NMHU Chemical Hygiene Plan for Laboratories and Studios

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Section 1: Chemical Hygiene Responsibilities and Program Coverage

1.1. Chemical Hygiene Responsibilities

Environmental health and safety responsibilities at NMHU, including chemical hygiene responsibilities, can be viewed at NMHU's Environmental Health and Safety Policy in Section 6 of the NMHU Research Handbook. Duties specific to the use of chemicals in laboratories and art studios are described in this section.

A. Building Supervisor

The building supervisor has responsibility for the safety and upkeep of instructional and laboratory building spaces assigned to them. The building supervisor, in collaboration with laboratory and studio supervisors, ensures that all employees and students follow NMHU environmental health and chemical safety policies within the building; including the chemical hygiene practices and documentation for laboratories and studios that utilize chemicals.

Specifically, the building supervisor shall:

- Ensure that appropriate training is being provided to employees and students.
- Ensure that regulatory compliance practices are being adhered to in the building.

- Oversee that pertinent documentation on chemical hygiene is up-to-date and being followed.
- Perform periodic inspections.

B. Laboratory or Studio Supervisor

The laboratory or studio supervisor is the faculty member who is the sole or primary faculty member responsible for operations in the studio or laboratory space(s). The laboratory or studio supervisor has ultimate responsibility for chemical hygiene throughout their workspaces. The laboratory or studio supervisor supports the chemical hygiene efforts of laboratory or studio workers, with the assistance of the NMHU Environmental Health and Safety Committee.

Specifically, the lab or studio supervisor shall:

- Develop implement appropriate chemical hygiene **policies and practices** specific to the operations of the workspaces they are responsible for.
- Perform regular, formal chemical hygiene **inspections**, including inspections of emergency equipment. The lab or studio supervisor will set the frequency of these with concurrence of the building supervisor. Weekly housekeeping and monthly equipment inspections are strongly urged, particularly where there is a lot of workspace use by undergraduate or graduate students.
- Develop Standard Operating Procedures specific to tasks in their lab or studio operations.
- Determine the proper level and type of **personal protective equipment** (PPE) for operations.
- Ensure that appropriate **training** has been provided to employees and students in the labs or studios, and, that the training has been documented.
- Maintain a current knowledge of the **legal requirements** of hazardous and regulated materials in their workspaces.
- Review and improve the laboratory's or studio's Chemical Hygiene Plan on an annual basis.

C. Environmental Health and Safety Program

The EHS committee at NMHU includes a Campus Safety Officer, and, a Campus Chemical-Biological Hygiene Officer. The EHS committee can direct laboratory or studio supervisors to information resources and provide direct services in assistance in meeting environmental and safety regulatory concerns. The EHS Committee provides technical and policy oversight of laboratory and studio activities that involve the use of hazardous chemicals.

1.2. Scope and Application of this Plan

This standard applies where "**laboratory or studio use"** of hazardous chemicals occurs. Laboratory or studio use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

- The handling or use of chemicals involves containers which can easily and safely manipulated by one person;
- Multiple chemical procedures or chemical substances are used; and
- Protective practices and equipment are available and in common use to minimize potential for employee or student exposures to hazardous chemicals.

This definition covers employees (including student employees, technicians, supervisors, researchers, and artists) who use chemicals in teaching and research or creative endeavors at NMHU. Certain non-traditional laboratory or studio settings may be included under this standard at the option of individual departments within the university. Also, it is the policy of the University that laboratory or studio students, while not legally covered under this standard, will be given training commensurate with the level of hazard associated with their laboratory or studio work.

Where the use of hazardous chemicals provides no potential for employee exposure, such as in procedures utilizing chemically impregnated test media and commercially prepared test kits, a Chemical Hygiene Plan is not required.

1.3. Coordination with Other Standards and Guidelines

This standard deals only with the use of hazardous chemicals; however, employees may encounter potential physical, biological, or radioactive hazards in laboratories or studios. Other campus policies and procedures also affect the use of hazardous chemicals. For instance Appendix B describes the proper procedures for the disposal of chemicals. In the event of conflict between various standards, the NMHU Environmental Health and Safety Committee should be contacted to assist in resolving the discrepancy.

Section 2: Information and Training

2.1. Information

It is essential that laboratory and studio employees have access to information on the hazards of chemicals and procedures fro working safely. Supervisors must ensure that laboratory and studio employees are informed about, and, have access to the following information sources:

- The contents of the OSHA laboratory standard, **Occupational Exposure to Hazardous Chemicals in Laboratories**, and its appendices (29CFR 1910.1450).
- The NMHU **Chemical Hygiene Plan** (this document) and local laboratory or studio Standard Operating Procedures (SOPs)
- The **Permissible Exposure Limits** (PELs) for OSHA regulated substances.
- **Material Safety Data Sheets** (MSDSs) for laboratory and studio chemicals. These are available from collections at Facilities Management, on the World Wide Web (Internet), and individual laboratories or studios. Departments that receive MSDSs in shipments will make such information available to employees using the chemicals.

2.2. Training

Each laboratory supervisor is responsible for ensuring that laboratory employees are provided with training about the hazards of chemicals present in their laboratory work area, and methods to control exposure to those chemicals. Each employee shall receive training at the time of their initial assignment to the laboratory, prior to assignments involving new exposure situations, and at a regular frequency.

A. Availability

Training is available in the form of:

- Literature describing proper lab practices.
- Group and individual training, conducted by lab or studio personnel, or EHS Committee staff.

B. Content

Employee training programs shall include, at a minimum, the following subjects:

- Methods of **detecting the presence** of hazardous chemicals (observation, signage and labeling, odor, real-time monitoring, air sampling, etc.);
- **Symptoms** associated with exposure to hazardous chemicals;
- **Good laboratory or studio practice**, including general techniques designed to reduce personal exposure and to control physical hazards, as

well as specific protective mechanisms and warning systems used in individual laboratories or studios;

- **Emergency response actions** appropriate to individual laboratories or studios;
- Applicable details of the departmental Chemical Hygiene Plan, including general and laboratory- or studio-specific **Standard Operating Procedures;** and
- An introduction to **Hazardous Waste Management** procedures at NMHU.

Section 3: Implementation of Control Measures

3.1. General Criteria

This Chemical Hygiene Plan is intended to limit laboratory and studio workers exposure to OSHA-regulated substances. Laboratory or studio workers must not be exposed to substances in excess of the **Permissible Exposure Limits** (PELs) specified in OSHA rule 29 CFR 1910 Subpart Z (Toxic and Hazardous Substances), or, **Threshold Limit Values** (TLVs) set by the American Conference of Governmental Industrial Hygienists (ACGIH). PELs refer to airborne concentrations of substances and are usually averaged over an 8-hour day. In some cases, there are 15-minute time weighted averages for higher than typical exposures. A few substances also have action levels. These levels are air concentrations below the PEL which require that certain actions take place (e.g., medical surveillance, workplace air monitoring, etc.).

An employee's workplace exposure to any regulated substance must be monitored if there is reason to believe that exposure will exceed and action level, PEL, or TLV. If exposures to any regulated substance routinely exceed an action level, PEL, or TLV, then **control measures must be implemented.**

Engineering controls are devices and room features that are specifically designed to reduce worker exposure to substances. Engineering controls are the best means of protecting workers. Personal protective equipment (PPE) are not as desirable for worker protection, however, in many situations PPE is the only means to adequately protect workers.

A. Professional Judgment

The lab or studio supervisor can use professional judgment to assess the nature of chemical exposure resulting from a lab procedure and prescribe engineering controls and personal protective equipment to be used during the procedure. This judgment shall be documented through use of standard operating procedures and Laboratory/Studio Chemical Safety Summaries.

B. Air Sampling

Air sampling for evaluating employee exposure to chemical substances shall be conducted on an as needed basis (determined by lab or studio supervisor). Conduct air sampling when there is reason to believe that exposure levels for regulated substances that require sampling routinely exceed the action level, PEL, or TLV.

Air sampling will be conducted according to established industrial hygiene practices. It may be conducted by lab/studio workers, EHS Committee members, or, outside consultants. The results of air sampling studies performed in the lab/studio shall be sent to EHS Committee for records maintenance.

3.2. Criteria for Implementation of Specific Control Measures

Engineering controls, personal protective equipment (PPE), hygiene practices, and administrative controls each play a role in a comprehensive laboratory and studio safety program. **Implementation of specific measures must be carried out on a case-by-case basis, using the following criteria for guidance in decision-making.**

A. When to Use Fume Hoods

Fume hoods are a type of local area ventilation (LAV) utilized for small sources of chemical releases. A LAV system may be called something different in various units. Fume hoods are enclosed spaces that pull clean air past the user through the small workspace past the source. The contaminated exhaust is vented to the outside.

The fume hood is the major protective device available to laboratory and studio workers. Characteristics of substances to be considered in requiring fume hoods for an operation are: physical properties, volatility (vapor pressure), eye and skin irritation potential, toxicity, flammability, and odor. Process characteristics in requiring fume hoods are reactivity (explosions, violent chemical reactions, and aerosol generation (smokes, dusts, sprays).

A fume hood should be used during a chemical procedure when:

- Airborne concentrations might approach the action level (PEL or TLV)
- Flammable vapors might approach $1/10^{th}$ of the lower explosion limit (LEL)
- Substances with unknown toxicities are generated or used
- Odor is annoying to laboratory occupants or adjacent units

Procedures that can generally be carried out safely outside of the fume hood (depending on the capacity of the room ventilation system to remove airborne contaminants) including those involving:

- Water based solutions of salts, dilute acids, bases, or other reagents (dilution of concentrated acids/bases may require a fume hood because of reactivity)
- Very low volatility liquids or solids
- Closed systems that do not allow significant escape of volatile substances to the workplace air
- Extremely small quantities of substances that otherwise would have to be handled in a fume hood

B. When to Use Safety Shields or Containment Devices

Safety shields, such as the sliding sash of a fume hood, are appropriate when working with highly concentrated acids, bases, oxidizers, or reducing agents, all of which have the potential to cause sudden spattering or explosive release of materials. Reactions carried out at non-ambient pressures (vacuum or high

pressure) also require safety shields, as do reactions or processes that are carried out for the first time, or, are significantly scaled up from normal conditions.

Other containment devices, such as glove boxes or vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for a process, when capture of any chemical, biological, or radiological emissions is desirable, or when standard fume hoods do not provide adequate assurance that overexposure to a hazardous chemical or agent will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices.

Local exhaust ventilation (LEV) may be required for equipment that exhausts toxic, small particulate, or irritating materials to the laboratory or studio environment (fine sawdust is now listed as a known carcinogen!).

Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable, or irritating levels of airborne contaminants.

C. When to Use Personal Protective Equipment

Laboratory supervisors or the Chemical-Biological Hygiene Officer shall designate areas, activities, and tasks which require specific types of personal protective equipment. **Protective equipment shall not be worn in public areas (e.g., hallways, restrooms, etc.), in order to prevent the spread of chemical or biological contamination**.

Eye Protection. **Eye protection is required for all personnel and any visitors whose eyes may be exposed to chemical or physical hazards**. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles and/or face shields are necessary when there is a greater than average danger of eye or face contact. A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems.

Protective Clothing. Lab coats or other similar clothing protectors are strongly encouraged for all lab or studio personnel. Lab coats are required when working with carcinogens, reproductive toxins, substances with high acute toxicities, strong acids and bases, and any substance on the OSHA PEL list with a “skin” notation. Protective clothing should be selected based upon resistance to specific types of substances. Information is available for selection of appropriate clothing from distributors of protective clothing.

Bare feet are not permitted in any laboratory or studio. Sandals and open-toed shoes are strongly discouraged in all laboratories and studios and **are not permitted in any situation where lab coats or gloves are required**.

Gloves. Gloves made of appropriate material are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or cause skin irritation or injury. Gloves are also required when working with particularly hazardous substances where possible transfer from hand to mouth must be avoided.

Gloves should be carefully selected using guides from the manufacturers or distributors. General selection guides are available, however, glove resistance to chemicals will vary with the manufacturer, model, and thickness.

Respiratory Protection. Respiratory protection is generally not necessary in the laboratory or studio setting and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals or materials that are highly toxic, volatile, or gaseous. If a procedure requires exposure above the action level that cannot be reduced, respiratory protection will be required. All use of respiratory protective equipment is covered under the NMHU Respiratory Protection program.

4: Management of Engineering Controls

The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized.

No modification of engineering controls will occur unless testing of the modification indicates that worker protection will continue to be adequate. Improper function of engineering controls must be reported to the laboratory or studio supervisor immediately. The system shall be taken out of service until proper repairs have been executed.

4.1. Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

- Intakes of local exhaust will be as close as possible to the source of contaminants;
- Local exhaust fans shall be turned on when exhaust hoods are being used;
- After using local exhaust, operate the blower for an additional period of time sufficient to clear the ducts of residual contaminants;
- The ventilation system shall be inspected annually by the EHS Committee representative; and
- Prior to a change in chemicals or procedures, the adequacy of the ventilation systems shall be determined by the laboratory or studio supervisor.

4.2. Fume Hoods

Work practices shall follow the NMHU Fume Hood Manual. Prior to introduction of new chemicals, the adequacy of hood systems shall be determined by the lab supervisor.

Ductless hoods recirculate exhaust air through filters back into the room. Therefore, they cannot be used for volatile toxic materials and should be posted as “Not for use with toxic materials.

4.3. Chemical Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will be ventilated as needed. They will be provided with a spill containment system appropriate to the chemicals stored within them.

4.4. Biosafety Cabinets, Glove Boxes and Isolation Rooms

The exhaust air from a biosafety cabinets, glove boxes or isolation rooms will pass through scrubbers, HEPA filters, or other treatment prior to release to the regular exhaust system. Biosafety cabinets will be certified annually and each time they are moved. Certification can be obtained through the EHS Committee.

4.5. Cold Rooms and Warm Rooms

Temperature-controlled rooms generally do not have fresh air ventilation. Do not use volatile chemicals in them! Leaking or improperly shutoff compressed gases cylinders can displace oxygen from room air causing dangerous oxygen-deficient conditions.

4.6. Emergency Equipment

Eye washes must be flushed weekly by the user. This will ensure that the eye wash is working, and the water is clean, should emergency use become necessary. Public eye washes and safety showers are to be flushed bi-weekly. Fire extinguishers are checked quarterly by the campus safety officer.

Section 5: Standard Operating Procedures

Standard operating procedures (SOPs) are generally accepted practices for use of chemicals in particular situations. The SOPs can be overridden in specific instances when appropriate. It is advisable to document the reasons for such modifications. When SOPs are not available for a specific laboratory or studio situation, the lab supervisor and Chemical/Biological Hygiene Officer will develop them, in consultation with the references cited below and the EHS Committee.

Appendix B provides general standard operating procedures for laboratories and studios. However, laboratory or studio activities that involve unique procedures will need to develop specific SOPs.

5.1. General Principles

A. Controlling Chemical Exposure

Each laboratory employee shall minimize personal and coworker exposure to the chemicals in the laboratory. General precautions, which shall be followed to achieve this goal during the handling and use of all chemicals, are:

- A chemical mixture shall be assumed to be as toxic as its most toxic component. Possibilities for substitution will be investigated (RCRA waste minimization, OSHA 29 CFR - 1910.1450);
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which the work and the precautions necessary to prevent exposure;
- Eating, drinking, and smoking are prohibited in areas where laboratory chemicals are present. Hands shall be thoroughly washed after working with chemicals. Storage, handling, and consumption of food or beverages shall not occur in chemical storage areas, refrigerators, with glassware or utensils also used for laboratory or studio operations;
- Mouth suction for pipetting or starting a siphon is prohibited;
- Smelling vapors from solvents to determine composition of a liquid is strictly prohibited;
- Sin contact with all chemicals shall be avoided. Employees shall wash exposed skin prior to leaving the laboratory or studio; and
- Additional specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the lab or studio supervisor.

B. Laboratory Equipment

The following rules shall apply to the use of laboratory and studio equipment:

- All laboratory equipment shall be used only for its intended purpose;

- All glassware will be handled and stored to minimize breakage; all broken glassware will be immediately disposed of in a broken glass (Sharps) container;
- All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should implosion occur;
- Waste receptacles shall be identified as such by signs attached to the receptacle. Signs shall include an indication of the type of waste that is accumulated in the container; and
- All laboratory and studio equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

C. Planning for Emergencies

Before work with laboratory or studio chemicals begins, plans for various emergencies will be developed. The circumstances to be covered include fire, chemical spill, and personnel exposure. In addition, the following work practices will be observed:

- Spill containment will be established around areas in which more than one liter of liquid is used;
- Workers manipulating chemicals will always be in easy communication distance of other people while handling chemicals; and
- Emergency equipment shall be checked on a daily basis for unusual conditions.

5.2. General References

Standard operating procedures found in ***Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*** (National Research Council, 1995 adopted for general use at NMHU.

A useful reference for **art hazards** and **other studio related occupational health issues** can be found at the Center for Research on Occupational and Environmental Toxicology.

5.3. Laboratory or Studio Specific SOPs

Laboratory or studio specific SOPs are available in each campus laboratory or studio where they are applicable. The SOPs developed for specific lab or studio should be listed in the lab or studio Chemical Hygiene Plan.

Section 6: Particularly Hazardous Procedures

The OSHA Laboratory Standard requires that special consideration be given to the use of chemicals or procedures with particular hazards. The definition of "particularly hazardous chemical" is given in the OSHA laboratory standard. Examples of such chemicals are given in **Chapter 3** of *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*. This consideration requires either the development of special operating procedures or prior approval of the laboratory supervisor as indicated by a written permit describing the conditions for the work to be done.

6.1. Work with Particularly Hazardous Substances

When laboratory procedures include the use of highly hazardous chemicals, special precautions shall be deemed necessary by the lab supervisor. These precautions will be developed for work with select carcinogens, reproductive toxins and substances, which have a high degree of acute toxicity. Development of these precautions will consider including the following provisions in special procedures:

- Establishment of a designated area for the use of high-hazard chemicals;
- Signage and access control to the work area where the chemical is used;
- Special precautions such as use of containment devices such as glove boxes; isolation of contaminated equipment, practicing good laboratory hygiene, and prudent transportation of very toxic chemicals;
- Planning for accidents and spills; and
- Special storage and waste disposal practices.

Prudent Practices provides detailed recommendations for work with particularly hazardous substances.

6.2. Pre-approval of Particularly Hazardous Work

The responsibility for approval of the acquisition and use of hazardous chemical agents rests with the Chemical Hygiene Officer or the Building Supervisor and with the Laboratory and Studio Supervisors for their laboratories and studios. Prior approval is required for substances listed in Appendix A of the Hazard Communication Plan. Certain materials including radioactive materials, explosives, recombinant DNA, and certain biohazards require prior internal (campus), or, external approval at various levels. If there are questions concerning the need for approvals and permits, the Environmental Health and Safety Committee should be consulted.

A. Working Alone - Unattended Operations

When working with hazardous materials, it is advisable to have a second person present, or at a minimum, maintain surveillance via telephone contact. Only those

undergraduates who carry on their person faculty approval may work in the research laboratories alone. By their signature, advisors indicate that these individuals have the proper training and experience to perform experiments by themselves.

No dangerous experiments or studio processes will be run unattended unless they are fail-safe. A dangerous experiment or studio process is one that will impose an immediate threat to life or property, if there is a loss of water pressure, electricity, or hood operation. Those experiments or processes which cannot be safely isolated shall not be performed unattended unless a suitable monitor is present and functioning. Standard Operating Procedures shall be developed that describe the safe operation of unattended processes.

Section 7: Emergency Response

7.1. Emergency Response

Telephone numbers of emergency personnel, supervisors, and other workers as deemed appropriate are posted on the lab or studio entrance. These signs will be checked quarterly for accuracy.

7.2. In Case of Fire

NMHU's policy is that the first reaction to a fire is to evacuate the occupants of the building. Fire extinguishers are available in labs and studios. Extinguishers can be used by trained personnel to fight small fires (size of wastebasket or less). Fire extinguisher training is available from the Campus Safety Officer.

7.3. In Case of Spills

In the event of a chemical spill, release, or other accident lab or studio workers will respond as outlined in the NMHU Emergency Response Plan. The size of the spill and its hazards will guide the appropriate response. If there is any doubt about the lab worker's ability to safely clean up the spill, call Campus Security (5555). Note that proper emergency response depends upon knowledge of the hazards present in the lab. For this reason a campus-wide inventory of the hazardous chemicals in the labs and studios is conducted annually.

7.4. In Case of Personnel Exposures

All employees shall be instructed in the location and proper usage of emergency showers and eyewashes. In case of a medical emergency phone Campus Security at 555. A person can seek a medical consultation after an exposure at NMHU expense (See Section 8).

7.5. Emergency Phone Numbers

- NMHU Campus Security(24 hours): 5555 (on campus) or 454-3278
- Campus Safety Officer: 454-3392
- Chemical/Biological Hygiene Officer : 454-2035
- Poison Control Center: 9-1-800-222-1222

Section 8: Medical Consultations and Examinations

8.1. Availability

All employees who work with hazardous chemicals will have an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary under the following circumstances:

- Whenever an employee develops symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory or studio;
- Where 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; and
- Whenever an event takes place in the work area, such as spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure.

The Campus Safety Officer will be contacted whenever the need for medical consultation or examination occurs, or when there is uncertainty as to whether any of the above criteria have been met.

8.2. Arranging for Medical Exams

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided through the NMHU Environmental Health and Safety Program, without loss of pay, and at a reasonable time and place.

In the event of a life threatening illness or injury dial 9-911 and request an ambulance.

8.3. Information

NMHU will provide the examining physician with the following information:

- The identity of the hazardous chemical(s) to which the employee may have been exposed;
- A description of the conditions under which exposure occurred including quantitative exposure data, if available; and
- A description of the symptoms of exposure an employee is experiencing, if any.

The above information will be collected and transmitted by the lab or studio supervisor and will be submitted to the NMHU Environmental Health and Safety Program, as well as to the examining physician.

8.4. Report

The examining physician will provide to the lab or studio supervisor and NMHU Environmental Health and Safety Program a written report including the following:

- Any recommendation for further medical follow-up;
- The results of the medical examination and any associated tests;
- Any medical condition 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.

The written opinion will not reveal specific findings or diagnoses unrelated to occupational exposure.

8.5. Confidentiality

The Federal *Health Insurance Portability and Accountability* of 2002 requires that any medical information remain confidential. Information from medical examinations will not be released either in print or verbally to anyone other than NMHU employees that are authorized to review the information. An employee can file a written request to receive a copy of records of consultations or medical examinations from NMHU. Records will be held for periods described in Section 9.

Section 9. Recordkeeping

NMHU policy is to maintain safety records as required by OSHA. Records shall be stored in fireproof lockable filing cabinets.

9.1 Accident Reports

Accident investigations will be conducted by the lab supervisor with assistance from the NMHU Environmental Health and Safety Program as deemed necessary. Accident reports will be written and retained for 5 years.

9.2. Exposure Evaluations

Any records of exposure evaluation carried out by NMHU Environmental Health and Safety Program will be filed. Raw data will be kept for one year. Summary data will be kept for the term of employment plus 30 years.

9.3. Medical Consultation and Examinations

The NMHU Environmental Health and Safety Program will keep results of medical consultation and examinations for a length of time specified for the appropriate medical records standard. This period will be at least the term of employment plus 30 years.

9.4. Training

Individual employee training will be recorded. The record will be kept in the individual's departmental file for 5 years.

9.5. Equipment Inspection

Records of inspections of equipment will be maintained for 5 years. NMHU Environmental Health and Safety Program will keep data on annual fume hood monitoring. Fume hood monitoring data are considered maintenance records; as such, raw data will be kept for one year, and summary data for 5 years.

Section 10: Annual Chemical Hygiene Plan Review

The laboratory supervisor and Chemical/Biological Hygiene officer will review the laboratory's or studio's Chemical Hygiene Plan annually, every June. Results will be provided to the NMHU Environmental Health and Safety Program and the building supervisor. Laboratory supervisors are responsible for taking corrective action for any deficiency noted.

Appendix A: Chemical Hygiene Plans

The chemical hygiene plan shall include each of the following elements and shall also indicate the specific measures to be taken to ensure that University employees are protected.

1. Standard operating procedures relevant to all laboratory operations, to be followed by laboratory employees.
2. Statements of the criteria that will be used to determine and implement control measures to reduce employee exposure to hazardous chemicals. These measures include engineering controls, use of personal protective equipment, and personal hygiene practices. Criteria to reduce exposure to extremely hazardous chemicals used in the laboratory shall be specifically included.
3. A requirement that fume hoods and other protective equipment shall function properly and descriptions of the methods to be taken to make sure that such equipment is functioning properly.
4. Provisions for employee training and information.
5. Circumstances under which a laboratory practice requires prior approval from a supervisor before implementation.
6. Provisions for medical consultation and examination.
7. Designation of personnel responsible for implementation of the chemical hygiene plan.
8. Provisions for additional protection for employees when working with particularly hazardous substances, including:
    - Select carcinogens.
    - Reproductive toxins.
    - Substances with a high degree of acute toxicity.
9. Specific mention of the following provisions, including when appropriate:
    - Establishment of a designated area.
    - Use of containment devices such as fume hoods or glove boxes.
    - Procedures for safe removal and disposal of contaminated and hazardous waste; and
    - Decontamination procedures.

Appendix 7:
Two Examples of Chemical Hygiene Plans from the University of Illinois

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EXAMPLE 1:
APPENDIX A
FELMLEY 444

CHEMICAL HYGIENE INFORMATION (as of 1/31/95)

LAB PURPOSE:
Undergraduate Teaching
Analytical Chemistry, Quant., Biochemistry.
Chem 315, 215, 343

FACULTY CONTACTS
Dr. John Baur: 438-2663 (w) 452-2065 (h)
Dr. James Webb:
438-2604 (w) 827-2192 (h)

Overview of Laboratory Operations
Chemistry 315 students perform chemical analysis using electroanalytical, spectroscopic, and chromatographic methods.

LABORATORY STAFF AND USERS

Faculty Name(s)	Office	Work Phone	Home Phone
Dr. John Baur	FSA 331	438-2663	452-2065
Dr. James Webb	FHS 207D	438-2604	827-2192

Undergraduate students will use the lab under the supervision of one of the employees listed above.

Hazardous Material Use
Some of the hazardous materials used in the lab include: (Extremely hazardous materials are in **bold.**)

In Hood:

Hydrochloric Acid, conc. (1 L)
Sulfuric Acid, conc. (1 L)

Under Hood:

Chloroform (8 L)
Sodium Hydroxide, conc. (1 L)
Nitric Acid, conc. (4 L)
Hydrochloric Acid, conc. (4 L)
Carbon Tetrachloride (4 L)
n-Propyl Alcohol (4 L)

Under South Countertop:

Methanol (4 L)
Dilute acids and bases in 1 L to 4 L quantities

In Cabinets on South Wall:

Silver Nitrate (600 g)
Lead chloride (100 g)
Mercurous chloride (110 g)
Lead nitrate (450 g)
Caffeine (100 g)
Mercury (3 pounds)

Extremely Hazardous Materials
The most toxic substances used in this lab include the following:
Mercury: highly toxic

Special Equipment and Procedures

A. Atomic Absorption Spectrometer (AA)
The AA may be used only under supervision of a qualified employee.

- Students wishing to use the AA for research purposes must undergo instruction by Dr. Webb or Dr. Baur.
- The air and acetylene tanks may be changed only by an instructor or TA.
- The hood above the AA must be on when the flame is burning.
- No flammable solvents may be brought near the AA when the flame is burning.

B. High Performance Liquid Chromatograph (HPLC)
The HPLC may be used only under supervision of a qualified employee.

- Students wishing to use the HPLC for research purposes must undergo instruction by Dr. Webb or Dr. Baur.

- The Nitrogen tank may be changed only by an instructor or TA.

- All safety shields must be in place when the system is pressurized.

Lab Safety Awareness Training -Specific Operations and Equipment - FHS 444

By our signatures below, we certify that we have been trained and agreed to be responsible for the following principles:

The lab safety rules designated by the general section of the Chemical Hygiene Plan.
The requirements and safety procedures described by Dr. Baur and Dr. Webb in Appendix A.
The use and location of all safety equipment within the laboratory.
Training Conducted by:

Date:

Name of Lab Worker:

Example 2: Teaching Laboratory from the University of Illinois

FELMLEY 301 and 302

CHEMICAL HYGIENE INFORMATION (as of 2/13/95)

LAB PURPOSE:
Instruction
CHEM 112,141,150,102

FACULTY CONTACTS:
Dr. Philip Morse (141) 438-5595(w) 829-9257(h)

Dr. James Webb (141)
438-2604(w) 827-2192(h)

Dr. Gary Clark (112)
438-2359(w) 454-5937(h)

Dr. Richard Reiter (112)
438-7905(w) 829-3708(h)

Dr. Otis Rothenberger
438-5359(w)

OVERVIEW OF LABORATORY OPERATIONS

Lab exercises for the first semester inorganic chemistry students.

LABORATORY STAFF AND USERS

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HAZARDOUS MATERIAL USE

Some of the hazardous materials used in the lab include:

(Extremely hazardous substances are in bold.)

Chemicals stored in the following locations:

SE corner cabinet	Acids, Bases (both dilute)	1L & 2L
	Ammonium thiocyanate	1L
	potassium hydrogen phthalate	500g

South wall (east end) cabinet	Acids, Bases (both dilute)	1L & 2L
	Thiourea	2L

South wall (west end) cabinet	NaBr	1L
	conc. HNO3 (nitric acid)	500mL
	AgNO3	500mL
	Acids, Bases (both dilute)	-
	FeCl3	500mL
	PbCl2	500mL
	ZnCl2	500mL

EXTEMELY HAZARDOUS MATERIALS

The most toxic substances used in this lab include the following:

- Ammonium thiocyanate: reacts violently with (conc.)HNO3.
- Thiourea: poison B, reacts with (conc.)HNO3.
- HNO3 (concentrated): strong oxidizer, caustic, reactive, toxic fumes.

SPECIAL EQUIPMENT and PROCEDURES

A. Handling Chemicals

1. The following chemicals should be dispensed in the hood: concentrated nitric, hydrochloric and

hydrobromic acids, concentrated ammonium hydroxide, ammonium sulfide, pyridine.

2. Always pour concentrated solutions (especially acids and bases) slowly into water or less concentrated solutions.

3. Never use mouth suction to fill a pipet; use a pipet bulb.

4. Corrosive liquids (such as acids or bases) should be dispensed in small containers no larger than 500 mL.

5. Solvents such as acetone, ether, acetonitrile, methanol, ethanol are to be used in the absence of any flames in the laboratory.

6. Protective gloves must be worn when using solvents such as dimethyl sulfoxide which are absorbed through the skin.

7. Students should avoid skin contact and should wash their hands each time after using thioacetamide.

B. Chemical Spills

1. All Teaching Assistants should be aware of proper safety procedures in the case of an accident. The instructor should be immediately notified.

2. If the skin or mucous membranes are affected, it should be washed with large quantities of soap and water. If medical attention is necessary, explain carefully what chemicals were involved.

3. The instructor should be notified of any chemicals spilled on the floor, benches, or in the hoods. Most small spills (< 100 mL) can be absorbed with paper towels, sand, or an absorbent (acids or bases should be first neutralized).

4. Spilled mercury should be immediately and thoroughly cleaned up using an aspirator bulb or a vacuum device. If a mercury spill kit is used, Teaching Assistants are

expected to become familiar with its location and proper use.

C. Chemical Disposal

1. Teaching Assistants should encourage students to take only the required quantities of chemicals and reagents to minimize disposal.

2. All chemicals must be disposed in appropriately labeled containers which are located in the hoods.

3. Small amounts of acids (nitric, hydrochloric, hydrobromic, acetic, sulfuric) or bases (aqueous ammonia - but not organic bases such as ethylenediamine, butylamine, or piperazine) may be flushed down the drain in the hood with copious amounts of water.

4. No other chemical may be disposed down the drain unless permitted by the instructor.

5. Filter paper which has contacted a chemical is to be treated as a chemical and should be disposed in appropriate container - not in the paper trash container.

6. Potassium cyanide solution should be disposed only in its appropriately marked container. The Teaching Assistant should check the pH of the solution after each lab period and insure that the solution is strongly basic.

7. Teaching assistants will disposes of excess powdered Zinc as directed by the course instructor.

D. General Housekeeping

1. It is the responsibility of the Teaching Assistant to insure that the laboratory is in good order at the end of the period.

    a. Clean up any spilled chemicals on the benches, in the hoods, and on the balances.

    b. Replace caps on reagent bottles.

c. Be sure that all natural gas valves are turned off.

d. . Place filled waste containers under the hood in room 302, FHS.

e. Return empty or nearly empty reagent bottles to the storeroom for refilling

f. Close and lock the lab door when the last student has left; do not allow students from another section to enter the lab unless the Teaching Assistant or Instructor is present.

g. Keep eyewash stations flushed weekly and sign log.

Lab Safety Awareness Training
Specific Operations and Equipment
FHS 301/302
By our signatures below, we certify that we have been trained and agreed to be responsible for the following principles:

1. The lab safety rules designated by the general section of the Chemical Hygiene Plan.

2. The requirements and safety procedures described by laboratory/studio supervisors. The use and location of all safety equipment within the laboratory.

3. Signatures on either FHS 301's or 302's Chemical Hygiene Plan are valid for both rooms.

Training Conducted by:

Date:

Name of Lab Worker:

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B.1 Administrative Procedures

a. Chemical Procurement

Chemical containers shall not be accepted by Receiving Staff without accompanying labels, and, packaging in accordance with all appropriate DOT regulations with little apparent damage.

All chemical shipments should be dated and initialed by storeroom personnel when received and opened by user and noted in the user records.

b. Prior Approval

The responsibility for approval of the acquisition and use of hazardous chemical agents rests with the Chemical Hygiene Officer or the Department Chairperson for his or her department and with the Laboratory and Studio Supervisors for their laboratories and studios. Certain materials including radioactive materials, explosives, recombinant DNA, and certain biohazards require prior internal (campus) or external approval at various levels. If there are questions concerning the need for approvals, the Office of Environmental Health and Safety should be consulted.

c. Working Alone - Unattended Operations

When working with hazardous materials, it is advisable to have a second person present, or at a minimum, maintain surveillance via telephone contact. Only those undergraduates who carry on their person faculty approval may work in the research laboratories alone. By their signature, advisors indicate that these individuals have the proper training and experience to perform experiments by themselves.

No dangerous experiments or studio processes will be run unattended unless they are fail-safe. A dangerous experiment or studio process is one which will impose an immediate threat to life or property, if there is a loss of water pressure, electricity, or hood operation. Those experiments or processes which cannot be safely isolated shall not be performed unattended unless a suitable monitor is present and functioning.

B.2 General Chemical Safety

a. Horseplay

Horseplay of any kind is strictly forbidden in the laboratories.

b. Personal Hygiene

(1) Wash promptly if skin contact is made with any chemical, regardless of corrosivity. Use emergency eyewash or shower when appropriate.
(2) Wear appropriate eye protection at all times.
(3) Mouth Pipetting is forbidden; use suction bulbs or other pipetting devices.

(4) Eating, drinking, and the application of cosmetics is forbidden in areas where hazardous chemicals are used and shall be done only in well-defined designated areas.
(5) Do not store food in the same refrigerator with chemicals, biohazards, or radioactive materials.

c. Housekeeping

(1) Access to emergency equipment, showers, eyewashes, and exits must NOT be blocked in anyway with equipment, furniture, etc.
(2) Work areas and floors are not to be used for excessive storage. No unauthorized items shall be stored in the corridors.
(3) Promptly respond to all spills according to Section 9.0; properly dispose of the spilled chemical and cleanup materials.

d. Material Transport

Glass containers or containers holding hazardous materials shall be transported in 5 gallon buckets, or in specifically designed carboys, with handles for every lab or studio. The secondary containers are available for transport from stockrooms. Elevators shall not be used to transport any hazardous material unless approved by a supervisor.

e. Solvent Storage and Handling

Flammable and combustible liquids in moderate amounts (less than 5 gallons) may be stored in the laboratory or studio . Larger quantities require a flammable liquid storage cabinet and cannot exceed 60 gallons of a class I flammable liquid or a class II combustible liquid (for definitions and allowable quantities go to the OSHA website).

f. Glassware and Laboratory Equipment

All broken glassware will be immediately disposed of in a rigid, puncture-resistant container, such as a metal trash can. The container must bear a legible sign that says “SHARPS”. Contaminated glassware should be de-contaminated in an appropriate manner for the chemical or biohazard used, but in such a manner, as to minimize harm from the glass to all present and future handlers.
All laboratory equipment shall be used only for its intended purpose, unless appropriately modified.

g. Vacuum and Pressure Operations

The hazards of high pressure systems arise largely from failures caused by leaks, pulsation, vibration, and over pressure. Pressure gauges should be checked and recalibrated on a regular basis.

Safety glasses are required at all times in laboratories and studios with pressure or vacuum equipment. Extra precautions are necessary when working with vacuum and high pressure devices. If explosion or implosion appears possible, face shields should be worn to protect the face and neck of the user.

If liquefied oxygen is suspected in a vacuum line, evacuate room and seek faculty assistance.

Note: Specific procedures should be developed for dealing with potential problems when using vacuum and pressure operations. The procedure must be described in the chemical hygiene plan.

h. Sinks and Refrigerators

Sinks:

(1) May only be used for aqueous/non-hazardous material.
(2) Must have a screen or appropriate cover over the drain to prevent solid material from entering the drain.
(3) Should have water added periodically to prevent desiccation of the drain trap and exposure to sewer gases.
(4) Should be kept clean and free of debris.

Refrigerators:

(1) Explosion proof refrigerators are to be used for storage of flammable or unstable chemicals.
(2) Under no circumstances should food or drink be stored in freezers, refrigerators or cold boxes containing chemicals.
(3) Stored chemicals and other materials must be tightly closed and labeled. Out of date chemicals should be disposed of in accordance with Section B.3.

i. Compressed Gases

(1) Cylinders must be stored in well-ventilated areas with their protective caps screwed on and the cylinder secured (e.g., strapped or chained) to reduce the chance of the cylinder being knocked over.
(2) Do not store cylinders near heat or high traffic areas.
(3) Separate flammables and oxidizers, and store empty and full cylinders separately.
(4) Storage of large quantities of cylinders must be done in an approved gas cylinder storage area.
(5) Use appropriate hand carts to move cylinders. Cylinders must be secured to the cart during transport with protective caps in place.
(6) Always consider cylinders as full and handle them with corresponding care.
(7) Cylinders should be secured at all times, during transport, storage and use.

j. Fume Hoods

(1) Make sure hood has been maintained in accordance with the Fume Hood Manual.
(2) Make sure the exhaust blower is operating and air is entering the hood prior to starting an experiment.

(3) Keep the sash of the hood as low as possible to increase the inward velocity of the air at the opening of the hood.
(4) Do not place your face inside of the hood. Keep hands out as much as possible.
(5) Keep sources of emission six (6) inches inside the hood.
(6) Minimize the storage of chemicals in the hood. Clean up all spills immediately.
(7) Periodically clean hood interior, including fluorescent bulb panel. If volatile or corrosive materials are stored in the hood, it should be in continuous operation.
(8) Do not use the hood for disposal. Use condensers, traps, or scrubbers. See Section 3.3 in NMHU Hazard Communication Program for waste disposal information.
(9) Do not handle toxic materials in a hood filled with equipment or chemicals.

k. Cryogenic Liquids

(1) Loose-fitting heavy cloth or dry leather gloves should always be worn when handling anything that comes in contact with cold liquids, cold solids and/or cold vapor. Gloves should be loose fitting so that they can be removed quickly if liquids are spilled into them. A potholder or other insulation should be used between the gloves and container except when the material is in a dewar.
(2) Keep container (dewar) vertical at all times. Do not roll the container on its side. Secure dewars in restrainers to avoid spills.
(3) Relief valves on dewars shall not be tampered with under any circumstances!
(4) Matches, lighters, etc. and other sources of ignition are prohibited where liquid hydrogen and oxygen are present. The use of smoking materials are prohibited anywhere in NMHU buildings by NM state law.
(5) Any frosting, ice formation, or excessive corrosion on safety valves may render the safety valves inoperative. In the event of any of these instances, the vessel should be taken out of service as these valves may not work, thus not allowing pressure release in the event of its buildup.
(6) Two individuals should be present when transferring cryogenic liquids.
(7) Store dewars and liquid gas cylinders in well-ventilated storage areas when not in use or connected to a closed system.

l. Laboratory Freeze Dryers (Lyophilizers)

(1) Sign log at time of use.
(2) In order to avoid implosion, use only appropriate lyophilizer flasks and inspect for cracks or scratches that may cause failure. Do not substitute regular laboratory glassware for vacuum use.
(3) Locate the unit out of the traffic flow.
(4) Empty the condensate trap regularly and change pump oil after large loads or every six months.

m. Autoclaves

(1) Sign log at time of use.
(2) Any time the door is closed on the unit, assume it is fully pressurized.
(3) Inspect the unit on a regular basis for closure alignment, cracks, damage or hot spots and clean once a month. Never leave flammable materials, debris, or plastics in or near the unit.
(4) When autoclaving potentially infectious material to render it non-infectious refer to Appendix C for proper procedures.
(5) Under no circumstances, should the door of the autoclave be opened until the interior or chamber pressure has been released.

n. Warning Signs and Labels

(1) Warning Signs:

Laboratory areas that have special or unusual hazards shall be posted with warning signs, such as carcinogenic hazards, biological hazards, fire hazards, laser operations, etc. Specific warning sign requirements can be found at OSHA website. Other signs shall be posted to show the locations of safety showers, eyewash stations, exits, and fire extinguishers.

(2). Labels:

Specific guidance on labeling for chemical, piping, and electrical systems requirements are discussed in Section 3.3 of the NMHU Hazard Communication Plan Labor*atory and studio supervisors must ensure conformance with the labeling policy.*

Waste containers should be labeled in accordance with Section B.3*a* below.

Unlabeled bottles of chemicals should not be opened; such materials should be disposed of promptly and will require special handling procedures.

Disposal costs for containers with contents that are unknown are the responsibility of the source department or grant activity.

o. Centrifuges

(1) Sign log at time of use.
(2) Each operator should be instructed on proper operating procedures before being allowed to use the centrifuge. Instructions should include requirements for balancing loads, using the proper rotor, and using accessory equipment.
(3) Each employee who uses a centrifuge is responsible for the condition of the machine and rotor at the end of the procedure.

B.3 Waste Disposal

We should strive to minimize or prevent waste generation. Waste minimization is an action of both local and global significance. Faculty and staff are encouraged to share thoughts and ideas concerning waste minimization and prevention. Inevitably, some waste will be generated. *NMHU is committed to managing its wastes in a safe and efficient manner.* These procedures govern the management of RCRA hazardous wastes at the University.

Hazardous waste management is ruled by increasingly stringent and complex regulations. Management of chemical and hazardous wastes at the University is accomplished by the generator of the waste with the assistance of the Office of Environmental Health and Safety (OEHS). OEHS will assist generators on campus to help assure that wastes are managed in accordance with the regulations. However, It is the generator who is ultimately responsible for assuring that waste generated is managed in a safe and appropriate manner.

Any waste material that may, upon contact, present a hazard to one's health or surrounding environment should be treated as a potentially hazardous waste. This includes spent or unused chemicals, cleaning solutions, oils, etc.. If there is any doubt whether a material should be treated as hazardous, contact OEHS at 8-8325. Only aqueous/non-hazardous waste may be disposed in the sewer or trash.

OEHS will pick up properly documented and packaged wastes and will store them prior to their final disposition. Waste is disposed of by contract and is picked up from the University usually twice a year. The hierarchy of disposal methods used for the University's waste is reclamation and residual destruction, high temperature incineration, chemical/physical treatment, and secure landfilling.

a. Labeling Waste Containers

All containers should be labeled with contents including %, accumulation date, associated hazards, necessary precautions, and generator identification. When a material has not been spent or otherwise altered, and has the original label in good condition, the original label will be sufficient. Otherwise, when container size and configuration allow, the uniform waste label shown in Figure 3.3.1 should be used. Labels are available from OEHS.

If for some reason the uniform waste label can not be used, the generator shall be sure to label the waste container with all of the information included in the uniform label. A material safety data sheet can often provide information necessary to label a container. MSDS's should be obtained and kept on file for each potentially hazardous material brought on campus. A typical MSDS is shown in Figure 3.3.2.

b. Storing Waste

All waste shall be stored in a safe and secure area. Waste shall remain in such areas until picked up by OEHS. Never leave waste in a hallway or other unsecured area where it may be subject to public contact. Wastes should be properly

segregated. Halogenated materials should be kept separate from non-halogenated and solids separated from liquids.

Generators are responsible for obtaining necessary storage containers. Containers shall be structurally sound, in good condition, and have a tight fitting cap. Stoppered bottles and plastic milk or soda bottles are not acceptable. A waste generator shall also assure that a container is compatible with the material to be stored. Materials that may generate vapor, such as solvents and other low boiling point materials, should be stored in a properly ventilated area. All waste containers should have at least 10 to 20% headspace left in them to avoid pressure build up that may occur with expansion.

c. Having Waste Picked Up for Disposal

Information must be provided to OEHS to adequately characterize and dispose of the waste, prior to having it picked up. This information is provided by the generator to OEHS by using the Pickup Request Form shown in Figure 3.3.3. Pickup requests shall be filled out and sent or faxed to OEHS. Four to five days should be allowed for pickup.

OEHS will evaluate the information and if sufficient, will schedule the material for pickup. If insufficient, OEHS will request additional information from the generator. A pickup will not be made until appropriate information is received.

Certain wastes will require the generator to certify the presence or absence of constituents and concentrations. This certification can be based on the generators knowledge, analytic testing, or other scientific data. OEHS will notify generators when additional information or certification is necessary.

The generator, defined as Laboratory Supervisor, in making the certification, accepts the associated liability and responsibility for possible misrepresentation of the waste. Penalties for misrepresentation, a violation of state and federal law, can include fines and/or imprisonment.

When the generator does not have sufficient knowledge or information to make the certification, the wastes must be analyzed at the Department's (generator's) expense. The analysis must performed by a laboratory acceptable to OEHS and be sufficient to provide necessary data for the generator to certify the waste. OEHS can provide guidance on appropriate analyses.

A comprehensive analysis of an unknown waste can cost well over $1,000. It is therefore in the generator's and Department's best interest to maintain meticulous data concerning the waste and strict control over its composition.

d. Radioactive Materials

Intentionally left blank for future use.

e. Potentially Infectious Material Waste

Potentially Infectious Material (PIM) refers to materials that can be infectious to humans and associated biologicals. The types of material are generated in connection with diagnosis, treatment (i.e., provision of medical services), or immunization of human beings *or animals*; medical research or the production or testing of biologicals. Examples of potentially infectious materials include:

(1) The following human body fluids: blood,semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.
(2) Any unfixed tissue, organ (other than intact skin), and body parts (except teeth and the contiguous structures of bone and gum) from a human (living or dead).
(3) HIV-containing cell or tissue cultures, organ cultures, and HIV or HBV containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.
(4) Cultures and stocks of agents infectious to humans, and associated biologicals; wastes from the production of biologicals; discarded live or attenuated vaccines; culture dishes and devices used to transfer, inoculate, or mix cultures.
(5) Waste materials originating from animals inoculated during research, production of biologicals, or pharmaceutical testing with agents infectious to humans; carcasses, body parts, blood, or bedding of animals known to have been in contact with agents infectious to humans.

Regulated Medical Waste means liquid or semi-liquid blood or other potentially infectious materials and includes the following:
(1) Contaminated items that would release blood or other potentially infectious material in a liquid or semi-liquid state if compressed.
(2) Items that are caked with dried blood or potentially infectious material and are capable of releasing these materials during handling .
(3) Contaminated sharps and Unused needles or syringes.
(4) Pathological and microbiological wastes containing blood or other potentially infectious material.

Non-Regulated Waste materials include:
(1) Waste generated as general household waste
(2) Waste (except for sharps) for which the infectious potential has been eliminated by autoclaving.
(3) Sharps that meet both of the following conditions:
    a. The infectious potential has been eliminated from the sharps by autoclaving.
    b. The sharps are placed in leak-proof, puncture-resistant containers.

Non-regulated waste that is contained in biohazard bags or biohazard sharps containers must first be marked "Treated" on the outside of the container, if the

container does not already have an autoclave heat/pressure tape indicator affixed to it, prior to disposing into general trash receptacles.

Potentially infectious material can be disposed of in one of several manners. Rendering the material non-infectious by such means as autoclaving allows the material to be considered a non-regulated waste. See Appendix C for disposal procedures for non-regulated waste. Totally destroying the material through incineration requires that each department collect the PIM in appropriate containers, store the material, and contact OEHS to pickup the material for incineration in an EPA approved incinerator.

Under no circumstances are any sharps to be discarded into the general trash. Departments will utilize the following storage requirements for regulated waste prior to treatment or transport off-site.

Regulated waste must be collected or secured at the end of each day by the generators of the waste. If there is sufficient waste in the container at the end of the day, the container should be removed to the storage area. If the storage container is to be left in the use area, it must be secured so no other personnel can get into the material or any of the infectious material can contaminate any other material.

Store waste in a manner and location that provides protection from water, rain, and wind.

Maintain PIM in a nonputrescent state, using refrigeration when necessary.

Lock outdoor storage areas to prevent unauthorized access.

Limit access to on-site storage areas to authorized employees.

Store in a manner that affords protection from animals and does not provide a breeding place or a food source for insects and rodents.

If PIM is to be rendered non-infectious by means of autoclaving the following should be adhered to:

All autoclaving of PIM must be documented. This documentation should include the date, the person conducting the autoclaving, the material autoclaved, and the verification that the material was rendered non-infectious. See appendix C.

Verification that the autoclave reached the right temperature and pressure for the required amount of time is required. One way to do this is by autoclaving, along with the waste, a jar with spores in it. The jar is to be placed in the center of the waste bags, then if the spores are destroyed, it is feasible that the infectious material has been rendered non-infectious. Once a week a spore test will be required, all other times a heat/pressure tape is required to be placed on the bags.

All autoclaves that will be used for this type of work should also be inspected annually by a certified inspector. These inspections are to ensure that the autoclaves are capable of conducting the procedures they are being used for.

f. Minimizing Waste

Waste minimization or prevention can be accomplished many different ways. Generators are strongly encouraged to be alert for alternative procedures or products that will reduce or prevent waste generation.

Departments should be familiar with the nature of the waste they generate, including composition and quantity. In so doing, goals or benchmarks should be identified with efforts focused on reaching them.

Chemicals or other materials which have not been opened or are still in usable form can be saved from becoming waste by being offered for other University staff use. EHS will periodically distribute a list of "unwanted but still usable" materials. Staff wishing to obtain a material for use may contact OEHS. OEHS will pickup and deliver the material to the requester.

Staff wishing to list materials should also contact EHS. Materials should continue to be stored by the listing Department until a user is found. If this is not possible, or if an appreciable amount of time has expired with no result, EHS can pickup the material.

Waste generated through scientific classroom instruction has additional reduction options available. These include converting to microscale experiments and incorporating material neutralization or inactivation into experiment procedures. This promotes environmental and product stewardship and could be a valuable theme in course curriculum.

g. Using Sink Drains and the Sewer

Sink drains or the sewer should never be used as a means to dispose of hazardous or other chemical waste unless it is known to environmentally compatible. Chemical and waste products should enter the sewer only through actions incident to the process or experiment, such as container washing and rinsing. Waste material should otherwise be collected for pickup and disposal.

Materials of questionable nature should not be put down the drain without first contacting OEHS. Never allow flammable liquids, mercury, or extremely toxic substances to enter the sewer.

3.4 Special Chemical Safety

a. Corrosive Substances

Biological corrosives attack human tissue and cause irritation, chemical burns, and in severe cases, tissue destruction. In case of skin or eye contact with

corrosives, prompt treatment with a physiologically correct buffered saline is important. Consultation with a medical professional is required. Safety showers and eyewash fountains must be provided for this purpose and must be readily available to all lab occupants. In laboratories which do not have safety showers, the nearest location should be posted. All labs should have eyewash stations.

Types of corrosives and examples of each are:

Acids:
Inorganic or mineral acids include sulfuric, nitric, hydrochloric, phosphoric and hydrofluoric. Concentrated solutions of hydrofluoric acid(HF) can penetrate the skin and soft tissue, causing destruction and intense pain. A neutralizing gel shall be kept in the lab any time HF is used.
Organic acids contain a carboxylic group, (-COOH) and are generally less acidic and corrosive than the mineral acids. Common organic acids include acetic, benzoic, citric, and oxalic.

Bases:
Bases are alkaline substances that have a pH above 7 when dissolved in water. Contact with the skin causes a "slippery" or "soapy" feeling. Examples of common bases include: Ammonium hydroxide Calcium hydroxide Potassium carbonate Potassium hydroxide Sodium carbonate Sodium hydroxide. The eye is especially susceptible to alkalies and splash goggles or face shields are required whenever there is a possibility of eye contact.

Halogens:
The elemental halogens (bromine, chlorine, fluorine, and iodine) are all extremely corrosive, especially to the respiratory system. They are also capable of causing the deterioration of many materials of construction used for gaskets, piping and tubing.

Organic Compounds:
Can be as corrosive as the inorganic acids and bases. Examples include phenols, amines and some unsaturated ketones. In addition, many organics can be absorbed through the intact skin and produce toxic effects.

b. Oxidizers

Oxidizers are compounds (solid, liquid, gas) that evolve oxygen or are electron acceptors either at room temperature or upon slight heating. This group includes peroxides, chlorates, perchlorates, nitrates, permanganates, and the elemental halogens. Oxidizers can react vigorously at ambient temperatures when they contact organic material or reducing substances.

c. Oxygen and Moisture Sensitive Compounds

Many chemical compounds deteriorate when exposed to air. For most of these, oxidation only causes a decrease in purity. But for a few, extreme reactivity with oxygen leads to other effects. Another group of compounds reacts with

atmospheric moisture and causes the release of toxic or flammable gases or vapors or the generation of enough heat to cause fires and explosions. In the following information, the threshold limit value (TLV) is the safe amount to which a person can be exposed to without harm.

Examples of Compound Effects:

- Aluminum Alkyls React with moisture to generate extremely flammable hydrocarbon vapor.
- Dichlorosilane Forms silicon dioxide and hydrogen chloride on contact with air. Will detonate spontaneously under some conditions.
- Phosphides React with moisture to form highly toxic phosphine (TLV=0.3 ppm)
- Potassium Reacts with moisture to release hydrogen and when combined with oxygen to cause ignition and explosion.
- Selenides Moisture causes release of the extremely toxic hydrogen selenide (TLV=0.05 ppm)
- Sodium Reacts with moisture to release hydrogen. The heat generated may cause a fire.
- Sulfides Hydrogen sulfide (TLV=10 ppm) formed on contact with moist air.

These substances should only be handled in a glove box with an inert atmosphere or in special glassware (Schlenk techniques) to avoid the aforementioned effects during experimental work. Storage in special containers with a nitrogen atmosphere is often necessary. Potassium and sodium are usually stored under a non-volatile hydrocarbon liquid to exclude oxygen and moisture.

d. Pyrophoric Compounds

Pyrophorics are a special subgroup of air-sensitive compounds. These substances are so reactive that they will ignite spontaneously when exposed to air. It is obvious that the handling requirements for pyrophorics are extremely restrictive.

Examples of Compound Effects:

- Aluminum Alkyls Ignite spontaneously in air. Also react violently with water and with oxygenated and halogenated solvents.
- Bromotrifluoro- Ignites spontaneously in air to form ethylene hydrogen bromide and hydrogen fluoride which are corrosive and toxic.
- Diborane May ignite spontaneously in air and may detonate under some conditions. Extremely toxic vapor (TLV=0.1 ppm)
- Phosphine Its ability to ignite spontaneously in air may depend on purity. Phosphine gas is highly toxic (TLV=0.3 ppm)
- Silane May detonate violently when released in air, but usually it only ignites.
- The use of any of these compounds requires special approval as discussed in Section 7.0. In all cases, a flow restrictive orifice in the cylinder valve is a required precaution. Special piping and fittings are also necessary.

e. Peroxide-Forming Compounds

Some organic compounds are unusually susceptible to atmospheric oxidation. They require special storage and handling procedures to minimize the formation of peroxides that may create an explosion hazard. Once formed, peroxides are thermally unstable and may also be shock-sensitive.

The types of organic compounds that are most apt to form peroxides include:

- Aldehydes and ketones
- Ethers-especially those with primary or secondary alkyl groups
- Allylic or benzylic structures
- Vinyl and vinylidine compounds

Avoid distilling compounds that may contain peroxides. There are test procedures for detecting peroxide compounds and approved methods are available for destroying them once they have formed.

Peroxide forming compounds must be dated upon receipt. Inhibited ethers can be stored for a maximum of one year. Uninhibited ethers may only be stored for six months. After these dates, peroxide formation may increase, thereby increasing the instability of the material. Disposal of dated peroxide-forming materials is quite difficult and must be accomplished by specially trained and outfitted personnel.

Workers should be aware that ethers have the greatest ability to form peroxides, but the other classes of compounds should be routinely evaluated by need and age for waste disposal.

f. Explosive and Shock-Sensitive Compounds

Shock-sensitive and/or explosive compounds are an obvious safety problem even for laboratory-scale quantities. The first step in safe operations with such substances is a recognition of the potential for damage and personal injury. If possible, avoid their use.

Examples of Compounds Types:

- Azides Lead azides
- Nitro-Compounds Trinitrotoluene (TNT)
- Poly-Nitrates Nitroglycol and Nitroglycerine
- Perchlorates Perchloric acid and its salts
- Picrates Picric acid and its salts
- Peroxides Benzoyl peroxide or Methylethyl ketone peroxide

Refer to the MSDS and other literature to learn about the potential problems and the proper procedures for working safely with these substances. Also be aware of the potential for inadvertent formation of explosive compounds such as heavy metal perchlorates when using perchloric acid to oxidize organic matter in an analytical procedure.

A key to safe operations with explosive or shock sensitive substances is to use very small quantities at any one time or place.

g. Incompatible Materials

Some materials when mixed together can react violently and/or liberate toxic gas. Groups of materials that do so are termed incompatible. The classic example of materials that are incompatible are cyanides or sulfides and acid. A mixture of the two generate hydrogen cyanide or hydrogen sulfide, respectively, both very deadly gases. Laboratory staff must be aware of the groups of materials in their labs that could be incompatible. These materials must be physically isolated from their incompatible counterparts. Emergency procedures must also be in place to guide laboratory staff action in the event that materials are inadvertently mixed together.

h. Laser Installations

Lasers produce non-ionizing radiation capable of causing eye injury. Lasers operating outside of the visible light region (ultraviolet or infrared red) are especially hazardous.

Laser dyes are complex fluorescent organic compounds. In solution with organic solvents, these dyes form a lasing medium. Toxicity information on commercially available laser dyes is not extensive. However, the current research has found a number of the dyes to be mutagenic and possibly carcinogenic. The active dyes identified thus far include:

- Cresyl Violet 670 Perchlorate Coumarin 7
- Coumarin 102 Coumarin 535
- DCM DODCI
- LD 490 Nile Blue 690 Perchlorate
- Oxazine 720 Perchlorate p,p-Diaminoterphenyl
- N,N,N'N'-Tetraethyldiaminoterphenyl
- Oxazine 170 Perchlorate

Because the toxicological properties of most laser dyes have not been fully investigated, these compounds must be handled with care.

i. Formaldehyde

OSHA has singled out formaldehyde for special regulation. This is due, in part, to formaldehyde being implicated as being a sensitizer and carcinogen. OSHA's requirement for a formaldehyde program requires the employer to document exposure levels, provide training, and in some cases, medical monitoring. Staff that work with formaldehyde should contact OEHS to assure they are in compliance with the standard.

j. Mercury

Mercury and mercury compounds can be highly toxic. Mercury compounds, other than metallic mercury, are extremely difficult to dispose of. There are currently no

disposal facilities in the United States capable of taking this type of waste. Staff are therefore encouraged to minimize mercury use and to eliminate it when possible. Elemental mercury should be stored in a non-breakable container in the fume hood.

k. Radioactive Materials

Intentionally left blank for future use.

B.5 General Biological Safety

a. Universal Precautions

Universal precautions shall be observed throughout all areas of NMHU where reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious material is possible. Universal precautions means that all blood or other potentially infectious material will be considered infectious regardless of the perceived status of the source individual. Engineering and work practice controls will be utilized to eliminate or minimize exposure to employees at the University. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be utilized.

b. Containers for Contaminated Material

Reusable contaminated sharps shall be placed immediately, or as soon as possible, after use into appropriate sharps containers. These containers shall be:

(i) Puncture resistant
(ii) Labeled or color-coded in accordance with the Hazard Communication Plan
(iii) Leakproof on the sides and bottom
(iv) Reusable sharps that are contaminated with blood or other potentially infectious material shall not be stored or processed in a manner that requires employees to reach by hand into the containers where these sharps have been placed.

Reusable containers shall not be opened, emptied, or cleaned manually or in any other manner which would expose employee to risk of percutaneous (introduced through the skin, as by rubbing, injection, etc.) injury.

Disposable contaminated sharps shall be discarded immediately or as soon as feasible in containers that are:

(i) Closable and puncture resistant;
(ii) Leakproof on sides and bottom; and
(iii) Labeled or color-coded in accordance with Hazard Communication Plan in Section 3.3.

Contaminated waste other than sharps shall be placed in containers which are:

i) Closable;

ii) Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping; and
iii) Labeled or color-coded in accordance with Appendix E

c. Work Area Restrictions

In work areas where there is a reasonable likelihood of exposure to blood or other potentially infectious material, personnel are not to eat, drink, apply cosmetics or lip balm, smoke, or handle contact lenses.

Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on countertops or benchtops where blood or other potentially infectious materials are present.

All procedures involving blood or other potentially infectious material shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.

d. Biosafety Cabinets

All biosafety cabinets shall be maintained according to National Sanitation Foundation Standard 49. Check with your supplier or EHS to see if this standard is being met.