GOUCHER | college

Chemical Hygiene Plan

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APPENDICES

I. ADMINISTRATIVE COMMITMENT

Goucher College is fully committed to providing a safe and healthful work environment for every employee. Sometimes it is necessary for employees, especially laboratory and facilities maintenance personnel, to work with or around potentially hazardous substances. In these instances, it is important that employees are aware of the identity of the substance, including its health-related and physical properties, and the work practices required to minimize potential hazards. Goucher College has provided engineering controls, personal protective equipment, emergency equipment and this Chemical Hygiene Plan (CHP) as measures to ensure a safe work environment for employees working in laboratories and support areas. The CHP has been formulated around fundamental principles of accident prevention. The CHP complies fully with the OSHA Laboratory Standard as well as other safety and health standards established by federal, state and municipal laws, guidelines and regulations. Personnel at all levels are expected to comply with requirements of the CHP and participate in the safety program. Employees/students are encouraged to report to their supervisors' unsafe processes or conditions as well as to provide ideas to improve the safety of the work environment at Goucher College.

A. Purpose

The purpose of the CHP is to provide guidance to laboratory personnel, faculty, and students for working safely in the laboratory environment. The CHP complies with the requirements of OSHA's Laboratory Standard and describes proper laboratory practices, procedures, protective equipment, and hazard identification. The CHP is available on the Goucher Website. A copy of the CHP should be maintained with or in the Safety Data Sheet (SDS) binder and be readily available to all personnel in the laboratory.

B. Scope

The provisions of the CHP apply to all laboratory personnel, faculty, students, and other employees who routinely visit or occasionally work in the laboratory, and all contractors who might be exposed to laboratory hazards while at Goucher College. All laboratory personnel are encouraged to contribute their skills and knowledge to the CHP such as routine activities, chemical safety, hazardous material handling, or procedures to minimize chemical exposures.

The Chemical Hygiene Safety Officer (CHO) annually review the CHP for effectiveness and amend as necessary. New laboratory personnel, faculty, and students will be required to review and understand the CHP as part of their Orientation and all will receive regular training.

II. CHEMICAL HYGIENE PLAN – RESPONSIBILITIES

In order to extend protection to employees, the Occupational Safety and Health Administration (OSHA) has enacted a standard entitled "Occupational Exposure to Hazardous Chemicals in Laboratories," 29 CFR 1910.1450 (attached as Appendix A) The center post of this standard is the CHP. All Goucher College employees are required to comply with specific guidelines set forth in this plan document. Responsibilities of specific Goucher College personnel are discussed below. Contact information for all personnel are included in Appendix B.

A. President

The President shall review and approve the Chemical Hygiene Plan and all updates to the plan.

B. Provost

The Provost is responsible for enforcement of the Plan as described in Section 13.0 of the Plan.

C. Center Directors/Program Coordinators

Program Coordinators are responsible for communicating and enforcing the Chemical Hygiene Plan within their programs.

D. Chemical Hygiene Officer (CHO) Responsibilities

The Chemical Hygiene Officer (CHO) will be responsible for measures that create a safe campus environment. An outside consultant from Triumvirate Environmental, Inc. serves as the college's CHO is responsible for:

1. Staff training required by supervisors to supplement program or laboratory training.
2. Facilitating/conducting laboratory inspections.
3. Monitoring hoods and other protective devices to ensure proper operation.
4. Approving procedures involving toxic and highly hazardous chemicals.
5. Monitoring employee exposure to chemicals, as needed.
6. Reviewing designs for new laboratory and support area construction.
7. Coordinating emergency response to hazardous material spills within laboratories, while onsite.
8. Advising on personal protective equipment.
9. Overseeing the handling of hazardous materials.
10. Maintaining safety data sheets (SDS) in a central location for the laboratories.
11. Overseeing the disposal of excess or waste hazardous materials from laboratories with sole signature authority for Hazardous Waste Manifests.
12. Recording incoming chemicals into chemical inventory.

E. Science Programs Designee Responsibilities

Each science program shall appoint a designee who is responsible for:

1. Acting as liaison between the College's CHO and the Program.
2. Assembling and updating an inventory list of all chemicals in the Program.
3. Maintaining SDSs in a central location for chemicals used in the Program. These can be maintained within the laboratories, in a central location, or on-line, depending on the needs of the department.
4. The Sciences' Program Designee will make sure the Main Accumulation Areas are checked weekly, as well as eye wash stations. This will be done by the Chemical Lab Prep assistant, and if they are not available, another employee will be assigned.

F. Faculty Responsibilities

Faculty bears responsibility for providing a safe environment within the laboratories or other areas under their control. Faculty members are responsible for:

1. Ensuring that science program staff under their supervision who work with hazardous materials know and have been trained in the requirements of the CHP.
2. Requesting assistance from the CHO, as needed, regarding hazard information and training.
3. Providing required training to staff and research students on the hazards of the chemicals used in their classes and research and proper chemical handling techniques. This training should be taken annually, and will be noted by the CHO.
4. Ensuring that staff and students follow proper procedures in the handling and disposal of chemicals.
5. Ensuring that staff comply with the Goucher College Hazard Communication and Chemical Hygiene Programs, as applicable.
6. Maintaining a list of all hazardous chemicals under their control, and uploading or providing at link to the SDS on the box website.
7. Identifying and labeling general procedures to be utilized according to the material safety data sheet (SDS) guidelines for materials to be used.
8. Determining the level of safety equipment needed according to the Hazard Ranking developed by the Safety Committee in consultation with SDS information (Appendix C).
9. Training all students on proper safety procedures and the College's procedures for handling emergencies.
10. Ensuring that all containers are properly labeled and appropriate warning signage is displayed.
11. Ensuring that all staff and students have and use appropriate protective equipment.
12. Ensuring that all hazardous waste is handled in accordance with the College's procedures.
13. Ensuring that the SDS information for all lab chemicals is readily available and all staff and students know the storage location of the SDS and review and understand the SDS prior to usage of the chemical.
14. Ensuring that safety checks have been performed prior to the use of the equipment.
15. Reporting all accidents, injuries and close calls to the CHO, the Department of Human Resources and the Office of Campus Safety.

G. Employee and Student Responsibilities

Employees and student employees bear the greatest responsibility for their own safety and, therefore, must:

1. Attend initial or annual refresher training as is appropriate;
2. Review SDS prior to using all unfamiliar hazardous materials;
3. Handle all chemicals safely;
4. Adhere to established policies and procedures;

5. Follow safe work practices;
6. Wear appropriate personal protective equipment;
7. Exercise good judgment;
8. Look out for each other;
9. Report all accidents, injuries and close calls to the laboratory supervisor, the CHO, the Department of Human Resources and the Office of Campus Safety;

H. Facilities Management Services (FMS)

This department has responsibility for the continuous operation of facilities where chemicals are used, and for maintaining engineered safety devices. The department also:

1. Tests eyewash stations every 3 months;
2. Inspects safety showers, eyewash stations, and hoods annually;
3. Maintains negative pressure in controlled work areas;
4. Maintains fire extinguishers;
5. Reviews construction, modification or renovation plans for safety design; and
6. Assists the Director of Campus Safety in carrying out fire drills and emergency and disaster drills.

I. Director of Campus Safety

This office has general responsibility for personal safety and:

1. Schedules and conducts fire drills and emergency and disaster drills;
2. Arranges transportation to a medical facility for a potential victim of overexposure.

III. GENERAL RULES AND PROCEDURES FOR WORKING WITH CHEMICALS

To ensure a safe and healthful work environment, Goucher College has prepared general rules and procedures, which must be followed when working with hazardous chemicals. The following standard operating procedures will be discussed with employees and students, prior to commencing experiments or other operations:

A. General Rules/Housekeeping

1. Containers of solvents, volatile materials, and other potentially hazardous materials should remain sealed when not in use to minimize potential for hazardous materials being released into the atmosphere.
2. Use only those chemicals for which the quality of the available ventilation system is appropriate.
3. Materials should not be stored in hoods unless in use; for example, leaving materials set up in the hood for a lab class is acceptable, or if an experiment is running overnight.
4. Always be alert for unsafe conditions and see that they are corrected when detected.

5. Conduct lab facility inspections according to the schedule outlined. Inspections shall be conducted by the CHO with the assistance of other individuals as needed, including department chairs, faculty members, lab instructors, and students.
6. Avoid unnecessary routine exposure to chemicals by any route.
7. Do not allow release of toxic substances in cold rooms and warm rooms, since these rooms have contained re-circulated atmospheres.
8. Use equipment only for its intended purpose.
9. Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware.
10. Use extra care with Dewar flasks and other evacuated glass apparatus, shield or wrap them to contain chemicals and fragments should implosion occur.
11. Horseplay is prohibited in the laboratory and other areas where hazardous chemicals are used.
12. Keep the work area clean and uncluttered, with chemicals and equipment properly labeled and stored.
13. Clean up the work area on completion of an operation or at the end of each day.
14. Seek information and advice about hazards, plan appropriate protective procedures and plan positioning of equipment before beginning any new operation.
15. If operation must be left unattended, leave lights on, place an appropriate sign on the door and provide for containment of the toxic substances in the event of failure of a utility service, such as water.
16. Do not work alone if the procedures being conducted are hazardous.

B. Personal Hygiene

1. Hands should be washed thoroughly with soap and water after removing protective gloves and prior to leaving the work area or taking breaks.
2. Confine long hair and loose clothing when working with hazardous materials.
3. Do not pipette or siphon by mouth.
4. Smelling or tasting chemicals is prohibited.

C. Food and Smoking

1. There is to be no eating, smoking, drinking, chewing gum or applying cosmetics in spaces where hazardous chemicals are present. Rooms which are separated by floor to ceiling walls, and do not have any chemical, radioactive or biohazardous agents may be used for food consumption, preparation or application of cosmetics at the discretion of the supervisor.
2. Storage, handling or consumption of food or beverages in refrigerators, glassware, utensils, or other areas that are also used for operations with hazardous materials is prohibited.
3. Do not store laboratory related or hazardous materials in refrigerators normally used to store food. There shall be no regular storage, use or disposal of food items in laboratories.

D. Protective Clothing and Personal Equipment

1. The principal investigator, who may consult with the CHO, should determine when protective clothing and personal equipment, including eye protection, is necessary, as set forth in Appendix C. Lab coats should not be worn outside the laboratory unless transporting chemicals. Lab coats will be removed immediately upon significant contamination.
2. Splash goggles are required for high and medium hazard procedures when handling hazardous liquids.
3. Face shields or goggles that effectively block UV light are required for high or medium hazard procedures when visualizing or photographing with UV light.
4. Protective gloves are required to prevent skin contact with potentially hazardous substances as determined by the principal investigator in reference to SDS guidelines and the Hazard Ranking guidelines (Appendix C). Inspect gloves before each use, wash hazardous chemicals off them before removal, and replace periodically.
5. Appropriate eye protection, as determined by the principal investigator, is required for all persons in areas where hazardous chemicals are handled.
6. Footwear that fully covers the feet at all times are required when working in a laboratory. Sandals and perforated shoes are not allowed.
7. Appropriate clothing should be worn in the lab to protect from chemical hazards.

E. Protective Laboratory Equipment

Equipment compatible with the required degree of protection for substances being handled will be supplied by Goucher College to employees and students. Guidance from the National Research Council is incorporated into this program for various toxicity classes.

1. The principal investigator is required to determine when protective laboratory equipment is necessary.
2. Drench-type safety shower and eyewash fountains must be easily accessible and in good working order in each laboratory.
3. At least one fire extinguisher will be provided for each laboratory and support area.
4. Fire alarms and telephones for emergency use will be located in close proximity to work areas.
5. Vent apparatus such as vacuum pumps, distillation columns, and glove boxes.
6. Chemical-hygiene related equipment such as exhaust hoods, incinerators, biosafety cabinets, etc. should undergo an annual inspection and be modified if inadequate. The CHO shall insure that such inspections are conducted.
7. Chemical laboratory ventilation should not be relied on for protection from toxic substances released into the laboratory. The lab air should be continually replaced, preventing increase of air concentrations of toxic substances during the working day.
8. Four (4) to twelve (12) room air changes per hour is normally adequate general laboratory ventilation if local exhaust systems such as a hood are used as the primary method of control.
9. General airflow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas.
10. Confirm adequate hood performance before use; keep hood closed to a minimum at all times except when adjustments within the hood are being made.

11. Use a lab hood for all operations which might result in release of toxic chemical vapors or dust (For example, a volatile compound with a PEL or TLV of less than 50 ppm should be handled only in a lab hood or have a dedicated local exhaust system.)
12. Adhere to the following procedures when utilizing the fume hood:
    - Check to see that the hood is operating.
    - Keep all operations six (6) inches back from the hood face.
    - Keep baffle slots and air foil free of obstructions.
    - Keep sash height to a minimum.
    - Do not put head into the hood.
    - Do not routinely store chemicals or associated apparatus in hood; and
    - Do not dispose of chemicals in the fume hood.
    - Air flow into and within lab hoods, should not be excessively turbulent and hood face
    - Velocity should be 60 to 100 linear feet per minute.
    - Laboratory hoods should not be used if the exhaust system is not functioning properly.
    - Leave the hood "on" when it is not in active use if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off".

F. Procedures for exposure incidents

1. If chemicals enter the eye due to accidents, such as a spill, promptly flush eyes with water for 15 minutes, call 911, call the Maryland Poison Control Center (1-800-222-1222) and seek medical attention immediately. Consult the SDS as soon as possible and provide the SDS to emergency personnel.
2. If chemicals are ingested, call 911, the Maryland Poison Control Center (1-800-222-1222) and seek immediate medical attention. Consult the SDS as soon as possible and provide the SDS to emergency personnel.

IV. PROCUREMENT, DISTRIBUTION AND STORAGE OF CHEMICALS

A. Procurement Policy

1. Personnel may order chemical supplies directly from the vendor:
    - No prior approval process is in place, but the CHO will review incoming chemicals for safety and waste disposal considerations. Faculty can discuss chemical safety with the CHO if they wish.
    - All chemicals should be delivered to Central Receiving in the FMS Building, unless circumstances mandate alternate delivery. FMS will deliver the chemicals to the chemical stockroom, where they will be distributed to the labs. FMS will place a copy of the shipping form with the SDS in the CHO mailbox, or put an electronic copy in the CHO box folder, and the CHO will update the inventory.
2. Chemical inventory
    - A chemical inventory must be completed by the program designee on an annual basis and provided to the CHO. Each program designee must be able to provide a list to the CHO by December 31st.

- The CHO will review the chemicals on the inventory and ensure that SDSs are available for each chemical in stock.
- The CHO will maintain a master list of laboratory chemicals for the college.
- When disposing of an empty chemical bottle, notify the CHO what you have thrown away so it can be removed from the inventory.
- Each laboratory program head will also maintain a complete list of SDSs for chemicals used in the program's laboratories.

B. Distribution

Goucher College requires that hand carried hazardous, toxic, or flammable chemicals be carried in containers which serve as a secondary containment system in case of breakage of the original container and which are compatible with the chemical being transported. Rubber or plastic containers are examples of carrying containers that might be used. Carts with closed sides are acceptable forms of transport for multiple chemicals. The elevator can be used when transporting chemicals between floors. If using the elevator is not possible, chemicals must be carried in secondary containment.

C. Storage and Preparation

Goucher College requires that all toxic substances be segregated in a well-identified area with local exhaust ventilation. Highly toxic, corrosive and flammable liquid chemicals must be stored in unbreakable secondary containers. Stored chemicals are to be examined periodically (at least annually) for replacement, deterioration and container integrity. The CHO shall ensure that such examinations occur. All preparation or repackaging should be completed under safe conditions.

Amounts to be stored should be as small as practical. Storage on bench tops and in hoods is not permitted. Chemicals should not be stored in areas which are heated or directly exposed to sunlight; these storage areas could cause the chemical to deteriorate. Particular care should be taken with respect to the storage of flammable materials and specific rules for these materials are set forth in Appendix E.

V. HAZARDOUS MATERIALS SPILL OR ACCIDENT PROCEDURES

The following emergency procedures will be communicated to all personnel prior to working with hazardous materials. **If a fire or other serious accident occurs, do not try to handle the emergency. Pull the Fire Alarm and get yourself and other occupants out of the space and building as quickly as possible.**

In the event of an accident or a spill involving hazardous materials that does not result in a fire or a threat to personal safety, the staff should notify the instructor or principal investigator immediately and then:

1. Evaluate the spill and obtain the SDS, considering:
    - Are the materials innocuous, corrosive, flammable, toxic, volatile or explosive?
    - Identify all materials by common or chemical name.
    - How much is spilled?
    - Determine danger to staff or visitors.
    - Determine danger to equipment or property.

2. Contain the spill using appropriate absorbent material to prevent further damage to personnel or equipment.
3. Evacuate the area if the spill cannot be contained, or if the spilled material produces irritating odors, or flammable, or explosive vapors.
4. Clean up of spilled materials:
    - Spills of innocuous material can be cleaned up by personnel or housekeeping.
    - Small spills (< 1 liter) of acids, bases and flammables should be cleaned up by personnel using appropriate neutralizer/absorbents and proper personal protective equipment.
    - Small spills of toxic or explosive material and large spills (> 1 liter) of corrosive or so designated flammable materials should be cleaned up only by appropriately trained emergency response personnel. Call Goucher Office of Campus Safety Personnel at 410-337-6112 if emergency response action is required. They will then contact Triumvirate Environmental at 410-636-3700 or 800-966-9282 (non-business hours). When calling, have the following information available:
        i. Name and phone number;
        ii. Location of spill;
        iii. Exact description of what was spilled (state any compounds which may form toxic compounds) and approximate quantity spilled;
        iv. Any steps taken to control the spill; and
        v. Any injuries that have occurred.

VI. WASTE DISPOSAL PROGRAM

Chemicals must be disposed of properly to assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste chemicals. Unwanted chemicals must be disposed of in accordance with Goucher's Hazardous Materials Management Program attached as Appendix F, through the Chemical Hygiene Officer.

VII. EMPLOYEE INFORMATION AND TRAINING

It is Goucher College's policy to assure that all employees at risk of exposure to hazardous materials are adequately informed about the work that may involve exposure to such materials, the risks and what to do if an accident occurs. Every employee who may work with or near such materials must be advised of the location of such materials and the proper use of required and recommended protective apparel and equipment. The College will provide training to faculty and staff as necessary and appropriate for such individuals to carry out their job duties in a safe manner.

VIII. ENVIRONMENTAL MONITORING

The OSHA Laboratory Standard suggests that regular instrumental monitoring of air contaminants is not justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices, or when a highly toxic substance is stored or used three or more times per week.

If employees are exposed to a chemical above the OSHA Action Level (AL) an exposure assessment will be performed on an as-needed basis by a qualified third party.

As part of its environmental monitoring program, Goucher College also performs laboratory safety inspections as set forth in Appendix G. The CHO will complete inspections at least once each semester. A checklist has been developed which will assist in identifying unsafe conditions or acts by personnel. The findings of the inspections will be reviewed with the appropriate laboratory supervisor and department head within one week. Work orders will be placed with FMS whenever a deficiency is noted that will require either FMS or contract assistance in correcting the deficiency. The inspection addresses housekeeping, gas cylinders, fire protection, egress, electrical, chemical exposure, first aid, ventilation systems, safety and emergency equipment and hazardous material handling. A blank Laboratory Safety Inspection Checklist is located in Appendix G of this Plan. The CHO will maintain inspection records in Appendix G or another location.

IX. MEDICAL CONSULTATION AND EXAMINATION

A. Circumstances Requiring Medical Consultation.

Goucher College will provide all employees an opportunity to receive medical attention, including any follow-up examination, which an examining physician determines to be necessary, under the following circumstances:

1. The employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed;
2. Exposure monitoring reveals an exposure level routinely above the action level, PEL or TLV for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements; or
3. An event takes place in the work area, such as a spill, leak, explosion or other occurrence, resulting in the likelihood of a hazardous exposure.

B. Procedure for Medical Evaluation and Monitoring.

If medical consultation is required as provided in paragraph A, such medical examination and consultation will be performed by or under the direct supervision of a licensed physician and will be provided without cost to the employee, without loss of pay and at a reasonable time and place.

1. At the time of the initial exposure event, Goucher College employees trained in first aid will be available to assist with such incidents. Any individual that observes an emergency situation involving hazardous materials shall contact the Goucher College Office of Campus Safety, which shall respond to the call in accordance with set procedures.

2. After the initial emergency has passed, and in non-emergency situations, the Department of Human Resources will refer the employee and provide the following information to a licensed physician so that a written opinion from the examining physician can be obtained:
    - The identity of the hazardous chemical(s) to which the employee may have been exposed;
    - A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and,
    - A description of the signs and symptoms of exposure that the employee has been experiencing, if any.
3. The Department of Human Resources will obtain a written opinion from the examining physician, which will include:
    - Any recommendations for further medical follow-up and/or monitoring;
    - The results of the medical examination and any associated tests, except that the written opinion will not reveal specific findings of a diagnosis unrelated to occupational exposure;
    - Any medical conditions which may be revealed in the course of the examination, which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and,
    - A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
4. If continued medical monitoring is recommended by the examining physician, the Department of Human Resources will arrange for such medical monitoring, which shall be in accordance with the applicable standard, and provided at the College's expense.

C. Record-keeping relating to medical examinations and monitoring

1. Goucher College's Department of Human Resources shall establish and maintain for each affected employee a file to include:
    - An accurate record of any measurements taken to monitor employee exposures, if any; and
    - Any medical consultation and examinations including tests or written opinions received by the College pursuant to the procedures, above.
2. Such records shall be maintained in accordance with 29 CFR 1910.1020 as follows:
    - Employee medical records. The medical records of each employee shall be preserved and maintained for the duration of employment plus thirty (30) years except for the following records:

        i. Health insurance claims records maintained separately from the employer's medical program and its records;

        ii. First aid records (not including medical histories) of one-time treatment and subsequent observation of minor injuries which do not involve medical treatment, loss of consciousness, restriction of work or motion or transfer to another job, if made on-site by a non-physician and if maintained separately from the employer's medical program and records;

iii. The medical records of employees who have worked for less than one year for the employer, provided that they are given to the employee upon termination.

- Employee exposure records. Each employee exposure record shall be preserved and maintained for 30 years except that:

  i. Background data to environmental monitoring, such as lab reports and worksheets, need only be retained for one year if the sampling results, the collection methodology, a description of the analytical and mathematical methods used and a summary of other background data relevant to interpretation of the results obtained are retained for at least 30 years;

  ii. Material safety data sheets need not be retained for any specified period as long as some record of the identity of the substance or agent, where it was used and when it was used is retained for at least 30 years.

- Analyses using exposure or medical records. Each analysis using exposure or medical records shall be preserved and maintained for at least thirty (30) years.

  i. Employees and their representatives and authorized representatives of the Occupational Safety and Health Administration shall be provided access to such records as provided in 29 CFR.1910.1020.

  ii. Copies of such records shall be maintained in the Department of Human Resources in the same manner as other medical records of employees are maintained, that is, they shall be maintained separately from the human resource records relating to employees.

X. RECORDKEEPING

Goucher College will maintain employee medical records, employee exposure records and analyses using exposure or medical records as provided in Section 9.0. In addition, the College will maintain the following records:

A. Safety inspection records of laboratory work areas. A blank copy of the Laboratory Safety Inspection Checklist is located in Appendix G of this CHP and copies of blank Safety Equipment Check Records are located in Appendix H of this CHP. These checklists should be maintained by the CHO for the most recent 3 years.

B. Laboratory accident reports. These records should be maintained for 30 years.

XI. SIGNS AND LABELS

Prominent signs and labels of the following types will be posted throughout Goucher College's laboratories and support areas and other areas where hazardous materials may be used or stored:

A. Emergency telephone numbers of emergency personnel/facilities, supervisors and laboratory workers. These telephone numbers will be verified on an annual basis by the CHO when the CHP is reviewed and revised as changes occur.

B. Identity labels, showing contents of containers and associated hazards, will be affixed to all hazardous material containers including laboratory chemicals and waste containers.

C. Location signs for fire extinguishers, safety showers, eyewash stations, other safety and first aid equipment, exits, and break areas where food and beverage consumption and storage are allowed.

D. Warnings at areas or equipment where special or unusual hazards exist.

All hazardous materials, hazardous waste, and chemical storage areas shall be appropriately labeled indicating the hazards present and any other relevant regulatory requirements. All chemical containers must be labeled regardless of size and whether or not they are hazardous.

Labeling of all chemical containers assists emergency personnel and others in identifying what is and what is not hazardous should a spill occur or other emergency situation arise. Original labels on chemical containers must not be removed or defaced. Labels must be in English and they must contain the complete name of the chemical and be traceable or easily linked to the appropriate SDS (chemical formulas are not allowed). The manufacturer's label is generally sufficient to meet OSHA labeling requirements and should be replaced only if it becomes damaged or illegible. All containers into which chemicals are transferred also need to be legibly labeled in English and include the name of the chemical and appropriate hazard warnings (chemical formulas are not allowed). Portable, secondary containers (flasks, bottles, etc.) only need to comply with labeling requirements if the following occurs:

E. The material is not used during the shift of the person who put the material into the secondary container;

F. The employee who filled the container leaves the area; or

G. The container is no longer in the possession of the person who filled the container.

The Global Harmonized System (GHS) labeling system should be used to utilize uniform labeling. The GHS system requires the chemical name to be listed along with pictograms of hazards. Pictograms are shown in Appendix H.

The CHO shall evaluate signage on an annual basis to update the signs and ensure that they are legible, accurate and up-to-date.

XII. NRC GUIDANCE FOR WORKING WITH HAZARDOUS CHEMICALS

National Research Council guidelines from "Prudent Practices for Handling Hazardous Chemicals in Laboratories," have been incorporated into Goucher College's CHP to provide safety guidance when working with various classes of hazardous materials included in that publication. Laboratory personnel must follow these guidelines found in Appendix I for the following classes of chemicals.

1. Allergens
2. Embryotoxins
3. Acutely toxic chemicals
4. Significant quantities of chemicals of moderate chronic or high acute toxicity
5. Chemicals of high chronic toxicity
6. Animal work with chemicals of high chronic toxicity

XIII. ENFORCEMENT OF THE CHEMICAL HYGIENE PLAN

In the event an employee intentionally violates a provision of this CHP, or in the event of an accident or spill involving hazardous material on campus resulting in (a) personal injury to a student, employee or visitor, (b) injury to property of a student, employee or visitor, or (c) a "close call" or "near miss" which could have resulted in injury to a person or property had not emergency action been taken to avoid injury, the following procedure shall be followed:

A. The individual involved in the incident or any individual with knowledge of the incident shall report the incident to the Center Director, following up with the Provost, if the incident involves a faculty member or student and occurs in a classroom or laboratory, or the Vice President for Human Resources if the incident involves a non-faculty employee. The appropriate Vice President shall determine, in his or her discretion, whether the matter can be resolved through ordinary disciplinary processes and, if so, shall resolve the matter by issuing written findings concerning the violation of policy or cause of the incident and imposing sanctions and other remedial action as appropriate.

B. If the Vice President believes the matter warrants an investigation, or if the individual involved in the incident requests an investigation, the Vice President shall convene a Committee to investigate the violation or incident. The Committee shall be composed of a faculty member (selected by the Vice President or Provost), the Chemical Hygiene Officer and either the director of the program which the incident occurred, if the incident occurred in a classroom or laboratory, or the appropriate supervisor, if the incident involved a non-faculty employee. If the program director was involved in the incident, the Provost shall appoint a tenured faculty member from the Center to serve in place of the program director. If a supervisor was involved in the incident, the Vice President for Human Resources shall appoint a senior administrator to serve in place of the supervisor. If either the Provost or the Vice President for Human Resources was involved in the incident, the President shall assume the responsibility of such Vice President pursuant to this paragraph.

C. In a timely manner, but barring special circumstances, no later than ten working days from the date the violation or incident occurred, the Committee shall convene and initiate an investigation of the incident according to procedures that the Committee shall agree upon. All persons involved in the investigation are obligated to keep information obtained in the investigation as confidential as is reasonably possible.

D. In a timely manner, but barring special circumstances, no later than one month from the date the violation or incident occurred, the Committee shall make a report with recommendations to the appropriate Vice President. The report shall describe the investigation and all relevant evidence obtained in the investigation, and provide support for the conclusions drawn by the Committee

regarding the violation of policy or causes of the incident. The report will also make recommendations to promote greater compliance and safety in the future to avoid recurrence of similar violations or incidents and, if necessary, make recommendations to the Vice President for sanctions or other remedial action as appropriate. The Provost shall be responsible for all actions concerning faculty members or students, and will consult with the Dean of Students in the case where disciplinary action may be required for a student. The Vice President for Human Resources shall be responsible for all actions concerning non-faculty staff members and shall consult with the appropriate supervisor where action is required for a non-faculty employee.

E. Within ten working days after receiving the report of the Committee, the Vice President shall issue a written decision concerning the violation of policy or cause of the incident and imposing sanctions and other remedial action as appropriate.

F. When the respondent is a faculty member, the provost shall institute sanctions in accordance with faculty legislation. If suspension or dismissal is imposed, the Provost will bring the case before the Dismissals and Suspensions Committee (DSC) for informal or formal resolution before that Committee. Faculty members have the right to grieve the imposition of any lesser sanctions, including written reprimands, before the Faculty Grievance Committee.

XIV. CHEMICAL HYGIENE PLAN CERTIFICATION

Goucher College's Chemical Hygiene Plan will be reviewed on an annual basis by the CHO and revised as needed. The CHP will be approved by the CHO and President of Goucher College.

Approved by: _____ Date: _____

Chemical Hygiene Officer

Approved by: _____ Date: _____

President

Chemical Hygiene Plan
Appendix A

Copy of OSHA Standard: Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450)

Chemical Hygiene Plan
Appendix B

COLLEGE PERSONNEL

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Laser Safety Officer Semyon Ginzburg	410-337-6321	Semyon.Ginzburg@goucher.edu

EMERGENCY

1. Baltimore County Fire Department (BCFD) 911

2. Office of Campus Safety and Security ..... x 6112

3. Medical Emergency (Ambulance) 911

4. Health Center x6050

5. Maryland Poison Control Center 1-800-222-1222

Greater Baltimore Medical Center (GBMC)
6701 North Charles Street
Baltimore, MD 21204
443-849-2225

St. Joseph's Hospital
7601 Osler Drive
Towson, MD 21204
ER 2 Urgent Care 410- 337-1224
ER 410- 337-1

Care Now
1220A E. Joppa Road
Suite 109
Towson, MD 21286
410-296-0018

Patient First
10755 Falls Road, Suite 160
Baltimore, MD 21204
410-583-2777
Walk-ins accepted

Triumvirate Environmental
410-636-3700 (business hours)
800-966-9282 (after hours)

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HAZARD ASSESSMENT OF LABORATORY WORKERS

Laboratory work and procedures can be segregated into one of the following hazard categories. The principle investigator will designate the appropriate hazard category for the procedure or protocol to be used in the laboratory. The hazard categories are as follows: high hazard, medium hazard, low hazard and no hazard.

1. High hazard procedures are those procedures, which pose a significant hazard to the laboratory workers. Examples of high hazard procedures are as follows: working with high levels of radioactive materials such as radioactive iodination, use of P32 and gamma emitters, working with human tissue or potentially infectious material, working with pure compounds and making stock solutions of human carcinogens and compounds with a IDLH (immediate dangerous to health and life) level of 5ppm or less.

   Protective equipment required for use of this high hazard procedures are as follows:

   - a chemical fume hood, biological safety cabinet or other appropriate containment **Required**
   - appropriate laboratory coat or gown that covers the complete front of an individual and covers the area above the knees when seated **Required**
   - appropriate gloves **Required**
   - appropriate eyewear **Required**

2. Medium hazard procedures are those procedures, which pose a hazard to the laboratory worker in the event of an exposure due to a splash or an accidental release. Examples of medium hazard procedures are as follows: working with radioactive materials not listed as high hazard, preparing working solutions from stock solutions of materials not listed as high hazard, working with other hazardous material not listed as a high hazard.

   Protective equipment items for use with medium hazard procedures are as follows:

   - chemical fume hood, biological safety cabinet or other containment **Recommended**
   - appropriate laboratory coat or gown **Recommended**
   - appropriate gloves **Required**
   - protective eyewear **Required**

3. Low hazard procedures are those procedures, which pose a minimal hazard to the laboratory worker in normal use and would only pose a hazard if a significant amount of this material is splashed or spilled. Examples of low hazard procedures are as follows: working with radioactive materials that are contained within scintillation vials, working with biological material that are

contained within serum bottles and other primary containment, working with solutions of low hazard materials such as buffers and salt solutions, conducting microscopic work with media inside culture tubes, clean-up of material from completed experiments.

Protective equipment required for low hazard procedures are as follows:

- chemical fume hood, biological safety cabinet or other containment **Optional**
- appropriate laboratory coat or gown **Recommended**
- appropriate gloves **Recommended**
- appropriate protective eyewear **Recommended**

4. No hazard procedures are those procedures conducted in a lab, which pose no hazard to the laboratory worker. Examples of no hazard procedures are as follows: entering data into a computer system, reviewing data and preparing reports, reviewing published documents, viewing of fixed slides microscopically. However, applicable PPE must still be worn if others around you are working with hazards.

   Protective equipment required for no hazard procedures are as follows:

   - chemical fume hood, biological safety cabinet or other containment system **Not applicable**
   - appropriate laboratory coat or gown **Optional**
   - appropriate gloves **Not applicable**
   - appropriate eyewear **Not applicable**

The principal investigator should review each protocol and procedure to be used in the laboratory and classify these procedures based upon these criteria and the information provided in the SDS for all hazardous materials being used in the procedure. The procedures should then be identified as to what hazard ranking has been given to the procedure and all laboratory personnel must be trained by the principal investigator in the proper procedures and the use of proper protective equipment, and should be expected to comply with this information. The principal investigator should contact the CHO for assistance in provided any necessary training.

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LINKS TO SAFETY WEB SITES

REFERENCES

1. Environmental Protection Agency (40 CFR 261) Identification of Hazardous Waste.
2. OSHA Hazard Communication 29 CFR 1910.1200.
3. OSHA Exposure to hazardous chemicals in the laboratory 29 CFR 1910.1045.
4. MOSH - Occupational Safety and Health Law and Regulation, Article 89 annotated code of Maryland.
5. Department of the Environment (COMAR 26.13.02) Identification and Listing of Hazardous Waste.

Compliance – Focused Resources

EPA Regulations

EPA Compliance Programs

Maryland Occupational Safety and Health (MOSH)

Occupational Safety and Health Administration

U.S. Department of Labor

Internet SDS Sites

Where to find SDSs on the internet - from Interactive Learning Paradigms Incorporated. This is an excellent site that contains numerous links to other SDS sites, including a link to a glossary of terms used on SDSs.

Other Chemical Hazard Information Sites

National Institute for Occupational Health (NIOSH)

NIH, National Library of Medicine, TOXNET, a cluster of databases on toxicology, hazardous chemicals, and related areas.

Agency for Toxic Substances and Disease Registry (ASTDR) - ToxfAQs

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LABORATORY STORAGE OF FLAMMABLE MATERIALS

Definitions

A flammable material - Any material with a flashpoint of less than 100°F
Extremely flammable material - Any material with a flashpoint below 32°F
Flashpoint - The temperature at which sufficient vapor is generated to support combustion.

Flammable and combustible liquids are separated into the following classes according to the National Fire Protection Association (NFPA):

Class 1A (Highly Flammable)	Flash Point <73°F (22.8°C) Boiling Point <100°F (37.8°C)	Ex: Ethyl ether, Dimethyl sulfide, Petroleum ether
Class 1B Flammable	Flash Point <73° F (22.8°C) Boiling Point >100° F (37.8°C)	Ex: Acetone, Toluene, Ethanol, Ethyl acetate, Hexane, Gasoline
Class 1C Flammable	Flash Point >73° F (22.8°C), but <100°F (37.8°C)	Ex: Amyl acetate, Bromopentane, Butyric acid, Hexene, Xylene
Class II Combustible	Flash Point >100°F (37.8°C) & <140°F (60°C)	Ex: Acetic acid, Cumene, Formaldehyde
Class IIIA Combustible	Flash Point>140°F (60°C) & <200°F (93.4°C)	Ex: Benzaldehyde, Ethanolamine, Nitrobenzene

Flammable materials pose a hazard as they are easily ignited at room temperature. In order to minimize the hazard related to these materials, the following procedures are required:

1. All flammable materials must be handled in a manner which ensures the safety of the user and others who may be in the area.
2. All flammable materials must be used in the smallest volume possible.
3. All flammable material waste must be handled and disposed of in accordance with all applicable Federal, State, local and college regulations.
4. The volume of flammable materials stored in laboratories is to be minimize and must not exceed the limits set forth below.
5. Flammable or combustible liquids may not be stored near sources of ignition and may not be stored in conventional (non-explosion proof) refrigerators because sparks generated by internal lights or thermostats may ignite flammable material inside the refrigerator.

Laboratory Storage of Flammable Materials

The NFPA has set limits for the storage of flammable liquids. The following table provides the maximum container size for each class of flammable liquid in a secondary container. These limits do not apply to bottles that the flammables come in from the manufacturer.

Maximum Container Sizes for Flammables & Combustibles					
Container Type	**Flammable Liquid Class**			**Combustable Liquid Class**	
	1A	1B	1C	II	IIIA
GLASS	1 pt	1 qt	1 gal	1 gal	5 gal
METAL	1 gal	5 gal	5 gal	5 gal	5 gal
SAFETY CANS	2 gal	5 gal	5 gal	5 gal	5 gal
METAL DRUM (DOT)	60 gal	60 gal	60 gal	60 gal	60 gal
POLYETHYLENE	1.3 gal	5.3 gal	5.3 gal	119 gal	119 gal

The following are other NFPA specifications.

1. Glass containers of Class 1A flammable material should be no larger than one pint (500 mil).
2. 2. Not more than 10 gallons of Class I or Class II liquids combined shall be stored outside of a storage cabinet or storage room, except in safety cans.
3. 3. Not more than 25 gallons of Class I or Class II liquids combined shall be stored in safety cans outside of a storage room or storage cabinet.
4. 4. Not more than 60 gallons of Class IIIA liquids shall be stored outside of a storage room or storage cabinet.
5. 5. Any quantity of liquids over these limits must be stored in an inside storage room or storage cabinet.
6. 6. Containers for storage of Class 1A flammable material should be no larger than one gallon (4 liters) unless the container is a NFPA approved safety container

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HAZARDOUS MATERIALS MANAGEMENT PROGRAM

Available at http://www.goucher.edu/policies/documents/Hazardous-Materials-Management-Program.pdf.

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GOUCHER COLLEGE LABORATORY SAFETY INSPECTION

Each laboratory and support area will be inspected by the principal investigator or designee for safety and health issues on a routine basis, at least weekly. The laboratory supervisor shall check eyewashes once a week by running the water for one minute. This will flush out any bacteria that grow in the stagnant water.

Formal lab inspections will be conducted once per semester no later than the second week of the semester. This ensures that the appropriate safety equipment is present and operational and that safe laboratory practices are being utilized. The CHO will conduct formal inspections and may be accompanied by the Laboratory Supervisor. The CHO will complete the attached Laboratory Safety Inspection Checklist to identify unsafe conditions or acts by laboratory personnel, which could pose a threat to other occupants of the laboratory or support areas. The findings of the inspection will be reviewed within two weeks with the appropriate Laboratory Supervisor and Department Heads except that follow-up with respect to serious deficiencies should occur immediately. When deficiencies are noted that require FMS or contractor assistance to correct, a work order will be placed with FMS by the CHO. The CHO will follow up within one month to ensure that deficiencies have been corrected. Serious deficiencies that could pose an imminent environmental, health or safety hazard must be corrected promptly.

The CHO will provide copies of the Safety Inspection Checklists the Laboratory Supervisor and Director of FMS.

Fire extinguishers are inspected and tagged annually by FMS. Chemical fume hoods are inspected and tagged annually by the CHO.

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OSHA Hazard Communication Standard Pictogram

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Appendix I

NRC GUIDELINES FOR WORKING WITH HAZARDOUS CHEMICALS

From "Prudent Practices in the Laboratory, An Update," National Research Council of the National Academies. [free PDF download available]

A. Allergens:

Allergens are any antigen (a microscopic compound that triggers an immune response) such as pollen, a drug or food that induces an allergic condition in humans or animals. Known chemical allergens include compounds such as formaldehyde, isocyanates, dichromate's and diazomethane. Laboratory workers should wear suitable gloves and long sleeved shirts and pants to prevent skin contact with allergens or substances of unknown allergenic activity. Use of allergens in a laboratory should be reviewed with the Laboratory Supervisor and CHO on an annual basis and whenever a procedural change is made. Allergenic compounds should be stored, properly labeled, in a well-ventilated area in an unbreakable secondary container. If a spill or exposure incident occurs, notify the Laboratory Supervisor immediately and consult a qualified physician when appropriate.

B. Embryotoxins:

Embryotoxins are materials harmful to a developing embryo. Included in this category are organomercurials, formamide, and lead compounds. Woman of childbearing age should handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel especially gloves and long lab coat, which will help prevent skin contact. Use of embryotoxins in a laboratory should be reviewed with the Research Supervisor and CHO on an annual basis and whenever a procedural change is made. Embryotoxins should be stored, properly labeled, in a well-ventilated area in an unbreakable secondary container. If a spill or exposure incident occurs, notify the Laboratory Supervisor immediately and consult a qualified physician when appropriate.

C. Acutely Toxic Chemicals:

Procedures, which require the use of acutely toxic chemicals, must be registered with and approved by the CHO. Acute toxicity means the adverse effects resulting from a single dose or single exposure to a hazardous substance. Acute toxicity normally refers to effects occurring over a very short period of time after exposure. A chemical is considered acutely toxic if it meets one of the following criteria:

1. A listed human or suspected human carcinogen as defined by 29 CFR 1910.1450 Appendix A.
2. A chemical that has an Immediately Dangerous to Life and Health (IDLH) level of five (5) parts per million (ppm) or less as published by the National Institute of Occupational Safety and Health (NIOSH).
3. A known mutagen or teratogen.
4. A chemical which meets the following toxicity levels:
    - LD50 of 50mg/kg or less when administered orally to albino rats;

- LD50 of 200 mg/kg or less when administered by continuous contact for 24 hours to the bare skin or albino rabbits; or
- LC50 in air of 200 ppm or less of gas or vapor, or 2 mg/liter or less of dust, mist or fume when administered by continuous inhalation to albino rats.

Toxicity definitions vary with sources. As an example, some of the toxicity classifications defined by various organizations are:

- LC50 Inhalation (ppm): extremely toxic is <10 ppm; highly toxic is 10 to 100 ppm; moderately toxic is 100 to 1,000 ppm; slightly toxic is 1,000 to 10,000 ppm and practically nontoxic is 10,000 to 100,000 ppm; and relatively harmless is >100,000 ppm. (Source: Hodge, H.C., and J.H. Sterner: Tabulation of Toxicity Classes, Am. Ind. Hyg. Quarterly 10:93, 1949).
- LC50 Inhalation (ppm): highly toxic is <200 ppm; toxic is 200 to 2,000 ppm. (Source: 29 CFR 1910.1200, Appendix A, Health Hazard Definitions).
- LC50 Inhalation (ppm): extremely toxic is < 10 ppm; highly toxic is 10 to 100 ppm; moderately toxic is 100 to 1,000 ppm; slightly toxic is 1,000 to 5,000 ppm; practically nontoxic is >5,000 ppm. (Source: E.I. du Pont de Nemours & Co., Haskell Laboratory).

D. Work with Significant Quantities of Chemicals of Moderate Chronic or High Acute Toxicity:

Exposure to these types of toxic chemicals must be minimized by all routes using "all reasonable precautions". Examples of compounds exhibiting a moderate chronic or high acute toxicity include: diisopropylflurophosphate; hydrofluoric acid; and hydrogen cyanide. Use and store these substances only in areas of restricted access with special warning signs. Always use a hood that has a face velocity of at least 60 linear feet per minute (lfpm) or other containment device for procedures, which may result in the generation of aerosols or vapors containing the substance. Released vapors should be captured to prevent their discharge with the hood exhaust. Store breakable containers of these substances in chemically resistant trays. Work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.

Personal protective equipment must be worn when handling moderate chronic or high acute toxicity chemicals. PPE requirements include chemically impermeable gloves, long sleeve lab coats, and other protective apparel, as appropriate. Laboratory personnel should always wash hands and arms immediately after working with these hazardous chemicals. Laboratory personnel should always be prepared for accidents and spills. Assure that at least 2 people are present at all times if a substance in use is highly toxic or of unknown toxicity. If a major spill occurs outside the hood, evacuate the area. Assure that cleanup personnel wear suitable protective apparel and equipment. Thoroughly decontaminate or incinerate contaminated clothing or shoes. If possible, chemically decontaminate by chemical conversion.

Records should be maintained of the amounts of these materials on hand, amounts used and the names of the workers involved.

E. Work with Chemicals of High Chronic Toxicity:

Further supplemental rules are to be followed, in addition to all these mentioned previously, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance (Procedure A of "Prudent Practices" pp. 47-50). Examples of chemicals that

have high chronic toxicity include: dimethylmercury; nickel carbonyl, benzo-apyrene; N-nitrosodiethylamine; other human carcinogens or substances with high carcinogenic potency in animals.

Conduct all chemical transfers and work in a "controlled area", a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions. A plan for use and disposal of these substances should be prepared and approval of the Laboratory Supervisor and CHO is required. Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containment systems.

If a negative pressure glove box is used, the ventilation rate must be at least 2 volume changes per hour and pressure at least 0.5 inches of water. For use in a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release into the hood.

Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area. Decontaminate the controlled area before normal work is resumed there.

When leaving a controlled area, remove any protective apparel, placing it in an appropriate, labeled container and then thoroughly wash hands, forearms, face and neck.

Special housekeeping procedures must be used in laboratory work areas. A wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping must be used if the toxic substances as a dry powder.

Use chemical decontamination whenever possible and ensure that containers of contaminated waste, including washings from contaminated flasks, are transferred from the controlled area in a secondary container under the supervision of authorized personnel.

Laboratory personnel using toxicologically significant quantities of such substances on a regular basis (i.e., 3 times per week) must consult a qualified physician concerning desirability of regular medical surveillance. An occupational health physician is recommended.

Keep an accurate record of the quantities of these substances stored and used, the dates of use, and names of users.

Assure that the controlled area is conspicuously marked with warning and restricted access signs and appropriately labeled with identity and warning labels. Users must be aware of any contingency plans, equipment, and materials to minimize exposure of people and property in case of accidents involving this class of toxic chemical.

F. Animal Work with Chemicals of High Chronic Toxicity:

When performing large-scale studies, special facilities with restricted access are preferable. When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar airflow directed toward HEPA filters.

The user should devise procedures, which minimize formation and dispersal of contaminated aerosols, including those from food, urine and feces. HEPA filtered vacuum equipment should be used for cleaning. Moisten contaminated bedding before removal from the cage. Mix diets in closed containers in a hood.

Personnel working in the animal room should wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit, and, if needed, because of incomplete suppression of aerosols, other apparel and equipment. Personal protective equipment should include shoes, head covering and a respirator.

Animal waste including tissues and excreta should be disposed of by incineration if the available incinerator can convert the contaminant to non-toxic products. If an incinerator is not available, package the waste appropriately for burial in an EPA-approved site.

The guidance provided for the toxicity classes above from "Prudent Practices" primarily address toxic exposure and do not address physical injury fully. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, page references for recommendations concerning some of the major categories of safety hazards, which also have implications for chemical hygiene, are listed below:

1. Corrosive agents: (35-6);
2. Electrically powered laboratory apparatus: (179-92);
3. Fires and explosions: (26, 57-74, 162-4, 174-5, 219-20, 226-7);
4. Low temperature procedures: (26, 88); and
5. Pressurized and vacuum operations, including use of compressed gas cylinders: (27, 75-101)