inside the hood, baffle adjustment, and sash opening. These are considerations for design, installation and use of ventilation hoods. Ideally, the air should flow into the lab from doors, hallways and the room air supply and exit the room through the ventilation hood. There should not be any turbulence at the hood face which could spill contaminated air into the room. All areas of the open hood face should have a velocity sufficient to draw room air and not spill contaminated air from the hood.

3. Hood Classification Guidelines

Standards of performance for ventilation hoods are set forth by ANSI/AIHA Z9.5 and OSHA 29 CFR 1910.145(e)(3)(iii). The average face velocity of optimally performing hoods should be between 80 and 120 feet per minute (fpm) when measured with the sash raised to the 15" mark. Practically speaking, all Science hoods will operate at 100 fpm when the sash is at 15", but this face velocity will decrease incrementally if the sash is opened past the 15" stopping device. Also, when P-listed acutely toxic materials are being used in a hood, the acceptable face velocity ranges should be between 90 and 120 fpm. These average face velocities and the date of survey will appear on the inspection sticker located on the front or side of each ventilation hood. Ratings are also stated according to the hood performance as follows:

Score	Criterion	Usage
Pass	Average face velocity 80-120 fpm	Normal chemical hood use
Pass	Average face velocity 90-120 fpm	P-listed acutely toxic materials/chemicals
Restrict	Average face velocity 70-89 or 120-159 fpm	Not recommended for use with highly toxic materials
Fail	Not meeting the above standards	Suitable for storage only

4. Ventilation Hood Work Practices

- Any direct handling and/or experimentation with chemical materials in a laboratory environment should attempt to make use of ventilation hood control measures to the greatest extent possible.

- Before work begins, check to be sure the hood fan is operating by observing airflow monitor.
- Check the inspection sticker to determine if the hood has been currently inspected and what performance rating it was given. If observable questions arise about inspection or current hood performance, notify the lab supervisor for assistance.
- If a hood's performance is questionable or malfunctioning, it should be marked in a fashion that takes it temporarily out of service, and the Physical Plant should be notified to arrange for timely repairs.
- Ventilation hoods should be used with the sash positioned at 15", or as otherwise specified on the inspection sticker.
- The sash position should be lowered as needed for additional physical barrier protection against splash hazards, and shall always be closed when the hood is not actively in use.
- All equipment and materials should be located at least 6" from the sash face.
- Large items should be elevated at least 2" from the hood base to ensure airflow to the baffle opening at the rear interior base of the hood.
- Do not use the ventilation as a storage cabinet—excessive storage can obstruct airflow and cause areas of low air velocity at the face opening.
- Do not extend face or head inside the hood.
- Minimize traffic and other sources of cross drafts (i.e. open windows, doors, fans, etc.) that may pull contaminated air from the hood.
- When using electrical equipment in a hood, take extra precautions to prevent spark sources from causing a fire or explosion—all electrical connections should be made outside the hood.
- When permitting other unattended operations to occur, like the use of apparatuses that require continuous flowing water, clamp hoses and select hoods in accordance with the Unattended Operations SOP from above.
- Do not use perchloric acid heated above ambient temperature in a ventilation hood unless it is a specifically designed perchloric acid hood with a wash-down system.
- In the event of an emergency spill, fire or explosion in a hood, the hood user should attempt to close the sash to isolate the emergency (as long as if doing so does not present any additional hazard to the user). The emergency purge control on the hood LCD should be used only in the following situations
    - A dangerous chemical has been spilled or is leaking (like a 1 liter benzene spill, or a leaking cylinder of hydrogen sulfide gas), such that normal fume hood operation is insufficient to protect the hood user; or
    - An experimental apparatus is off-gassing or smoking,
    - The emergency purge control SHOULD NOT (generally speaking) be engaged to control a fire. This might add additional air/fuel to the fire, allowing it to grow out of control. IMMEDIATELY evacuate the lab, notify your lab supervisor, find a fire alarm pull station, and activate it.

SECTION 5
EMPLOYEE INFORMATION AND TRAINING

The Office of EPS&S shall develop a general employee training program to meet the information requirements of the Lab Safety Standard. It is the responsibility of each department to provide its employees training for activities which are unique and/or specific to that department. The Director of EPS&S is available for assistance in the development of these programs.

1. Mandatory Employee Informational Training and Orientation

All college employees working in a laboratory setting shall be trained upon, and informed of the location and availability of, the following:

- 29 CFR Part 1910.1450 "Occupational Exposures to Hazardous Chemicals in Laboratories" (OSHA Lab Standard). Click HERE to see the standard.
- The Hamilton College Chemical Hygiene Plan (CHP).
- Reference materials on chemical safety, including Material Safety Data Sheets (MSDS's).
- Permissible exposure limits (PEL's) for OSHA regulated substances, or if there is no applicable OSHA Standard, the recommended exposure limits (REL's) as per NIOSH, or threshold limit value (TLV's) as per the ACGIH.
- Signs and symptoms associated with exposure to hazardous chemicals found in the lab.

This type of informational training shall be required at the time of an employee's initial assignment, and shall be repeated at least semi-annually thereafter. It will be the responsibility of the employee's department with the assistance of the Office of EPS&S to provide this informational training. Appendix D provides an example of how this informational training and orientation will be documented accordingly.

2. Mandatory Laboratory Training

All college employees working in specified laboratories shall be trained upon the following:

- The specific details of the Chemical Hygiene Plan applicable to the individual lab.
- Any other department or lab-specific SOP's developed for such activities.
- Methods and observations that may be used to detect the presence or release of hazardous chemicals, such as air monitoring, continuous monitoring devices, or the visual appearance or odor of hazardous chemicals.
- The physical and chemical hazards of chemicals in the work/lab area.
- The measures employees can take to protect themselves from these hazards, including specific procedures that have been implemented to protect employees from exposure to hazardous chemicals, such as safe work practices, engineering controls, emergency procedures, and personal protective equipment.

This type of laboratory training shall be required before employees/students (restricted personnel) work with hazardous chemicals in the lab setting. It will be the responsibility of the lab supervisors and Departmental Chemical Hygiene Officers to devise and implement this type of training. Appendix E provides a recommended worker agreement form by which lab supervisors/Departmental Chemical Hygiene Officers may document this training. Additionally, Appendix M provides lab faculty/supervisors with additional guidance regarding hazard evaluations for PPE determinations.

3. Non-Mandatory Lab Training

Although students registered in laboratory courses where hazardous chemicals are used are not required to be trained by the mandatory elements described above, student safety and training should be an integral part of every laboratory course curriculum. Student safety and training programs should be sufficient enough to address the type, variety and nature of the chemical and physical hazards posed by the laboratory course. Department chairs, lab faculty/instructors and DCHO's are charged with devising and implementing such student safety/training programs in accordance with these non-mandatory recommendations, with assistance from the Office of EPS&S. Appendix F provides an example of a recommended lab safety agreement form that can be utilized to document this process.

SECTION 6
PRIOR APPROVAL

The use of a select group of chemicals will require prior approval before they are introduced and/or utilized in the laboratory setting. This will ensure that:

- The chemical and physical hazards associated with these chemicals are adequately assessed.
- Sufficient hazard/exposure control strategies and equipment are available to safely utilize those chemicals.
- Certain administrative procedures, such as the generation of hazardous wastes within the specified small quantity generator thresholds, are maintained.

1. Chemicals Requiring Prior Approval

The introduction and/or utilization of chemicals that fall into this category are contained in Appendix G. They will be referred to as Particularly Hazardous Substances (PHS's), and typically include select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity. PHS substances include those that are more stringently regulated by state and federal agencies (NYSDEC/EPA P-listed chemicals, Department of Homeland Security Appendix A chemical facility rules, etc.), or are otherwise are included for best chemical safety management practices.

2. Prior Approval Procedure

Before any Particularly Hazardous Substances (PHS's) are utilized in the laboratory setting, the lab supervisor will complete the Particularly Hazardous Substance Use Approval form contained in Appendix H, using the Appendix I reference key. The completed form will be submitted to the Department Chemical Hygiene Officer and then the Director of EPS&S for approval, subsequent actions prior to approval, or denial based upon technical or administrative limitations.

3. Other Prior Approval Considerations

Although outside of the purview of the Chemical Hygiene Plan, certain other activities lab supervisors may wish to engage in require prior approval from College offices other than EPS&S. These activities include:

- The use of live animals—contact the Animal Care & Use Committee (Doug Weldon).
- The use of human subjects—contact the Institutional Review Board for Research with Human Participants (Doug Weldon).
- The use of radiation generating equipment or radio-isotopes—contact the Radiation Safety Committee (Pearl Gapp).

SECTION 7
PARTICULARLY HAZARDOUS SUBSTANCES

In addition to the general chemical safety guidelines mentioned throughout this plan, special precautions are needed when using Particularly Hazardous Substances (PHS's) during laboratory teaching or research activities. The PHS chemicals and information sources noted in Appendix G contain the minimum, though not exhaustive, list of chemicals that must abide by this PHS procedure. PHS chemicals generally include those that are select carcinogens, reproductive toxins, or chemicals with a high degree of acute toxicity. Lab supervisors using hazardous chemicals not on this list, but determined to fall within any of these three categories as per the MSDS, should similarly abide by this procedure.

Required Steps to Using Particularly Hazardous Substances

Whenever PHS chemicals are utilized, the steps listed below must be followed:

1. Review the information sources identified in Appendix G to determine whether or not the chemical you intend to use is regulated as a PHS.

2. Follow the "Prior Approval" procedure from above, to help characterize and assess the risks and hazard abatement measures that will be implemented.

3. The area where the PHS is to be used will be posted as a "designated area". Signs conveying this designated area will include the following information:

DESIGNATED AREA

**For Select Carcinogens,
Reproductive Toxins and
High Acute Toxicity Chemicals**

Authorized Personnel Only

4. The lab activities utilizing PHS may then proceed, following the practices outlined in the Particularly Hazardous Substance Use Approval form, as well as the appropriate work practices included throughout this plan. All work must be conducted within the designated area.

5. At the conclusion of the experiment, personnel using PHS will then decontaminate all equipment and dispose of waste promptly and properly, as outlined in the Particularly Hazardous Substance Use Approval form.

SECTION 8
MEDICAL CONSULTATIONS

All college employees/students working with hazardous chemicals in a laboratory setting shall have an opportunity to receive medical consultation, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

- If an employee/student develops signs or symptoms associated with a hazardous chemical to which they may have been exposed.
- There has been a spill, leak, explosion, or other occurrence in the work area resulting in the likelihood of a hazardous exposure.
- If exposure monitoring reveals that a PEL or action level is routinely violated for any OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

In the event a medical consultation is deemed necessary, the Department Chemical Hygiene Officer or Director of EPS&S will complete the injury report contained in Appendix J (for students) or Appendix K (for employees). This report will be forwarded to the Director of Human Resources, who will make the necessary arrangements with Health Services, or other local health care providers. In addition, employees who need to wear respirators to control chemical exposures must be approved through the Director of EPS&S prior to wearing the respirator to ensure they are physically able to wear one, and are trained and fit tested.

SECTION 9
EMERGENCY PROCEDURES/CONTINGENCY PLAN

All college employees using hazardous chemicals and/or generating hazardous wastes should be thoroughly familiar with the proper chemical/waste handling and emergency procedures relevant to their responsibilities during normal institutional activities and foreseeable emergencies. The following outlines those basic procedures.

1. Emergency Preparedness

All who use dangerous chemicals or equipment in laboratory workstations should be prepared for emergencies before they actually occur. Emergency preparedness begins at a minimum with the following:

- Be prepared for chemical spills, or spills of hazardous/universal/other wastes;
- Before you begin using hazardous materials, be familiar with the MSDS for the appropriate containment materials and safety precautions;
- Before you begin using dangerous equipment, ensure you have been properly trained and authorized to use it;
- Ensure the appropriate emergency equipment, such as fire extinguishers, first aid equipment, emergency eye washes and/or showers, and spill equipment, is accessible as required; and
- Know the procedures for handling those emergencies that may arise in your work area.

2. Level 1 Emergencies

Level 1 emergencies, otherwise referred to as incidental or incipient emergencies, are those that do not pose a significant threat to life, the environment or property. Level 1 emergencies are routine occurrences that normally may be handled safely by trained operational employees in the immediate work area or by maintenance personnel. Common examples of Level 1 emergencies include:

- Minor/incidental spills that pose minimal risk to safety, health or the environment;
- First-aid injuries that can be safely treated with a first aid kit; and
- Minor fires that can be safely extinguished with a hand-held fire extinguisher.

Minor/Incidental Spills

Minor/incidental spills that do not pose a significant safety, health or environmental hazard may include any of the following:

- A spill of a hazardous chemical, such as a solvent like acetone, in a laboratory in quantities not to exceed 1 liter (as a general rule of thumb), that can be safely isolated and contained by lab personnel with staged spill kits;
- A broken universal waste lamp in a maintenance area that again can be safely isolated and contained by trained maintenance personnel with the appropriate equipment; and
- A spill of used oil on a concrete floor within a maintenance area that can be immediately controlled and cleaned up before the oil reaches any release pathways.

Minor Spill Response Steps

- Immediately alert area/nearby personnel, secure the scene, and notify your supervisor.
- The supervisor shall make the determination as to whether or not the spill can be safely controlled and cleaned up by trained individuals with the appropriate equipment, or whether an evacuation and Campus Safety notification is necessary.

- Donn the appropriate personal protective equipment located within your workstation or in a nearby spill kit.
- Deploy spill absorbent/neutralization materials upon the spill as necessary.
    - Spill kits in laboratories have 3 absorbent/neutralization materials for this purpose; sodium sesquicarbonate for acid/acidic spills, citric acid for caustic/basic spills, and Magic-Sorb for solvent/other spills.
    - Additionally, the Science Stockroom has Hg-Absorb for mercury spills.
- Once the chemical or waste has been controlled, absorbed and/or neutralized, consolidate the spill cleanup materials by sweeping inward, and collect in a suitable container.
- Notify your Departmental Chemical Hygiene Officer that you have a full container of spill cleanup materials, who will both label it accordingly and have it picked up by the Director of EPS&S.

Minor First-Aid Injuries

First-aid injuries in general include those that will not require medical treatment, and can be safely and thoroughly addressed by the equipment staged in small first-aid kits. These types of incidents include, but are not limited to, minor cuts, scrapes and abrasions, as well as topical burns and foreign bodies not embedded in the eye. Injuries beyond those that are minor in nature, such as chemical splashes in the eye thus requiring the engagement of an emergency eye wash followed by medical treatment, must be immediately conveyed to Campus Safety, who will notify the appropriate College personnel or external response agency. The procedures for responding to a minor first-aid incident are as follows:

- The injured individual will immediately notify his/her supervisor, who will assist in determining the nature and severity of the injury, as well as the location of the first-aid equipment.
- The injured individual shall utilize the first-aid equipment as necessary to treat the minor injury. The supervisor shall not assist in treating the first-aid injury unless he/she is properly certified by the American Red Cross.
- In the event blood is dripped upon the floor or other surfaces, the supervisor will notify the area custodian or the Physical Plant, who will take the necessary precautions to clean up the blood spill.

The supervisor must then complete the required accident report form—Appendix J is the accident report form for students injured on campus, while Appendix K is the accident report form for employees injured on campus. Either form, upon completion, must be forwarded to both the Human Resources Department and the Health Center.

Minor Fires

Although a properly trained individual with an appropriately rated fire extinguisher may easily extinguish minor fires involving isolated pieces of equipment, fires in general are inherently extremely dangerous. Since college personnel will not engage in fighting uncontrolled fires, the key to knowing the difference between a "minor" and "major" fire is **discretion**. Should there be any question as to the nature and dangers involved with a fire, fires should be considered an emergency incident, requiring the immediate evacuation of all area personnel and building occupants, followed by the notification of Campus Safety. In general, using fire extinguishers to extinguish a fire would not be appropriate if any of the following conditions exist:

- The fire could block your only exit;
- The fire is large, and/or is spreading quickly or uncontrollably;
- The type or size of the fire extinguisher is wrong or insufficient; or
- You have not been properly OSHA trained on using a fire extinguisher.

Minor Fire Extinguishing Steps

- In the event a fire is determined to be minor or incipient in nature, personnel trained in the use of fire extinguishers may proceed with extinguishing activities **AFTER** they have notified Campus Safety, as follows:
    - Retrieve an appropriately rated fire extinguisher staged from a safely accessible location, and follow the PASS method:
        - **Pull** the trigger pin;
        - **Aim** the extinguisher nozzle toward the base of the fire;
        - **Squeeze** the handle or trigger to activate the device; and
        - **Sweep** the nozzle of the fire extinguisher in a side-to-side motion, applying the dry chemical to the fire from the base of the fire up, until the fire is adequately suppressed or the extinguisher is empty.

3. Level 2 Emergencies

Level 2 emergencies are those that pose some threat to health, safety or the environment, and typically require 1—localized evacuations from buildings/groups of buildings on campus, 2—employee/student mustering at designated assembly points, and 3—the notification of trained internal or external emergency responders (i.e., the local fire department, ambulance services, police, private Hazmat teams). Common examples of Level 2 emergencies include:

- A 5-gallon spill of a highly flammable solvent on a lab floor;
- An actual or potential fracture injury at the Physical Plant; and
- A lab benchtop fire that includes mixed hazard classes (flammable liquids, solid oxidizers, poisons).

The following actions are generally applicable following a Level 2 emergency:

- Know who your Building Coordinator is, as well as the location of you building's Assembly Points and Initial Gathering Points.
- Those teaching or supervising personnel in laboratories are responsible for both communicating the Assembly/Initial Gathering Points information, and for accounting for their whereabouts during an actual emergency evacuation.
- If you discover a potential Level 2 emergency, immediately notify and evacuate all personnel in the immediate area of the emergency incident.
- Contact Campus Safety at x4000 from a secure location, and be prepared to provide the dispatcher with as much information relative to the emergency, including the following:
    - Your name, phone number and exact location;
    - Nature of the incident, and name/type/volume of substances involved (if known);
    - Advise if there are any injuries requiring an ambulance, or if there are visible flames.
- The individual(s) making the initial notification to Campus Safety should secure the area to the safest extent possible, until he/she is relieved by a more experienced or senior college official. Under no circumstances should anyone attempt a rescue operation, fire-fighting, or a spill response during a Level 2 emergency incident. Toxic substances commonly have no odor or other warning properties, and untrained personnel can only worsen the initial emergency incident.
- Campus Safety will immediately dispatch security personnel to the scene, and will notify the primary facility emergency coordinator(s), or any alternates as required.
- The facility emergency coordinator will then authorize which outside emergency response organization(s) will be contacted to safely respond to the emergency incident, and will take any further action in accordance with other College procedures.

4. Level 3 Emergencies

Level 3 emergencies, otherwise referred to as catastrophes, are those occurrences that pose a significant threat to human health, public safety or the environment, and will typically involve a great number of emergency responders/response agencies, and resources. Common examples of Level 3 emergencies include:

- A natural disaster resulting in the widespread disruption of essential functions/services on campus; and
- A major/multi-building fire, or active shooter on campus.

In the event of a Level 3 emergency, emergency responders and local/state/federal authorities will likely assume on-site decision-making. For planning purposes, a Level 3 incident requiring the evacuation of the campus will utilize the Clinton High School as its safe place of refuge, and St. Mary's Church will serve as the alternate location.

APPENDIX A
CHEMICAL STORAGE GUIDANCE

Hazard Class	Examples	Regulatory Guidance	Best Management Practices
Flammable and Combustible Liquids	Acetone, toluene, mineral spirits, paint aerosol cans	No more than 10 gallons of flammable/combustible liquids combined may be stored outside of an approved flammable storage cabinet. Refrigerators used to store flammable/combustible liquids must be explosion proof and labeled as such.	Labs and prep areas should primarily store flammable/combustible liquids in flammable storage cabinets or hoods. De minimus quantities, i.e. 5 gallons/10 containers or less, may otherwise be stored away from ignition sources, and should not be stored on open shelving at or above eye level.
Flammable-Air-Water Reactive Solids	Flammable Solid: --aluminum powder Air Reactive: --lithium hydride Water Reactive: --potassium metal	Reactive chemicals must be stored in accordance with chemical-specific storage guidelines.	Labs and prep areas should primarily store flammable/air/water reactive solids in main chemical storage areas, in designated flammable storage cabinets. De minimus quantities, i.e. 5 pounds/10 containers or less, should otherwise be stored in a cool, dry and closable cabinet.
Oxidizers	Class 1, 2 and 3: --lead nitrate --potassium permanganate --potassium bromate Class 4: --ammonium perchlorate	Oxidizers must be isolated from any flammable or combustible materials. Though there are no other special storage requirements for Class 1, 2 or 3 oxidizers in quantities less than 200 pounds, Class 4 oxidizers may not be stored in excess of 10 pounds in any lab.	Labs and prep areas should primarily store oxidizers in main chemical storage areas, in designated flammable storage cabinets for oxidizers only. De minimus quantities, i.e. 10 pounds/20 containers or less, should otherwise be stored in a cool, dry and closable cabinet.
Corrosive Liquids	Inorganic Acids: --hydrochloric, sulfuric, nitric Organic Acids: --acetic, formic Bases: --sodium hydroxide, potassium hydroxide	Acids and bases must be stored separately from one another, and may not be stored on open shelving at or above eye level.	Labs and prep areas should segregate and store all concentrated inorganic/mineral/oxidizing acids and/or bases in designated corrosive storage cabinets. Concentrated organic acids should be stored in flammable storage cabinets. Hydrofluoric and perchloric acids should be stored in secondary containers. De minimus quantities of concentrated corrosives, i.e. 2 liters or less, or dilute solutions of corrosive liquids, should be stored in designated areas underneath lab hoods.
Highly Toxic Materials	Particularly Hazardous Substances (listed in Appendix G)	Highly toxic materials may be stored with other hazard classes based upon common chemical properties, but should be segregated or isolated in some fashion from those other less hazardous chemicals.	Labs and prep areas should designate specified storage areas for highly toxic materials suitable to the nature and variety of such chemicals the lab primarily uses. These storage areas should be securable and lockable. Secondary containers are recommended for all highly toxic materials.
Low Hazard Chemicals	Agars, sodium chloride, potassium chloride, glycerin, amino acids	Common low-hazard chemicals should be stored in a fashion that minimizes the likelihood of spillage.	Labs and prep areas should store low-hazard chemicals in suitable cabinets or shelves of sturdy construction that are not exposed to heat or light. Open shelves should have lipped edges, and should be floor mounted so as to minimize the need to reach high when retrieving/replacing chemicals.

APPENDIX B
PEROXIDE-FORMING CHEMICALS

List A: Severe Peroxide Hazard on Storage with Exposure to Air—Discard within 3 months	
diisopropyl ether (isopropyl ether)	potassium amide
divinylacetylene (DVA)	sodium amide
potassium metal	vinylidene chloride (1,1-dichloroethylene)
List B: Peroxide Hazard on Concentration; Do Not Distill or Evaporate Without First Testing for the Presence of Peroxides—Discard or test for peroxides within 6 months	
acetaldehyde diethyl acetal	ethylene glycol dimethyl ether (glyme)
cumene (isopropylbenzene)	ethylene glycol ether acetate
cyclohexene	ethylene glycol monoethers (cellusolves)
cyclopentene	furan
decalin (decahydronapthylene)	methylacetylene
diacetylene (butadiene)	methylcyclopentane
dicyclopentadiene	methyl isobutyl ketone
diethyl ether (ether)	tetrahydrofuran (THF)
diethylene glycol dimethyl ether (diglyme)	tetralin (tetrahyronaphthalene)
dioxane	vinyl ethers
List C: Hazard of Rapid Polymerization Initiated by Internally Formed Peroxides	
C-1—Normal liquids—Discard or test for peroxides after 6 months	
chloroprene (2-chloro-1,3-butadiene)	vinyl acetate
styrene	vinylpyridine
C-2—Normal gases—Discard after 12 months	
butadiene	vinylacetylene (MVA)
tetrafluoroethylene (TFE)	vinyl chloride

APPENDIX C
GENERAL SOP FORMAT

Chemical Information

Chemical name: _____

NFPA Rating: *Flammability:* 0 1 2 3 4 *Reactivity:* 0 1 2 3 4 *Health:* 0 1 2 3 4

Special Hazard: Acid Base Pyrophoric Water Reactive Peroxide Former

Other Information:_____

Process Information

Briefly describe the process and/or equipment utilized in the process:

Identified Physical Hazards

Cryogenic hazards ☐ Yes ☐ No Compressed gas hazards ☐ Yes ☐ No Eye/Skin hazards ☐ Yes ☐ No

High heat hazards ☐ Yes ☐ No Crush/Pinch hazards ☐ Yes ☐ No

Other:_____

Hazard Control Strategies

Engineering Controls

Ventilation required ☐ Yes ☐ No Micro-scale considered ☐ Yes ☐ No

Administrative Controls

Training required ☐ Yes ☐ No Signage required ☐ Yes ☐ No

Personal Protective Equipment Controls (*check all that apply*)

☐ Safety glasses ☐ Chemical splash goggles ☐ Face shield ☐ Lab coat ☐ Apron

☐ Gloves (type _____) ☐ Other (specify)_____

Emergency Controls

Spill kit available ☐ Yes ☐ No First aid kit available ☐ Yes ☐ No

Emergency contact person (specify)_____

SOP Completed By_____

Print Name Sign Name Date

APPENDIX D
LABORATORY SAFETY TRAINING DOCUMENTATION & CERTIFICATION

The following individuals have been trained in accordance with both the Federal Laboratory Safety Standard informational training program requirements, and Hamilton College's written Chemical Hygiene Program.

Training Instructor Name	Signature	Date of Training

Name (Print)	Signature	Dept.

Hamilton College Worker Agreement Form

- ☐ The specific details of the Chemical Hygiene Plan with direct significance and applicability to my work are have been made clear to me by my lab supervisor or the Departmental Chemical Hygiene Officer.
- ☐ I understand and agree to abide by any other specified SOP's applicable to my department, lab or specific area of responsibility.
- ☐ I have been trained upon and/or understand the various chemical and physical hazards associated with the materials and processes I utilize in my work area, and know to contact my lab supervisor for any additional information I may need.
- ☐ The methods and/or observations that may be used to detect the presence or release of any hazardous chemical, including air monitoring, continuous monitoring devices, or the visual appearance or odor of hazardous chemicals, have been made clear to me by my lab supervisor.
- ☐ The measures I can take to protect myself from the chemical and physical hazards located in my work area, including SOP's, safe work practices, engineering controls, emergency procedures, and personal protective equipment, have been made clear to me by my supervisor.

I, _____, have carefully read the worker agreement form for Hamilton College, and understand that the various elements of the Chemical Hygiene Plan and other Departmental requirements will be rigorously and impartially enforced. I also understand that willful or repeated violations will result in my being dismissed from my lab responsibilities and privileges.

_____ _____

Date Signed

_____

Training Provider Name Signature Date

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX F
RECOMMENDED LAB SAFETY AGREEMENT FOR STUDENTS

Hamilton College is committed to providing *all laboratory users* a safe environment in which to work and learn. Students must be well informed of the chemical and physical hazards associated with laboratory activities, and conform to the following rules established for all college laboratories:

1. Eye protection is required at all times.
2. All laboratory work must be approved by the designated lab supervisor.
3. Report all injuries to your lab supervisor immediately. Any person injured in a laboratory must be seen by the Health Center.
4. Eating, drinking or smoking in the laboratory is strictly forbidden. Further, laboratory refrigerators may not be used for the storage of any food/liquid products for consumption.
5. Everyone who uses a laboratory must know the locations of emergency equipment, such as fire extinguishers, fire blankets, eyewashes, showers, first aid kits, spill kits and telephones.
6. Wear the appropriate clothing. Do not wear shorts, cutoffs, or short skirts, nor high-heeled shoes, open-toed shoes or sandals. Confine long hair, jewelry and loose clothing.
7. Never use your mouth to fill pipettes or start siphons. Nothing in the laboratory should go into one's mouth.
8. Unauthorized experiments, horseplay or pranks are strictly prohibited.
9. Always wash your hands prior to leaving the laboratory, even after wearing protective gloves.
10. All hazardous materials must be properly used, stored, labeled and disposed of.
11. Dispose of used hazardous materials, including the first rinse from chemical containers, into designated containers. Thoroughly clean and wash any area contaminated with chemicals in use. Report all spills to your lab supervisor immediately.
12. Know the flammability, reactivity, health hazard and special hazards of any materials you use. All toxic and/or carcinogenic materials must be used in a lab hood. Report any lab hood deficiencies to your lab supervisor. Wear the specified safety equipment at all times.
13. All broken glassware and syringes must be disposed of in designated containers. Never place any sharp item in a regular trash receptacle. Report any broken glassware, faulty equipment or dangerous situation to your lab supervisor.

I, _____, have carefully read the lab safety agreement for Hamilton College and understand that these rules will be rigorously and impartially enforced. I also understand that willful and/or repeated violations will result in my being dismissed from the lab.

_____ _____

Date Signed

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX G
LISTS OF PARTICULARLY HAZARDOUS SUBSTANCES

As noted in Section 7 above, OSHA generally defines Particularly Hazardous Substances as those chemicals which are carcinogenic, reproductive toxins, or have a high degree of acute toxicity. Additionally, there are other reasons why the College would need to evaluate a chemical intended for use in a laboratory setting before it is procured, by way of the Prior Approval Procedure. As such, the following information sources should be checked by lab supervisors wishing to procure/use chemicals that may need to be managed in accordance with this procedure:

EPA/NYS DEC P-List

P-listed chemicals are generally considered to be those of a high degree of acute toxicity. Further, since the College is regulated as a "Small Quantity Generator" of hazardous waste, it may neither generate nor store more than 1 kg of P-listed waste on campus during any calendar month. So before a lab supervisor intends on using a chemical which may result in the generation of P-listed waste, they should check the following information source to determine whether or not the chemical species must be managed in accordance with this program:

EPA P-List

- Note #1—the EPA P-list is organized both alphabetically, and in numerical order by the specific P number. So the table that is shown on this website provides the full list by both of these strategies back to back (first alphabetically, then by the P-list number).
- Note #2—frequently, there are also a number of different names/synonyms for the same chemical. For example, the chemical "propanenitrile, 2-hydroxy-2-methyl- "(P069) is also listed by the name "2-methyllactonitrile" and "acetone cyanohydrin". So please be sure to check these different chemical names when you are using the EPA P-list.

Federal Department of Homeland Security—"Chemicals of Interest" List

In November of 2007, the federal Department of Homeland Security (DHS) enacted a new rule that created a "Chemicals of Interest" list, whereupon possession of any listed chemical above a certain quantity or concentration threshold mandates certain security measures to be taken by the College. This list includes nearly 350 individual chemical species, across 3 chemical categories—Release Chemicals, Theft Chemicals, and Sabotage Chemicals. While the College is in possession of some of the chemicals on this list, it does not currently possess any at or above the technical screening thresholds. So as to ensure the College continues to maintain chemical inventories with quantities/concentrations below those thresholds regulated by the DHS, lab supervisors should check the following information source:

DHS Chemicals of Interest List

- Note—the chemical information contained on this list, as well as the enabling legislation and regulations, are complicated for a first time user to understand. Additionally, it is difficult for an individual lab user who is interested in procuring a single chemical at a certain weight/concentration to know whether or not that purchase will put the entire College over the threshold. So for the purposes of conformance with this procedure, lab supervisors should use this information as a screening tool to determine the presence of a chemical on the list, but must also work with the Director of EPS&S or the Science Stockroom & Facility Coordinator to determine the full implications of their intentions to procure and use listed chemical species.

EPA/NYS DEC List of Extremely Hazardous Substances

The EPA/NYS DEC regulates the possession of certain "Extremely Hazardous Substances" (EHS Substances) by way of this list. The possession of any chemical upon this list at or above the threshold planning quantity (or TPQ), obligates the College to notify state, county and local emergency response personnel on an annual basis of such possession. While the College must traditionally notify such authorities of the possession of any chemical at or above the default TPQ of 10,000 pounds, TPQ's for chemicals on the EHS Substance list are often as low as 10 pounds. As such, lab supervisors should consult this list when they are looking to procure new or novel chemicals that are acutely toxic, and work with the Director of EPS&S to ensure that the College's reporting obligations are satisfied.

EPA EHS Substance List

- Note #1—when viewing this list, please be sure to look at the chemical and its corresponding column marked Threshold Planning Quantity (TPQ in pounds). The adjacent column marked as the Reportable Quantity (or RQ in pounds), concerns itself with the quantity of the chemical that, following a release to the air, water or land, would necessitate a formal notification to federal regulators.
- Note #2—practically speaking, a listed chemical with a TPQ at or below 100 pounds should result in a discussion between the lab supervisor and the Director of EPS&S.

CDC/USDA Select Agents & Toxins List

The CDC/USDA regulates the possession of a number of viruses, bacterial lines, and toxins derived from biological sources. At this time, the College is restricted from procuring or possessing **ANY** agents/toxins on this list without having first been authorized by the US Department of Justice, as well as establishing a number of additional managerial and technical safeguards. As such, this list is provided for informational purposes only:
CDC/USDA Select Agents & Toxins List

Other Information Sources For PHS Determinations:

- OSHA Carcinogens Web Site
- National Toxicology Program Report on Carcinogens
- International Agency for Research on Cancer
- California Reproductive Toxins List

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX H
PARTICULARLY HAZARARDOUS SUBSTANCE USE APPROVAL FORM

Lab Supervisor:_____ Building/Dept._____

1. Substance Information

A. Chemical name _____ CAS number _____

B. ☐ Carcinogen ☐ Reproductive Toxin ☐ High Acute Toxicity

C. Estimated Rate of Use (e.g., grams/month) _____

D. MSDS reviewed and readily available ☐ Yes ☐ No

2. Hazards

Physical Hazards

A. Flammable ☐ Yes ☐ No B. Corrosive ☐ Yes ☐ No C. Reactive ☐ Yes ☐ No

D. Stability (e.g., decomposes, forms peroxides, polymerizes, shelf-life concerns) ☐ Yes ☐ No

E. Temperature sensitive ☐ Stable ☐ Unstable F. Known incompatibilities_____

Health Hazards

G. Significant Route(s) of Exposure
Inhalation Hazard ☐ Yes ☐ No
Skin Absorption ☐ Yes ☐ No

H. Sensitizer ☐ Yes ☐ No

3. Procedure

A. Briefly describe how the material will be used

B. Vacuum system used ☐ Yes ☐ No

C. If yes, describe method for trapping effluents _____

4. Engineering Controls

Ventilation/Isolation

A. Hood required ☐ Yes ☐ No *See hood sticker for the following information*
If yes, hood currently operates at 90 - 120 feet per minute face velocity ☐ Yes ☐ No
Hood number _____

B. Glove box required ☐ Yes ☐ No C. Vented gas cabinet required ☐ Yes ☐ No

5. Personal Protective Equipment (PPE) *(Check all that apply)*

☐ Safety glasses ☐ Chemical splash goggles ☐ Face shield

☐ Gloves (type _____) ☐ Lab coat ☐ Chemical Splash Apron

☐ Respirator (*requires approval)*

☐ Other, please describe _____

6. Location/Designated Area

A. Building _____ B. Room _____

C. Describe below the area where substance(s) will be used and the method of posting as a designated area.

D. Location where substances will be stored

_____

E. Storage Method/Precautions

☐ refrigerator/freezer ☐ hood
☐ double containment ☐ vented cabinet
☐ flammable liquid storage cabinet ☐ other, describe _____

7. Emergency Equipment

A. Spill control materials readily available ☐ Yes ☐ No

B. First aid equipment readily available ☐ Yes ☐ No

C. Any specialized spill/first aid equipment needed ☐ Yes ☐ No

If so, describe _____

8. Waste Disposal

A. In-lab neutralization ☐ Yes ☐ No B. Deactivation ☐ Yes ☐ No

C. Dispose as hazardous waste ☐ Yes ☐ No

If yes, estimate rate of waste generation (e.g., grams or liters/month)_____

9. Authorization

This individual has demonstrated an understanding of the hazards of the listed substance and plans to handle the substance in a manner that minimizes risk to health and property. He/she is authorized to use the substance in the manner described.

_____ _____

Laboratory Supervisor/Date Chemical Hygiene Officer/Date

Please submit this form to _____. Do not use the substance until approval is granted.

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX I
KEY TO USING THE PHS USE APPROVAL FORM

Most of the information required as follows can be obtained from the appropriate MSDS sheet for the chemical product to be utilized.

1. Substance Information

A. Enter name and CAS (Chemical Abstract Service) number of the PHS.
B. Carcinogen: if on IARC, OSHA or NTP list; Reproductive toxin: mutagens, teratogens, embryotoxins; High Acute Toxicity: oral LD50 ≤ 50 mg/kg, skin LD50 ≤ 200 mg, air LC50 ≤ 200 ppm or ≤ 2 mg/l.
C. Self-explanatory
D. MSDS must be available in hard copy.

2. Hazards

A. Flammable liquid: flashpoint ≤ 100° F; Flammable solid: liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or which can be ignited readily and when ignited burns vigorously
B. Corrosive: Causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact (pH equal to or less than 2.0, or equal to or greater than 12.5)
C. Reactive: May become unstable or contact with water produces flammable or toxic gas.
D. Unstable: substance will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, or high or elevated pressure or temperature. Also includes time-sensitive materials, particularly those that produce peroxides over time.
E. Temperature Sensitive: Must be kept within a certain temperature range to ensure stability.
F. Known Incompatibilities: List chemicals or materials that might cause instability or adverse conditions if mixed with the particularly hazardous substance(s).
G. Inhalation: inhalation of the substance may cause adverse health effects.
Skin exposure: substance is readily absorbed through skin, or can cause damage to skin upon contact.
H. Sensitizers: Likst any chemicals known to effect the immune system, causing a person to experience allergic reactions, up to and including anaphylactic shock, upon exposure to the chemical, after the initial sensitization.

3. Procedure

A. Briefly describe the part of the experimental procedure that involves the substance, with particular attention to how the chemical will be manipulated.
B. Vacuum systems include central vacuum systems and vacuum pumps within the lab.
C. Describe what will be done to ensure that the substance is not accidentally drawn into the vacuum system. Cold traps or filters are some examples of such measures.

4. Engineering Controls

A. A fume hood should be used for chemicals that may produce vapors, mists, or fumes, or if the procedure may cause generation of aerosols. The hood must have an average face velocity of between 90 and 120 feet per minute. This measurement is noted on the hood survey sticker or flow monitor. The hood number is noted on the top of the fume hood inspection sticker.
B. A glove box should be used if protection from atmospheric moisture or oxygen is needed or when a fume hood may not provide adequate protection from exposure to the substance; e.g., a protection factor of 10,000 or more is needed.
C. Highly toxic gases must be used and stored in a vented gas cabinet connected to a laboratory exhaust system. Gas feed lines operating above atmospheric pressure must use coaxial tubing.

5. Personal Protective Equipment (PPE)

A. Safety glasses protect from flying particles and minor chemical splashes, i.e. opening a centrifuge tube.

B. Chemical splash goggles should be worn when there is a possibility of a significant chemical splash. Most chemical manipulations, particularly where pressure is involved, warrant chemical splash goggles.
C. Face shield, worn with splash goggles, provides full-face protection when working with large volumes of chemicals, or as a secondary means of eye protection.
D. Gloves should be worn when working with any particularly hazardous substance. Since not all gloves offer significant protection from every chemical, it is important to choose the glove that offers the best resistance. See the MSDS, or glove manufacturer compatibility charts for more information.
E. Lab coats should be worn when working with hazardous substances likely to splash. The coat should not be worn outside the laboratory and should be laundered separately from other clothing.
F. Aprons offer chemical resistance/protection from splashes and can be used in conjunction with a lab coat.
G. Respirators offer protection from inhalation of substances when engineering controls are not sufficient. Use of respirators must be approved.

6. Location/Designated Area

A. A and B. Building and room number where the substance will be used.
C. Describe where in this room the substance will be used. For example, in a hood, on a specific benchtop, in several areas of the laboratory, etc. This room or area must be posted with a Designated Area sign available through your department Chemical Hygiene Officer or the Science Stockroom Coordinator.
D. Describe where the substance will be stored. Be specific, e.g, on a shelf, in a refrigerator, in a hood, etc.
E. Self-explanatory. Double containment means that the container will be placed inside another container that is capable of holding the contents in the event of a leak and provides a protective outer covering in the event of contamination of the primary container.

7. Emergency Equipment

A. A and B. Self-explanatory.
C. Describe what, if any, special emergency equipment is staged and/or available in the event of an accident. For example, the use of a 2.5% calcium gluconate gel as a topical neutralizing agent for dermal exposures to hydrofluoric acid.

8. Waste Disposal

A. Some corrosive chemicals may be neutralized before disposal via the drain or the hazardous waste program.
B. Some materials, such as ethidium bromide, can be chemically deactivated before disposal via the drain or the hazardous waste program.
C. Self-explanatory.

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX J
SUPERVISOR'S ACCIDENT INVESTIGATION REPORT (For Students/Non-Employees)

HAMILTON COLLEGE ACCIDENT REPORT FORM		
Reported By:	Telephone:	Location:
Incident Date: Incident Time:	Report Date: Report Time:	
Injury Type(s):	Individual(s) Involved: Year:	
Location: Department:	Room/Specific Area:	
Incident Description: Did Student/Employee Go To Health Center? ☐ Yes ☐ No		
Corrective Action To Prevent Recurrence:		
Report Reviewed By: Date:	Report Submitted To: Date:	

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX K
SUPERVISOR'S ACCIDENT INVESTIGATION REPORT (For Employees Only)

Report to be completed by employee's/student's supervisor within 24 hours of the accident, and routed to the Personnel Department upon completion.

(Check One) _____ Employee _____ Student Worker(TA/Work-Study) _____ Student Researcher/Other

Name	Age	Time of Accident am pm	Date of Accident	Date Returned to Work

Job Classification	Job Assignment when Injured	Length of Service	Location of Accident (specific)

Nature of injury and any first-aid administered:

Doctor/Hospital referred to:

Detailed description of accident:

_____

_____

_____

_____

Primary cause of accident:

_____

_____

_____

Injury cause types (check all that apply):

□ Struck by Tool/Object
□ Struck Against
□ Strain or Overexertion
□ Slip/Trip/Fall
□ Falling/Flying Objects
□ Caught On/In/Between
□ Hot/Cold Contact
□ Faulty Equipment
□ Inexperience
□ Safety Rule Violation
□ Inattention To Job
□ Other (describe) _____

When was supervisor informed of accident?	Were any witnesses present?
Was any equipment involved?	If yes, was there any equipment damage?

Supervisor's/instructor's investigation findings and corrective action recommended/taken to prevent recurrence:

_____

_____

_____

Investigation completed by:_____ (Supervisor/Instructor)	Date of investigation: _____/_____/_____
Report reviewed by:_____ (Human Resources Department)	Date of review: _____/_____/_____

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX L-1
GENERAL GLOVE SELECTION CHART

Type	Advantages	Disadvantages	Use Against
Natural rubber	Low cost, good physical properties, dexterity	Poor vs. oils, greases, organics. Frequently imported; may be poor quality	Bases, alcohols, dilute water solutions; fair vs. aldehydes, ketones.
Natural rubber blends	Low cost, dexterity, better chemical resistance than natural rubber vs. some chemicals	Physical properties frequently inferior to natural rubber	Same as natural rubber
Polyvinyl chloride (PVC)	Low cost, very good physical properties, medium cost, medium chemical resistance	Plasticizers can be stripped; frequently imported may be poor quality	Strong acids and bases, salts, other water solutions, alcohols
Neoprene	Medium cost, medium chemical resistance, medium physical properties	NA	Oxidizing acids, anilines, phenol, glycol ethers
Nitrile	Low cost, excellent physical properties, dexterity	Poor vs. benzene, methylene chloride, trichloroethylene, many ketones	Oils, greases, aliphatic chemicals, xylene, perchloroethylene, trichloroethane; fair vs. toluene
Butyl	Speciality glove, polar organics	Expensive, poor vs. hydrocarbons, chlorinated solvents	Glycol ethers, ketones, esters
Polyvinyl alcohol (PVA)	Specialty glove, resists a very broad range of organics, good physical properties	Very expensive, water sensitive, poor vs. light alcohols	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone), esters, ethers
Fluoro-elastomer (Viton)	Specialty glove, organic solvents	Extremely expensive, poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Norfoil (Silver Shield)	Excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Use for Hazmat work

HAMILTON COLLEGE
ENVIRONMENTAL HEALTH & SAFETY PROCEDURES
APPENDIX L-2
GLOVE TYPE AND CHEMICAL RESISTIVITY

*** Limited Service**	**VG= Very Good**	**G= Good**	**F=Fair**	**P=Poor (not recommended)**

Chemical	Neoprene	Natural Latex Rubber	Nitrile
*Acetaldehyde	VG	G	G
Acetic acid	VG	VG	VG
*Acetone	G	VG	P
Ammonium hydroxide	VG	VG	VG
*Amyl acetate	F	P	P
Aniline	G	F	P
*Benzaldehyde	F	F	G
*Benzene	F	F	P
Butyl acetate	G	F	P
Butyl alcohol	VG	VG	VG
Carbon disulfide	F	F	F
*Carbon tetrachloride	F	P	G
Castor oil	F	P	VG
*Chlorobenzene	F	P	P
*Chloroform	G	P	P
Chloronaphthalene	F	P	F
Chromic Acid (50%)	F	P	F
Citric acid (10%)	VG	VG	VG
Cyclohexanol	G	F	VG
*Dibutyl phthalate	G	P	G
Diesel fuel	G	P	VG
Diisobutyl ketone	P	F	P
Dimethylformamide	F	F	G
Dioctyl phthalate	G	P	VG
Dioxane	VG	G	G
Epoxy resins, dry	VG	VG	VG
*Ethyl acetate	G	F	F
Ethyl alcohol	VG	VG	VG
Ethyl ether	VG	G	G
*Ethylene dichloride	F	P	P
Ethylene glycol	VG	VG	VG
Formaldehyde	VG	VG	VG
Formic acid	VG	VG	VG
Freon 11	G	P	G
Freon 12	G	P	G
Freon 21	G	P	G
Freon 22	G	P	G
*Furfural	G	G	G
Gasoline	G	P	VG
Glycerine	VG	VG	VG
Hexane	F	P	G
Hydrochloric acid	VG	G	G
Hydrofluoric acid (48%)	VG	G	G
Hydrogen peroxide (30%)	G	G	G
Hydroquinone	G	G	F
Isooctane	F	P	VG
Isopropyl alcohol	VG	VG	VG
Kerosene	VG	F	VG
Ketones	G	VG	P

Chemical	Neoprene	Natural Latex Rubber	Nitrile
Lacquer thinners	G	F	P
Lactic acid (85%)	VG	VG	VG
Lauric acid (36%)	VG	F	VG
Lineoleic acid	VG	P	G
Linseed oil	VG	P	VG
Maleic acid	VG	VG	VG
Methyl alcohol	VG	VG	VG
Methylamine	F	F	G
Methyl bromide	G	F	F
*Methyl chloride	P	P	P
*Methyl ethyl ketone	G	G	P
*Methyl isobutyl ketone	F	F	P
Methyl methacrylate	G	G	F
Monoethanolamine	VG	G	VG
Morpholine	VG	VG	G
Naphthalene	G	F	G
Naphthas, aliphatic	VG	F	VG
Naphthas, aromatic	G	P	G
*Nitric acid	G	F	F
Nitromethane (95.5%)	F	P	F
Nitropropane (95.5%)	F	P	F
Octyl alcohol	VG	VG	VG
Oleic acid	VG	F	VG
Oxalic acid	VG	VG	VG
Palmitic acid	VG	VG	VG
Perchloric acid (60%)	VG	F	G
Perchloroethylene	F	P	G
Petroleum distillates-naphtha	G	P	VG
Phenol	VG	F	F
Phosphoric acid	VG	G	VG
Potassium hydroxide	VG	VG	VG
Propyl acetate	G	F	F
Propyl alcohol	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG
Sodium hydroxide	VG	VG	VG
Styrene	P	P	F
Stryene (100%)	P	P	F
Sulfuric acid	G	G	G
Tannic acid (65%)	VG	VG	VG
Tetrahydrofuran	P	F	F
*Toluene	F	P	F
Toluene diisocyanate	F	G	F
*Trichloroethylene	F	F	G
Triethanolamine	VG	G	VG
Tung oil	VG	P	VG
Turpentine	G	F	VG
*Xylene	P	P	F

APPENDIX M
WRITTEN LABORATORY HAZARD EVALUATION & CHECKLIST FOR PERSONAL PROTECTIVE EQUIPMENT (PPE) USE

Laboratory faculty/supervisors (i.e. authorized personnel) should consider using this form/format so as to facilitate and achieve written laboratory hazard evaluations as required by OSHA. The goal is to ensure that any actual or potential hazards associated with work in teaching or research labs are properly identified, such that students and employees fully understand the PPE control measures to employ to avoid injury/illness.

Faculty/Supv. Name:	**Department:**
Faculty/Supv. Signature:	**Date of Assessment:**
☐ **Teaching Lab**	**List Course #, Lab Section and Lab/Room #:**
☐ **Research Lab**	**List Project/Scope of Work, Researcher Names and Lab/Room #:**

STEP 1: Hazard Identification		
Review and list the chemical (or biological) hazards associated with the lab activity.		**Initials:** _____
STEP 2: Selection of Personal Protective Equipment Control Strategies From Table M-1 Below		
Review Table M-1 below, and identify the typical PPE control strategies to be utilized (otherwise, you may list the specific PPE control measures)	Table M-1 Typical PPE Control Measures:	**Initials:** _____
	Other Specific PPE Control Measures:	
STEP 3: Lab Specific Training for Personal Protective Equipment		
Train lab personnel on the type and variety of PPE to be used, as follows:	• What types of PPE are used in the lab. • When is PPE necessary in the lab. • How to obtain PPE for this lab. • How to wear, adjust, and use PPE for this lab. • How to properly care/maintain, useful life, and disposal of PPE for this lab. • Limitations of the PPE for this lab. • Proper PPE practices including not wearing PPE outside of lab hazard areas (i.e. in hallways and eating areas)	**Initials:** _____
STEP 4: Documentation		
• Post a copy of this written laboratory hazard evaluation within the lab, and maintain a copy for future reference.		
• Deliver original signed laboratory hazard evaluation to the Departmental Chemical Hygiene Officer for permanent recordkeeping and retention.		

Table M-1: Personal Protective Equipment Control Strategies			
Control Strategy	**Activity**	**Potential Hazards**	**Recommended PPE**
A	Low/no hazardous activity (i.e. lab instruction or training)	None	None
B	Work with small volumes (<1 liter) of low hazard chemicals or simple flammables (ethanol) with no splash hazard.	Eye or skin damage.	Safety glasses, light chemical-resistant gloves.
C	Work with small volumes (<1 liter) of common corrosive liquids.	Eye or skin damage.	Safety goggles, light chemical-resistant gloves, lab coat.
D	Work with moderate volumes (>1 liter) of common corrosive liquids, or where any corrosive splash hazard exists.	Poisoning, increased potential for eye or skin damage.	Safety goggles, light chemical-resistant gloves, lab coat and chemical resistant apron.
E	Work with moderate volumes (>1 liter) of simple flammables (alcohols), or work with any volume of poisonous organic solvents (without splash hazards).	Skin or eye damage, potential poisoning through skin contact.	Safety goggles, light chemical-resistant gloves, lab coat.
F	Work with moderate volumes (>1 liter) of simple flammables (alcohols), or work with any volume of poisonous organic solvents (with splash hazards).	Major skin or eye damage, potential poisoning through skin contact, and fire.	Safety goggles, light chemical-resistant gloves, lab coat and chemical resistant apron.
G	Work with moderately toxic or hazardous chemicals (solid, liquid, or gas).	Eye or skin damage, potential poisoning through skin contact.	Safety glasses, light chemical-resistant gloves, lab coat.
H	Work with acutely toxic or hazardous chemicals (solid, liquid, or gas).	Increased potential for eye or skin damage, increased potential poisoning through skin contact.	Safety goggles, heavy chemical-resistant gloves, lab coat.
I	Work with Biosafety Level 1 materials.	Eye or skin damage.	Safety glasses, light chemical-resistant gloves.
J	Work with Biosafety Level 2 materials.	Increased potential for eye or skin damage, increased potential poisoning through skin contact.	Safety glasses, light chemical-resistant gloves, lab coat.
K	Work with an apparatus with contents under pressure or vacuum.	Eye or skin damage.	Safety glasses or goggles, face shield for high risk activities, chemical-resistant gloves, lab coat, chemical-resistant apron for high risk activities.
L	Work with air or water reactive chemicals.	Severe skin and eye damage, and fire.	Work in inert atmosphere, when possible. Safety goggles, chemical-resistant gloves, lab coat, flame resistant lab coat for high risk activities (e.g. Nomex), and chemical-resistant apron for high risk activities.
M	Work with potentially explosive chemicals or reactions.	Splash, detonation, flying debris, skin and eye damage, fire.	Safety glasses, face shield and/or blast shield, heavy gloves, flame-resistant lab coat for high risk activities (e.g. Nomex).
N	Work with low and high temperatures (cryogens, heated materials).	Burns, splashes, fire.	Safety glasses, face shield (when dispensing), lab coat, thermally insulated gloves.
O	Minor chemical spill cleanup.	Skin or eye damage, respiratory damage.	Safety glasses or goggles, light chemical-resistant gloves, lab coat, chemical-resistant apron and booties for high risk activities, dust mask (as needed).