Villanova University
Chemical Hygiene Plan

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By the Environmental Health & Safety Department

Table of Contents

I. Introduction 1
A. Purpose ***1***
B. Scope and Application ***1***
C. Responsibilities ***2***
1. Chief Executive Officer 3
2. Environmental Health and Safety Office 3
3. Laboratory Safety Committee 3
4. Deans and Department Chairperson 3
5. Departmental Chemical Hygiene Officer 3
6. Principal Investigator/Faculty Member 4
7. Group Safety Officer 5
8. Laboratory Worker/Student Worker 5
9. Students (and non-employees) 5
II. Standard Operating Procedures 5
A. General Rules ***5***
B. Personal Hygiene ***8***
C. Protective Clothing and Equipment ***8***
D. Housekeeping ***10***
E. Prior Approval ***11***
F. Spills and Accidents ***11***
G. Chemical Inventory ***133***
H. Chemical Storage ***14***
I. Chemical Waste Plan ***17***
J. Safety Data Sheets ***19***
K. Labeling ***19***
L. Signage & Life Safety Boxes ***19***
M. Chemical Purchasing ***200***
III. Procedure-Specific Safety Procedures 211
A. Procedures for Toxic Chemicals ***211***
B. Procedures for Flammable Chemicals ***211***
C. Procedures for Reactive Chemicals ***222***
D. Procedures for Corrosive Chemicals and Contact-Hazard Chemicals ***23***
E. Control Measures and Equipment ***233***
1. Ventilation – Laboratory Hood Guidelines 233
3. Eyewash Fountains and Safety Showers 244
4. Respirators 255
5. Vapor Detection 255

F. Procedures for Carcinogens, Reproductive Toxins, Substances That Have a High Degree of Acute Toxicity, and Chemicals of Unknown Toxicity.....255
G. Other Special Precautions.....277
IV. Records and Recordkeeping:.....300
V. Employee Information and Training:.....311
VI. Medical Consultation and Examination.....311
VII. Appendices.....333
APPENDIX A - CHEMICAL COMPATIBILITY CHART (GLOVES) 333
APPENDIX B - OSHA LABORATORY STANDARD, 1910.1450.....34
APPENDIX C – CLASSES OF INCOMPATIBLE CHEMICALS 35
APPENDIX D - EXAMPLES OF COMMON COMPOUNDS THAT FORM PEROXIDES AND RECOMMENDED MAXIMUM STORAGE TIMES.....39
APPENDIX E - CARCINOGEN LIST.....42

APPENDIX F - DEPARTMENT CHEMICAL HYGIENE OFFICERS.....44
APPENDIX G - ACRONYMS.....45
APPENDIX H - PROPER ATTIRE FOR INDIVIDUALS IN LABORATORIES 46

APPENDIX I- SAMPLE INJURY INVESTIGATION FORMS.....47

I. INTRODUCTION

A. Purpose

The purpose of the Chemical Hygiene Plan is to provide guidelines for the use of chemicals in the laboratory setting. Exposures to chemicals in laboratories tend to be of intermittent nature rather than regular exposure to a few chemicals. The Occupational Safety and Health Administration (OSHA) has addressed this situation by issuing a generic Laboratory Standard, 29 CFR 1910.1450. The primary goal of this standard is to encourage the implementation of work procedures and practices which will reduce "significant risk of harm". This involves an in-depth look at what is occurring in the lab and what exposures may result. This risk assessment is then used to formulate a systematic approach for controlling chemical exposures in the form of a Chemical Hygiene Plan (CHP). In addition, the OSHA Lab Standard requires employee training, provisions for medical consultation and examination, personal protective equipment, and recordkeeping.

The risk assessment involves examining the way in which chemicals in each department are used and evaluating the potential for exposure.

Examining chemicals and the ways they are used identifies where exposures must be controlled:

- Administrative controls or altered operating procedures can be used to reduce exposures to hazardous substances.
- Substitution of a less hazardous chemical for a more hazardous one (i.e. use of toluene, xylene and other solvents instead of benzene).
- Engineering controls (fume hoods, etc.) can be implemented or upgraded.
- Protective equipment such as gloves and respirators can be used to limit exposures.

B. Scope and Application

This standard applies where "laboratory use" of hazardous chemicals occurs. Laboratory 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 occurs on a "laboratory scale", that is, the work involves containers which can easily and safely be manipulated by one person.
- Multiple chemical procedures or chemical substances are used.
- Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

This plan covers all laboratory personnel who are working with, or who may come in contact with, hazardous substances at Villanova University. More specifically, employees who use chemicals in teaching and research or work in an area where chemicals may be used and non-employee personnel including graduate and undergraduate students, postdoctoral associates, visiting scientists, and visitors are all covered by the Laboratory Standard.

The CHP is not intended to be a static collection of standard operating procedures or practices. It should be evaluated and updated at least annually. The required components include standard operating procedures, criteria for determining and implementing control measures, a plan to ensure adequate performance of fume hoods and other protective equipment and provisions for employee information and training. OSHA also requires laboratories to identify circumstances in which a particular activity may need prior approval of the department head or his/her designee and to make special provisions for work with particularly hazardous substances. Finally, if there is reason to believe that exposure levels for a substance routinely exceed the action level or, in the absence of an action level, the permissible exposure limit (PEL), exposure monitoring and medical consultation and examination must be provided.

Chemical hygiene is important in the academic setting. When researchers, instructors and other university employees show familiarity with and an interest in providing a safe work environment, they set an example for students and show them that safety is a real concern.

C. Responsibilities

Responsibility for chemical hygiene rests at all levels including the following:

1. Chief Executive Officer

The President of Villanova University has the ultimate responsibility for chemical hygiene throughout the laboratories and, with the assistance of other program administrators, will provide continued support for chemical hygiene.

2. Environmental Health and Safety Office

The Director or person designated by the Director shall be the Chemical Hygiene Officer (CHO) for the University.

- Consults with and advises users on safe practices for handling chemicals.
- Monitors the procurement, use and disposal of chemicals.
- Develops written procedures for safe laboratory practices, when requested.
- Knows current legal requirements concerning regulated substances.

3. Laboratory Safety Committee

Reviews the University Chemical Hygiene Plan annually. Members include departmental Chemical Hygiene Officers, Environmental Health & Safety department personnel, and other departmental representatives.

4. Deans and Department Chairperson

Responsible for establishing and maintaining compliance with the CHP. Department Chairpersons designate departmental CHOs for all applicable departments to oversee and implement the CHP.

5. Departmental Chemical Hygiene Officer

The CHO is designated by the department chairperson and is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the CHP. Training can include formal safety training, a degree in a safety-related field, and/or attendance at professional courses. Experience can include participation on a safety committee or through other safety-related responsibilities in the workplace.

- Reviews and provides input into the annual CHP update.
- Acts as liaison between the department, administration, and EHS.
- Responsible for safety recordkeeping including chemical inventory management, chemical disposal and department-specific safety training.

6. Principal Investigator/Faculty Member

It is the primary responsibility of the Principal Investigator/Faculty member to implement the CHP and ensure compliance with the OSHA Laboratory Standard in her/his lab.

- Requires all personnel to conduct work in accordance with the CHP.
- Defines designated areas for work with particularly hazardous substances and ensures that an inventory of these substances is properly maintained.
- Reviews and approves standard operating procedures for work involving hazardous substances.
- Establishes safe practices and specifies appropriate protective equipment.
- Ensures that all staff and students receive instructions and training in safe work practices, use of personal protective equipment, and response procedures in the event of laboratory accidents.
- Assures personnel use protective equipment necessary for the safe performance of their assigned task.
- Monitors the performance of personnel with regard to required safety procedures.
- Formulates procedures for dealing with accidents that may result in the unexpected exposure of personnel or the environment to toxic substances.
- Investigates all accidents and report them to the appropriate CHO. Institutes procedures which to minimize repeat events.
- Reports to the CHO incidents that cause personnel to be seriously exposed to hazardous chemical or materials, or that constitute a danger of environmental contamination.
- Acts to correct work practices and conditions that may result in the release of toxic chemicals.
- Instructs laboratory personnel to properly dispose of unwanted and/or hazardous chemicals and materials.
- Assures that support staff can access the CHP.
- Arranges for non-laboratory personnel to be informed of potential hazards to which they may be exposed when working in the laboratory, and provides proper instruction to minimize the risk of harmful exposure to hazardous substances.
- Ensures that particularly hazardous chemicals (i.e. peroxide formers and explosive types, short-lived chemicals, etc.) are labeled with date received.

7. Group Safety Officer

- A faculty member may choose to appoint a Group Safety Officer for his/her research laboratory. Group Safety Officers are responsible for evaluating and making recommendations on safety issues which concern the department. Safety Officers also participate in periodic safety inspections of department laboratories.
- Group Safety Officers advise and assist their faculty member in training personnel, disseminating safety information, conducting inspections of their group's laboratories, and inspecting and ensuring the maintenance of group safety equipment such as spill control kits, fire extinguishers, safety showers, and eyewash facilities.

8. Laboratory Worker/Student Worker

- Plans and conducts each operation in accordance with safe procedures.
- Develops and maintains good personal chemical hygiene habits.
- Reports any unsafe acts to her/his lab supervisor or EHS.
- Wears appropriate personal protective equipment at all times.
- Participates in all required safety training program offered by the Department or EHS.

9. Students (and non-employees)

- Adhere to safety guidelines provided by the faculty member/advisor.
- Wear appropriate personal protective equipment at all times.
- Participate in all required safety training offered by the Department or EHS.

II. STANDARD OPERATING PROCEDURES

A. General Rules

1. DO NOT WORK ALONE in the laboratory without approval on a department-specific basis:
    a. Biology Department – Undergraduate and Graduate Students
        i. In cases in which hazardous chemicals may be used, students who have been appropriately trained may perform tasks alone in the laboratory during normal working hours with written approval from their faculty advisor.

ii. In cases in which hazardous chemicals may be used, students who have been appropriately trained may work alone in the laboratory outside of normal working hours with approval of their faculty advisor.
iii. Students working alone outside of normal working hours must notify a friend or faculty member as to when they will arrive and leave the laboratory.
iv. Emergency numbers are posted in all laboratories in which hazardous chemicals are used.

b. Chemistry Department –
   i. No student in an instructional laboratory may work unless a supervisor authorized by the Department is in attendance.
   ii. Students may only pursue experiments defined for their course unless the instructor has been informed and has given written permission to the student carrying out the work.
   iii. Graduate students/research students may work alone but must NEVER perform a hazardous procedure without first ensuring that someone is available for immediate assistance in case of an accident.
c. Chemical Engineering – Undergraduates
   i. May perform tasks alone in the laboratory only during normal working hours (M-F 8:30am-5pm) with prior approval of their faculty advisor.
   ii. Must know the location of their advisor or designated representative in case of emergencies.
d. Chemical Engineering - Employees and Graduate Students
   i. Need prior approval of faculty member advising the work.
   ii. Must know the location of their advisor or designated representative in case of emergencies.
   iii. Graduate students must receive permission from supervising faculty member and department chairperson to work alone in the laboratory outside of normal working hours
   iv. Must notify Public Safety, ext. 4444, that they are in the building working alone, room location, and expected time of departure.
e. Civil and Environmental Engineering – Undergraduates
   i. After training, may perform tasks alone in the laboratory during normal working hours (M-F 8:30am-5pm) with prior approval of their faculty advisor.

ii. Emergency numbers are posted in all laboratories.

f. Civil and Environmental Engineering – Employees and Graduate Students
   i. After training may perform tasks alone in the laboratory during normal working hours (M-F 8:30am-5pm) with prior approval of their faculty advisor.
   ii. Graduate students must receive permission from supervising faculty member and department chairperson to work alone in the laboratory outside of normal working hours.
   iii. Students working alone outside of normal working hours must notify a friend or faculty member as to when they will arrive and leave the laboratory.
   iv. Emergency numbers are posted in all laboratories.

g. Mechanical Engineering – Undergraduates
   i. May perform tasks alone in the laboratory during normal working hours (M-F 8:30am-5pm) with prior approval of their faculty advisor or immediate supervisor.
   ii. Must know the location of their advisor or designated representative in case of emergencies.

h. Mechanical Engineering – Graduate Students
   i. Graduate students must receive permission from supervising faculty member or department chairperson to work alone in the laboratory outside of normal working hours.
   ii. In cases in which hazardous chemicals may be used, Graduate students who have been appropriately trained may work alone in the laboratory outside of normal working hours. Students must NEVER perform a hazardous procedure without first ensuring that someone is available for immediate assistance in case of an accident.
   iii. Students working alone outside of normal working hours must notify a friend or faculty member as to when they will arrive and leave the laboratory.

2. Wear appropriate personal protective equipment at all times.
3. Eye protection is required for any visitors whose eyes may be exposed to chemical or physical hazards.
4. When working with flammable chemicals, be certain that there are no ignition sources near enough to cause a fire or explosion in the event of a vapor

release or liquid spill. The minimum separation distance for such a source is 10 feet.

5. Use a tip-resistant shield for protection whenever an explosion or implosion might occur.
6. When working with chemicals, all faculty, students, and employees should know and be constantly aware of:
    a. The chemical's hazards, as determined from the Safety Data Sheet (SDS) and other appropriate references.
    b. Appropriate safeguards for using that chemical, including personal protective equipment.
    c. The location and proper use of emergency equipment.
    d. Proper laboratory safety practices.
    e. Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures, and proper waste disposal.
    f. Proper procedures to follow for chemical storage. See section II H, Chemical Storage.

B. Personal Hygiene

1. Wash promptly whenever a chemical has contacted the skin.
2. Avoid inhalation of chemicals. Do not "sniff" to test chemicals.
3. Mouth pipetting is strictly prohibited. Only pipetting devices are to be used.
4. Wash well with soap and water before leaving the laboratory; do not wash with solvents.
5. Do not drink, eat, smoke, or apply cosmetics in the laboratory.
6. Do not bring food, beverage, tobacco, or cosmetic products into chemical storage or use areas.

C. Protective Clothing and Equipment

1. Clothing worn in the laboratory should offer protection from splashes and spills, be easily removable in case of accident, and be fire resistant when working with flammable materials.
    a. <u>Whenever working at the bench, University-provided lab coats, per the Principal Investigator/Lab Supervisor recommendation, must be worn.</u> . These coats are to be fastened closed while working and they should be removed prior to exiting the building. When working with flammable materials, a Nomex (blue) coat is required.

   b. Laboratory aprons are available and may be required for certain tasks such as dispensing, mixing, etc. Check with the lab supervisor.
   c. Shorts are not to be worn in the laboratory; wear long pants only. Leggings are not appropriate. Jeans or "scrubs" are ideal. . See Appendix I for Proper Attire in Laboratories.
2. Eye Protection
   a. At a minimum, safety glasses with side shields are required in all laboratories covered under the CHP. Operations that require improved protection against impact, liquid splash, and other eye hazards will require safety goggles and/or face shields. Information on appropriate eye protection is available on the SDS.
   b. Contact lens policy – Wearing contact lenses in the lab is acceptable; however, glasses are preferable. If contact lenses are worn, goggles or safety glasses with side shields are required in addition. Some soft lenses absorb organic vapors and corrosive vapors like hydrogen chloride or ammonia. If, while wearing contact lenses, any discomfort is noticed while working with volatile solvents, or corrosive liquids or gases, leave the lab and remove the lenses.
   c. Eye protection worn when working with the chemicals should meet the requirements of the American National Standards Institute (ANSI) Z87.1 and be approved by the Department CHO. Always consult the chemical's SDS for specific personal protective equipment to be used.
3. Gloves
   a. No single glove provides an effective barrier against all chemicals used in laboratories. The selection of the appropriate glove material is critical. Use of an inappropriate glove may actually increase the risk of hazardous skin contact or absorption. For specific recommendations regarding the type of glove to be used, consult the Chemical Compatibility Chart (Appendix A), the SDS of the chemical, the lab supervisor or the Chemical Hygiene Officer. Should a glove tear while being worn, simply add another pair of gloves over the torn pair
4. Dust Masks/Respirators
   a. When working with toxic powders or fine powders, all procedures should be carried out in a hood if possible. Disposable dust and mist respirators are available from the departmental CHO
   b. Contact EHS for assistance in selection of appropriate respirators.
   c. In order to use a respirator (including a dust mask with exhalation valve) the following are required:

   i. Medical examination
   ii. Fit-testing by EHS
   iii. Training
5. Footwear should be low-heeled and cover the foot. Bare feet, sandals, and open-toed shoes are not permitted in the laboratory.
6. Carefully inspect all protective equipment before using it. Do NOT use defective protective equipment.

D. Housekeeping

1. Access to emergency equipment, showers, eyewashes, and exits must never be blocked by anything, not even a temporarily-parked chemical cart.
2. All containers storing chemicals must be labeled with the identity (no formulas, use full name of chemicals) of the contents and their hazards as defined by the globally harmonized system (GHS) hazard communication standards.
3. Keep all work areas, especially laboratory benches, clear of clutter.
4. Keep all aisles, hallways, and stairs clear of all obstructions.
5. All chemicals must be placed in their assigned storage areas at the end of each workday or experiment.
6. Wastes must be properly labeled and kept in proper containers. No chemicals should be disposed of in regular trash. Contaminated clothing or shoes should be thoroughly decontaminated or handled as waste.
7. Promptly clean up all spills. Properly dispose of the spilled chemicals and cleanup materials. For large spills, contact department CHO or the EHS department See Section II. F. (Spills and Accidents) and Section III. G. (Other Special Precautions).
8. All working surfaces and floors should be cleaned regularly.
9. No hazardous chemicals are to be stored in aisles or stairwells, on desks or laboratory benches, on floors or in hallways, or to be left overnight on shelves over the workbenches.
10. All used needles, syringes, and other sharps are to be collected and disposed of in an approved biohazard sharps container. Unused syringes and needles must be kept in locked drawers, cabinets, or desks.
11. Empty chemical containers should be disposed of properly. Plastic containers containing non-toxic chemicals may be rinsed, cut up, and recycled or discarded. Empty glass containers can be reused to collect waste or taken to the Chemistry Department for crushing or reuse for waste.

E. Prior Approval

Students and employees must obtain specific approval from the Laboratory Supervisor or her/his designate whenever:

a. A new laboratory procedure or test is to be carried out.
b. Toxic limit concentrations could be exceeded or other harm is possible.
c. There is failure of any of the equipment used in a process, especially safeguards such as fume hoods or clamped apparatus.

F. Spills and Accidents

1. To prepare for a chemical spill the appropriate safety equipment must be available and a plan in place. Areas where there is a potential for a chemical spill or explosive reaction that may cause injuries, illnesses, property damage or a significant contamination of the environment must be identified. Spills of toxic substances or accidents involving any hazardous chemical should be resolved immediately.
2. Large spills should only be handled by laboratory personnel trained in spill cleanup. They should be able to evaluate situations and take necessary response actions to efficiently contain and dispose of the various chemicals present in the laboratory as well as the use and maintenance of respirators.
3. The following steps should be followed in the event of a moderately toxic to highly toxic or flammable material spill in the laboratory:
    a. **Notify** all personnel in the immediate area of the spill and evacuate if necessary.
        i. Chemistry may call 610-519-7481 for assistance in clean-up. In case of injury, fire, or uncontrolled spills call Public Safety ext 9-4444.
    b. **Confine** the spill area by closing doors or lift the hood sash to maximize exhaust air to the outside. Do not re-enter the area unless you are trained and wearing appropriate protective equipment.
    c. **Verify** the identity of the spilled material and determine the scope of the hazard via the SDS.
    d. **Clean-up** <u>ONLY IF</u>
        a. you have the proper training
        b. you have the appropriate personal protective equipment
        c. you have the appropriate spill absorbent materials and clean up equipment

d. the spill is contained and non-life threatening
e. Otherwise, call Public Safety and evacuate the entire building and other areas if warranted.

4. A spill is considered to be a minor spill if:
    a. It is contained within the area.
    b. Has a low level of toxicity.
    c. Does not generate toxic vapors.
    d. There is not threat of fire or explosion.
    e. There is not threat of discharge to drain/sewer.
    f. Exposures do not exceed short-term exposure limits.
    g. There is no threat to the community.
5. If it has been determined the spill is of minor nature and one has the proper training, personal protective equipment, and the proper material to absorb and clean up the chemical spill, follow these procedures:
    a. Don appropriate protective equipment.
        i. Always wear lab coat, protective gloves and eye protection
        ii. If the spill is on the floor, wear rubber or plastic boots (NOT leather).
    b. Remove ignition sources.
        i. Turn off hot plates, stirring motors, flame sources.
        ii. Shut down all equipment.
        iii. If unable to shut off sources of ignition, notify emergency responders.
    c. Confine or contain the spill.
        i. Cover with an absorbent mixture.
        ii. Clean up minor spills with paper towels or sponge if they won't react.
        iii. Sweep solid materials into a dust pan, place in sealed container.
        iv. If acid/base, first add a neutralizing agent; sodium bicarbonate for acids, sodium bisulfate for bases.
        v. Small amounts of inorganic acids/bases: use neutralizing agent and absorbent material.
        vi. Small amounts of other materials: absorb with non-reactive material (e.g. vermiculite, sand, towels, Floor-Dri).
        vii. Large amounts of inorganic acids/bases: neutralize and call for help.

viii. Large amounts of other materials: make a judgment call; depending on the amount, toxicity or what the substance can run into or react with, you may handle it yourself or call for help.

d. Remove absorbent material with a broom and dust pan.
   i. Place in plastic bag or other appropriate container.
   ii. Dispose of the material through the Chemistry Department Safety Officer.

e. Wet mop the spill area.

6. Mercury Spills: Minor mercury spills, such as broken mercury thermometers, can be handled by the department.
   a. The teaching assistant or laboratory manager responsible for the lab should secure the area with the broken thermometer.
   b. Notify the Department Safety Officer and the EHS department at X7838. They will evaluate the spill.
   c. If the spill is deemed small enough to handle in-house, the Departmental Safety Officer will use the mercury vacuum located in the chemical waste room to clean up the spill.
   d. If the spill is deemed too large to handle in-house, notify Public Safety at ext.. 9-4444 who will call emergency services and the Environmental Health & Safety Department.

G. Chemical Inventory

1. In general, all chemicals received at Villanova University must be dated when received and entered into the on-line ChemTracker chemical inventory system. All hazards associated with the chemical as defined by GHS hazardous communications should be indicated on the label. Chemical inventories must be updated at least annually.
2. The Chemistry Department uses a more detailed chemical tracking system due to the hazardous nature of the chemicals used in the department.
3. Faculty Departure
   a. Before leaving the employ of Villanova University, faculty members are responsible for the cleanup of their laboratories, both teaching and research. An inventory of chemicals should be circulated to others who may be able to use the materials. If another department member can use the material, it should be taken to his or her laboratory. If the material cannot be used, it should be disposed of in an appropriate

manner. In either case the chemical inventory should be changed to reflect the relocation.

b. Notify the CHO and EHS of the cleanout.
c. If no other laboratory accepts the surplus chemicals, the CHO will declare that the surplus chemical is waste and store it according to environmental regulatory requirements.

H. Chemical Storage

1. Proper chemical storage is the key to maximize employee and student safety within the laboratory. Read the label of the chemical and its SDS to determine the appropriate storage areas. In general, chemicals are segregated by compatibility and hazard classification.
2. It is the responsibility of faculty, research students, and storeroom personnel to ensure adequate and proper chemical storage exists in the laboratory.
3. Faculty should perform semi-annual inspections of the laboratory to verify adequacy of chemical storage.
4. General rules for chemical storage (Consult Appendix C: Classes of Incompatible Chemicals)
    a. Every chemical in the laboratory should have a definite storage place and should be returned to that location after each use.
    b. Date of receipt must be on the label of the container.
    c. Do not store excessive amounts of chemicals in the laboratory. Purchase the minimum amount of chemical required and dispose of unneeded chemicals in a timely fashion.
    d. Store reagents on shelves or in cabinets. Store large bottles of chemicals on the lowest shelves of any chemical storage area.
    e. Ideally, storage shelves have a ¼-1/2" lip on the forward edge of the shelf. Do not allow bottles to extend over the edge of the shelf.
    f. Except for synthetic work in progress (*), no chemicals should be stored in any fume hood, unless that hood is used only for storage. The front sash of all storage fume hoods must be secured all the way down when not in use.
        i. *Containers with left over reagents used in synthesis do not qualify as work in progress – these must be put away.
    g. No chemicals (either reagents or waste chemicals) should be stored on the floor. Floor storage presents a major safety hazard because bottles can break if knocked over or struck together.

h. Only a day's supply of chemicals should be "stored" on the bench top, and all of these chemicals should be returned to their storage locations at the end of the day.
i. Inspect storage areas periodically for damaged containers such as cracked bottles or caps or rusted can. Replace loose or deteriorating labels.
j. Whenever possible, all incompatible chemicals should be segregated – stored in the same room but with a physical barrier. At the very least, all incompatible chemicals must be separated – stored in the same room but separated by as much space as practical.
k. Wherever possible, compatible materials should be stored according to container size to minimize accidental breakage of small bottles. If this is not possible, large bottles should be kept to the back.
l. Chemicals requiring refrigeration should be properly labeled and sealed to prevent escape of any vapors. The refrigerator should bear a label similar to "No food or drink storage permitted" or "For chemical storage only". Flammables requiring refrigeration should be stored in explosion-safe refrigerators only.
m. Chemicals should be stored by compatibility first. Solvents, acids, bases, reactives, oxidizers, and toxins will be stored separately – that is, physical separation of containers and isolation of potential spills and releases with the goal of preventing chemical reactions. Once separated into hazard classes, chemicals may be stored alphabetically.
n. Small bottles or vials of chemicals may be stored in drawers in ventilated cabinets. Drawers or cabinets used for chemical storage must be labeled with the approximate contents.

5. Guidelines for Storage of Specific Classes of Chemicals
   a. Store **acids** separate from **bases**. Store ammonium hydroxide in a separate cabinet, preferably ventilated.
   b. Store **oxidizers**, including oxidizing acids such as nitric acid and perchloric acids separate from oxidizable chemicals such as acetic acid. Perchloric acid MUST be stored where it cannot contact organic material.
   c. Store **highly toxic chemicals** in unbreakable secondary containers labeled with a description of the contents. Cyanides and sulfides MUST be kept safe from any contact with acids. Store cyanides in a closed cabinet, not in a location visible to passerby. Dispose of cyanides for which you have no current use.

d. Store **pyrophoric** materials separate from flammable materials, in a dry inert atmosphere such as a nitrogen-filled desiccators or a glove box.
e. **Organic peroxides** should be kept in the laboratory no longer than 12 months. They should be properly labeled with the date of receipt, opening date, and the date recommended for disposal. Peroxide formers should be stored in air-tight containers in a cool, dry, dark place. See Appendix D, Examples of Peroxide Forming Compounds and recommended storage time.
f. Solvents are classified by the National Fire Protection Association (NFPA) by flash point and boiling point. Flash point is defined as the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

NFPA Class	Flash Point	Boiling Point
Class IA (Flammable Liquid)	<73 °F (22.8 °C)	<100 °F
Class IB (Flammable Liquid)	<73 °F (22.8 °C)	≥100 °F
Class IC (Flammable Liquid)	≥73 °F (22.8 °C)	<100 °F
Class II (Combustible Liquid)	≥100 °F and <140 °F (60°C)	N/A
Class IIIA (Combustible Liquid)	≥140 °F and <200 °F (93°C)	N/A
Class IIIB (Combustible Liquid)	≥200 °F (93°C)	N/A

g. Proper storage of flammables and combustible liquids depends upon the Class distinction. See section III. B. Special Precautions for specific storage requirements for flammables and combustible liquids as determined by NFPA codes.

I. Chemical Waste Plan

1. This plan covers hazardous chemical waste and does not include infectious, biological, or radioactive waste or sharps. These are covered in the Bloodborne Pathogens Program, BioSafety Manual or Radiation Safety Manual.
2. In general, chemicals will not be disposed of in the regular trash. Evaporation or dilution is not an acceptable means of disposal for toxic and/or ignitable wastes. Unwanted chemicals or reaction by-products will be kept in closed containers until a university-wide chemical disposal is conducted (approximately twice per year).
3. Chemical waste will be labeled with a VU chemical waste label. Complete information as possible regarding the chemical identity and composition including:
    a. Name(s) of the chemicals
    b. Approximate amount of each chemical
    c. Room number
    d. Hazards if known
    e. Date the first drop of waste added
    f. Fill date of the container (NOTE: when fill date is entered, the container must be removed to central storage within 3 days).
4. Use appropriate containers for the type of waste collected. Use only tight fitting screws to close.
5. Instructional Laboratory Waste
    a. Collect, label and date waste from instructional labs. Use containers appropriate for the waste.
    b. Segregation of incompatible chemical waste is carried out in compliance with accepted guidelines as set forth in “Prudent Practices in the Laboratory - Handling and Disposal of Chemicals” by National Academy Press.
    c. Volume reduction through chemical treatment (neutralization, metal precipitation, conversion to less hazardous forms, etc.) is implemented as part of the experiment. Solvent consolidation is permissible.

6. Research Laboratory Waste
    a. Chemical waste from the research labs is divided into two general classes:
    b. Waste Organic Solvents
        i. Segregate into halogenated and non-halogenated in 4L bottles.
        ii. List the ingredients and approximate amounts, the initial date waste is placed in the container and room number on the University Hazardous Waste label and affix to the bottle.
        iii. Periodically the solvents will be collected for bulking in the Mendel storage room.
        iv. Sulfur containing compounds, amines or other odoriferous materials as well as reactives are to be labeled and kept SEPARATE from these solvents. When in doubt, label and SEPARATE it out.
    c. Waste and Surplus Chemicals
        i. Label with the ingredients, approximate amounts, and primary hazard
        ii. Follow proper storage guidelines for compatibles/incompatibles.
        iii. Include the date waste is first placed in container and PI name on the label.
        iv. Store in the research lab until a waste shipment is implemented.
        v. For research products, the general chemical class or list of starting materials is sufficient if more accurate identification is not possible.
        vi. Pretreatment of waste to the lowest possible volume should be practiced whenever possible. Consult "Hazardous Laboratory Chemicals: Disposal Guide" by M.A. Armour, seek advice from the Chemistry Department Safety Officer and/or other faculty.
7. Drain Disposal – only neutralized acid/base solutions or non-hazardous aqueous metal salt solutions as described in "Vogel's Qualitative Inorganic Analysis" by G. Svehla (most current edition) should be disposed of down the drain and only with excess amounts of water.
8. Waste Collections
    a. Research personnel will be notified via e-mail 4 weeks prior to a waste shipment.
9. Waste Shipments

a. Waste shipments occur semi-annually in conjunction with the Environmental Health & Safety Office. ALL chemical waste must be sent for disposal every 6 months.
b. Waste is collected and organized safely in a central location for lab packing, manifesting and labeling.
c. Completed copies of all shipping papers and notification are sent to the appropriate agencies. A complete set of documents is forwarded to the Environmental Health & Safety Office.

J. Safety Data Sheets

1. Employers must make available the SDS for every hazardous chemical used on-site. SDS provide specific information on the hazards of the chemicals used by employees.
2. SDS are readily available from Villanova's on-line SDS service, msdsonline. See the EHS home page for details.
3. Some PI's or lab managers may choose to have hard copy SDS in their labs. In that case the PI/lab manager is responsible to assure that the most current version of the SDS is the one being used.

K. Labeling

1. All chemicals received will be properly labeled with the date received or generated, the responsible person, and the contents.
2. Solutions/mixtures prepared on-site must be labeled at the time of preparation with the following:
   a. Name of the material(s)
   b. Name or initials of the person preparing it
   c. Date prepared
   d. Course and/or laboratory in which it is to be used
   e. Hazards as defined by GHS

L. Signage & Life Safety Boxes

1. Prominent signs and labels of the following types must be posted or affixed.
   a. Door signs – name of the laboratory supervisor/research advisor, campus extension, Public Safety extension, and the types of hazards located in each lab displayed outside the lab.
   b. Eye wash/safety showers

   c. Fire extinguishers
   d. Warning signs in areas or at equipment where there are special or unusual hazards.
2. ALL laboratories (instructional and research) maintain red life safety boxes mounted adjacent to the lab door. Boxes are updated at least annually
   a. Research labs: Box contains a current chemical inventory, generated from ChemTracker. The box is secured with a zip tie. Chem Tracker is used to generate the Lab Hazards sheet; sheet is placed in the plastic sleeve on the front of the box.
   b. Instructional labs: Box contains a current chemical inventory, generated from ChemTracker. The box is secured with a zip tie. Chem Tracker is used to generate the; sheet is placed in the plastic sleeve on the front of the box. A copy of the current lab experiment SOP is placed in the plastic sleeve on the front of the box along with Safety Data Sheets for the chemicals being used in the experiment.

M. Chemical Purchasing

1. Chemicals for use in research laboratories should, whenever possible, be purchased by authorized Villanova purchasing agents. In the Chemistry Department, most chemicals are purchased by Eydiejo Kurchan and Steve Berlin. If your department does not have an administrative assistant authorized to purchase and receive chemicals, you should consult with either Eydiejo or Steve. However, Chemistry will **not** purchase chemicals for other departments.
2. After consultation with Eydiejo or Steve, if they determine that the chemical you need is best purchased using local retail outlets, the chemical or chemicals in question should be purchased by an authorized Villanova University employee. **Under no circumstances should a Villanova student purchase chemicals for research or instructional lab use at Villanova.**
3. If a student attempts to bring outside chemicals into your laboratory, do not accept these chemicals and notify the Office of Environmental Health and Safety.
4. Chemicals purchased by other means should be treated in the same manner as described above. Upon arrival, they should be recorded in the Department's Chemical Inventory as described in this CHP. They should be placed into proper chemical storage as described in the CHP.

5. Faculty should refer to the CHP for guidance describing the safe use of chemicals in research lab, especially with respect to the nature of required safety equipment, supervision of research students, etc.

III. PROCEDURE-SPECIFIC SAFETY PROCEDURES

Each laboratory procedure must contain a written description of specific safety practices. All involved should read and understand these practices before commencing a procedure. In all cases, appropriate personal protection equipment will be used when handling any of these chemicals.

A. Procedures for Toxic Chemicals

The SDSs for many of the chemicals used in the laboratory state recommended limits or OSHA mandated limits, or both, as guidelines for exposure. Typical limits are threshold limit values (TLV), permissible exposure limits (PEL), and action levels. When such limits are stated, they will be used to assist the Chemical Hygiene Officer in determining the safety precautions, control measures, and safety apparel that apply in working with toxic chemicals

B. Procedures for Flammable Chemicals

Chemicals with a flash point below 200 degrees F (90 degrees C) will be considered "fire-hazard chemicals".

1. Fire-hazard chemicals must be stored in a flammable-solvent storage area or in storage cabinets designed for flammable materials.
2. Fire-hazard chemicals should be used only in vented hoods and away from sources of ignition.
3. Fire-hazard chemicals in quantities greater than 500 mL should be kept in metal safety cans designed for such storage. The cans should be used only as recommended by the manufacturer. The following safety practices should be enforced:
    a) Never disable the spring-loaded closure
    b) Always keep the flame-arrestor screen in place; replace if punctured or damaged.
4. Cabinets designed for the storage of flammable materials should be properly used and maintained. Read and follow the manufacturer's information and also follow these safety practices:
    a. Store only compatible materials inside a cabinet.

b. Do not store paper or cardboard or other combustible packaging material in a flammable-liquid storage cabinet.
c. Do not overload a cabinet. The manufacturer establishes quantity limits for various sizes of flammable-liquid storage cabinets.
d. See Section II.H, Protocol For Chemical Storage.

C. Procedures for Reactive Chemicals

A *reactive chemical* is a chemical substance that will vigorously polymerize, decompose, condense, or become self-reactive due to shock, pressure, or temperature.

a. Is so identified or described in the SDS or on the label
b. Is ranked by the NFPA as 3 or 4 for reactivity.
c. Is identified by the DOT as:
    i. An oxidizer
    ii. An organic peroxide, or
    iii. An explosive, Class A, B or C
d. Fits the EPA definition of reactive in 40 CFR 261.23
e. Fits the OSHA definition of unstable in 29 CFR 1910.1450,

OR

f. Is known or found to be reactive with other substances.

2. Handle reactive chemicals with all proper safety precautions, including segregation in storage and prohibition on mixing even small quantities with other chemicals without prior approval and appropriate personal protection and precautions.
3. A convenient reference on chemical reactivity is found in the current edition of Handbook of Reactive Chemical Hazards by L. Bretherick, published by Butterworths. Reactivity information is sometimes given in manufacturer's SDSs and on labels. Guidelines on which chemicals are reactive can be found in regulations promulgated by the Department of Transportation (DOT) in 49 CFR and by the Environmental Protection Agency (EPA) in 40 CFR. Also see NFPA Manual 325M, Fire Hazard Properties of Flammable Liquids, Gases, Volatile Solids; Manual 49, Hazardous Chemicals Data; and Manual 491M, Manual of Hazardous Chemical Reactions.

D. Procedures for Corrosive Chemicals and Contact-Hazard Chemicals

Corrosivity, allergenic, and sensitizer information is usually given in manufacturer's SDSs and on labels.

1. A *corrosive chemical* is one that causes visible destruction of or irreversible alternations in living tissue by chemical action at the site of contact and
    a. Fits the OSHA definition of corrosive in Appendix A of 29 CFR 1910.1200, Hazardous Communication Standard.
    b. Fits the EPA definition of corrosive in 40 CFR 261.22 (has a pH greater than or equal to 12.5 or less than 2.0), OR
    c. Is known or found to be corrosive to living tissue.
2. A *contact-hazard chemical* is an allergen or sensitizer that:
    a. Is so identified or described in the SDS or on the label.
    b. Is so identified or described in the medical or industrial hygiene literature, OR
    c. Is known or found to be an allergen or sensitizer.
3. Handle corrosive chemicals with proper safety precautions including wearing both safety goggles and face shield, gloves tested for absence of pin holes and known to be resistant to permeation or penetration, and a laboratory coat.
4. See Section II.H, Chemical Storage.

E. Control Measures and Equipment

Chemical safety is achieved by continual awareness of chemical hazards and by keeping the chemicals under control by using precautions, including engineering safeguards such as hoods. Laboratory personnel should be familiar with the precautions to be taken. Engineering safeguards and controls must be inspected annually be the Environmental Health and Safety Office.

1. Ventilation – Laboratory Hood Guidelines

a. Laboratory ventilation should be at least eight air changes per hour (calculated). This flow is not necessarily sufficient to prevent accumulation of chemical vapors. Work with toxic chemicals that have low air concentration limits or that have high vapor pressures should always be done in a hood.

b. Whenever exposure by inhalation is likely to exceed the threshold limits described in SDS's, use a hood. Consult with lab supervisor before doing any such work.
c. Fume hoods should provide 80 linear feet per minute of air flow.
d. Faculty, staff, and students in laboratories with fume hoods should understand that:
    1) A fume hood is a safety backup for condensers, traps, or other devices that collect vapors and fumes. It is NOT used to "dispose" of chemicals by evaporation unless the vapors are trapped and recovered for proper waste disposal.
    2) All apparatus inside the hood should be placed on the floor of the hood at least six inches away from the front edge.
    3) Fume hood windows should be lowered (closed) at all times except when necessary for adjusting the apparatus that is inside the hood.
    4) The hood fan should be kept "on" whenever a chemical is inside the hood, whether or not any work is being done in the hood.
    5) Hoods that have been tagged out of service do not provide protection and should not be used.
    6) Hood vent ducts and fans must be inspected at frequent intervals to be sure they are both clean and clear of obstructions.
    7) Hoods should never be used as storage areas for chemicals, apparatus, or other materials unless reserved exclusively for that use.
e. Annual fume hood inspections are provided by EHS.

2. Eyewash Fountains and Safety Showers

All laboratories that work with corrosive chemicals as defined by OSHA should be equipped with eyewashes and safety showers. These must be located so they can be easily reached from any point in the laboratory.

a. Be sure that access to eyewash fountains and safety showers is not restricted or blocked by temporary storage of objects or in any other way.
b. Eyewashes should be tested weekly by laboratory staff to ensure that they are working and that the water is clean, should an emergency use become necessary.
c. Eyewashes and safety showers should be inspected annually by EHS.

3. Respirators

When exposures to dust, fumes, mists, radionuclides, gases, and vapors are expected to exceed established limits of exposure, respiratory protection is required. With the exception of spill cleanup involving volatile or irritating materials, respirators are not expected to be needed for routine operations at Villanova University. Those personnel who assist with spill or other emergency situations and may need to don a respirator must complete:

a. A medical evaluation.
b. Fit-testing of the respirator.
c. Training in the proper use, inspection, and maintenance of the respirator.

For those routine operations which may require use of respirators, special permission must be obtained from the Chemical Hygiene Officer and EHS. Training will be performed by the CHO or her/his designee. A copy of the Villanova University Respiratory Protection program is available on the EHS Department website**.**

4. Vapor Detection

Odor alone is not a reliable means of determining that inhalation exposure limits are or are not being exceeded. Whenever there is reason to suspect that a toxic chemical inhalation limit might be exceeded, evacuate the room and notify the supervisor.

F. Procedures for Carcinogens, Reproductive Toxins, Substances That Have a High Degree of Acute Toxicity, and Chemicals of Unknown Toxicity

Follow the procedures described in this section when performing laboratory work with greater than 10 mg of any carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical which is reasonably suspected of being toxic.

The following definitions will apply:

a. *Select carcinogen*: any substance defined as such by 29 CFR 1910.1450 and any other substance described as such in the applicable SDS.
b. *Reproductive toxin*: any substance described as such in the applicable SDS.

   c. *Substance with a high degree of acute toxicity*: any substance for which the LD50 (lethal dose) data described in the applicable SDS cause the substance to be classified as a "highly toxic chemical" as defined in ANSI Z129.1.
   d. *Chemical whose toxic properties are unknown*: a chemical for which there is no know statistically significant study conducted in accordance with established scientific principles that establishes its toxicity.
   e. For the purpose of this CHP, chemicals in these four categories will be called *inimical*.
   f. *Designated area*: a hood, glove box, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of the inimical chemicals in excess of the specified limit shall be conducted.
2. Designated areas shall be posted and their boundaries clearly marked. Only those persons trained to work with inimical chemicals will work with those chemicals in a designated area. All such persons will:
   a. Wear appropriate personnel protective equipment.
   b. Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
   c. Use high-efficiency particulate air (HEPA) filters or high efficiency scrubber systems to protect vacuum lines and pumps.
   d. Store inimical chemicals or remove them from storage.
   e. Decontaminate a designated area when work is completed.
   f. Prepare wastes from work with inimical chemicals for waste disposal in accordance with the Resource Conservation and Recovery Act (RCRA) and as designated by Villanova University's hazardous waste officer.
3. Store all inimical chemicals in locked and enclosed spaces with a slight negative pressure compared to the rest of the building.
4. Because the decontamination of jewelry may be difficult or impossible, do not wear jewelry when working in designated areas.
5. Wear long-sleeved disposable clothing, protective dust mask and gloves known to resist permeation by the chemicals to be used when working in designated areas.
6. See Appendix E - Carcinogen List and Section II. H, Chemical Storage.

G. Other Special Precautions

1. Designated Work Areas are areas established for work involving the use of carcinogens, reproductive toxins, and/or substances with a high degree of acute toxicity.
    a. These may be lab hoods or a bench top area.
    b. Conduct work and mount apparatus above trays made of a chemically resistant material such as polyethylene, or cover work and storage areas with plastic backed paper.
    c. Dispose of this paper as contaminated waste after each work session.
    d. Decontaminate all equipment including trays, and replace the paper and trays for future activities.
    e. Some operations cannot be conducted in a designated area – in this case, conduct the activity in such a manner that the intent of the designated area is maintained - use trays, diaper paper under equipment, etc.
    f. Use and store these substances only in areas of restricted access with warning signs.
    g. Thoroughly decontaminate or dispose of contaminated clothing or shoes as hazardous waste.
    h. Label designated hoods in the following manner:

THIS HOOD IS TO BE USED FOR WORK WITH CARCINOGENS, REPRODUCTIVE TOXINS AND SUBSTANCES WITH A HIGH DEGREE OF ACUTE TOXICITY.

2. Work with additional classifications of chemicals such as allergens, compressed gases, light sensitive chemicals, peroxide forming compounds, shock sensitive and water reactive chemicals, and hydrofluoric acid, require additional special precautions to be implemented.
    3. Allergens are substances which produce skin and lung hypersensitivity. There is a variety of responses from one individual to another.
        a. Wear suitable gloves and clothing to prevent skin contact. Consult the Chemical Compatibility Chart in Appendix A and the SDS
        b. Use adequate ventilation when handling volatile chemicals.
        c. Seek medical attention immediately if signs of an allergic reaction appear.
        d. Avoid contact with allergens when cleaning up spills.
        e. Examples – formaldehyde, some phenols, picric acid, ntirotoluene, maleic anhydride, diethylene triamine.

4. Compressed Gases
    a. Wear appropriate personal protection equipment for the gases involved.
    b. Inspect all pressurized cylinders for leaks or other defects upon receipt.
    c. Close the main valve when the gas is not in use.
    d. Position the cylinder to maintain direct access to the cylinder valve.
    e. Use the proper regulator for each cylinder and gas.
    f. Store in a cool, dry place, away from direct sunlight and other heat sources.
    g. Do not store oxygen cylinders adjacent to flammable gas cylinders.
    h. Securely attach cylinders to a wall or laboratory bench 1/3 from the top of the cylinder or supported in an appropriate cylinder stand.
    i. Protect the cylinder stem with a cap unless a regulator is attached.
    j. Only move gas cylinders that have the safety cap in place.
    k. Move large cylinders with cylinder hand carts – never carry or walk them.
    l. Store cylinders containing flammables and other hazardous gases in a well-ventilated area.
    m. For acutely toxic gases use small cylinders that can be placed in fume hoods. Exceptions are made for large cylinders of asphyxiants such as nitrogen and carbon dioxide.
    n. Gases must be included in the lab/department chemical inventory.
    o.
5. Hydrofluoric Acid (HF)

    Hydrofluoric acid is a non-flammable acid that is difficult to contain because it attacks glass, concrete, and some metals – especially cast iron and silica alloys. It can cause the formation of hydrogen in metallic containers and piping, a fire and explosion hazard

    a. An HF spill response kit must be kept in the immediate vicinity of the work.
    b. Exclude ignition sources from areas having equipment containing HF
    c. Always use a hood and cover all exposed skin surfaces.
    d. Use protective equipment such as a face shield and neoprene or polyvinyl chloride gloves that protects the eyes, skin, respiratory system or digestive system. Wash this equipment after each use.

e. If contact is even suspected, flush the exposed area with water and get medical attention immediately.
f. If HF gets under the fingernails it may be necessary to receive calcium gluconate injections.
g. Limit the size of the experiment to eliminate the chance of large spills or exposures.

6. Light Sensitive Chemicals

   Light sensitive chemicals degrade upon exposure to light and should be stored in amber containers.

7. Peroxide Forming Compounds
   a. General information
      1. Formed by chemicals that react with oxygen present in the atmosphere.
      2. Unstable and pose a risk of explosion.
      3. Affected by heat, shock and friction that can create dangerous situations leading to explosions.
      4. Aldehydes, ethers, most alkenes, and vinyllidene compounds.
      5. Production is affected by the aging of the chemical
   b. Safety Precautions
      1. Purchase in small quantities.
      2. Never return unused chemicals to the container.
      3. Sensitivity of most peroxides to shock and heat can be reduced by dilution with inert solvents, such as aliphatic hydrocarbons.
      4. Solutions in volatile solvents should be handled so as to prevent evaporation of solvent and an increase in the peroxide concentration.
      5. Do not use metal spatulas to handle chemicals because metal contamination can lead to explosive decomposition.
      6. Do not use in areas where ignition sources are present.
      7. Avoid friction, grinding, and other forms of impact.
   c. Storage
      1. Store in airtight containers in a cool, dry, dark place.
      2. Do not use glass containers that have screw tops or glass stoppers. Use polyethylene containers.
      3. To minimize the rate of decomposition peroxides should be stored at the lowest temperature consistent with their solubility or freezing

point but not lower because they become more sensitive to shock and heat.

4. Label with the receiving date, the opening date, and the date recommended for disposal.
5. Never store for periods longer than a year. Discard as a chemical waste after this length of time.

d. Examples – acetal, dioxane, ethyl ether, isopropyl ether, tetrahydrofuran, vinyl ether, cyclohexene, diethyl ether, dimethyl ether and diethylene glycol. See Appendix D for more examples.

8. Shock Sensitive

Shock sensitive chemicals are susceptible to rapid decomposition or explosion when struck, vibrated or otherwise agitated.

a. Read the SDS and label.
b. Write the date received and the date opened on all containers.
c. Open containers should be discarded within 6 months of opening.
d. Closed containers should be discarded after 1 year unless an inhibitor was added by the manufacturer.
e. Wear appropriate personal protective equipment.

9. Water Reactive

Water reactive chemicals lead to formation of flammable or toxic gases following contact with water.

a. Handle in a manner similar to reactive solids.
b. Post area where compounds are present to alert fire fighting personnel.
c. Store in polyethylene bags and tightly sealed containers.
d. Examples include potassium and sodium metals and many metal anhydrides.

IV. RECORDS AND RECORDKEEPING:

Accident/incident investigations will be conducted by the immediate supervisor with assistance from other personnel as deemed necessary.

1. Accident/incident reports are available on line:
   a. Employee Report
   b. Student Report

2. All medical and exposure records are maintained by Human Resources and Environmental Health and Safety departments in accordance with 29 CFR 1910.1020.
3. Inventory and usage records for high-risk substances (amounts of substances on-hand, amounts used, and names of workers involved(shall be maintained for at least as long as the employees involved are employed at the university.
4. Records of equipment inspections will be maintained for one year.
5. Records of employee training will be maintained for at least as long as the employee is associated with the university.

V. EMPLOYEE INFORMATION AND TRAINING:

Multiple training options are available for those working in laboratories. The method of maintaining training records varies by format. They include:

1. Chemistry Department required video for all students, faculty, and staff.
2. Environmental Health and Safety Department on-line training for students, faculty, and staff working in laboratories.
3. Lab-specific training for persons working in research laboratories.
4. Radiation Safety training for persons working with radioactive materials.
5. Biological Safety training for persons working with biologics.
6. New employee training for faculty and staff that addresses injury reporting and hazard communication. The Environmental Health and Safety Department is available to provide additional specialized training as needed.
7. The content, location, and availability of the Villanova University Chemical Hygiene Plan.

VI. MEDICAL CONSULTATION AND EXAMINATION

All Villanova employees who work with hazardous chemicals are provided the opportunity to receive medical consultation and examination under the following circumstances:

1. Whenever an employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed in the laboratory,

2. Where exposure monitoring suggests that there could have been an exposure above the action level, or PEL if there is no action level, for a chemical for which a substance-specific standard has been established, or
3. Whenever an occurrence such as a spill, leak, explosion, or other uncontrolled release of a hazardous chemical in the laboratory resulted in the likelihood of an exposure.

This consultation with a medical professional is provided free to the employee, as is any examination or other attention recommended by the consulting physician, at a reasonable time and place. Records of medical consultations and exposure evaluations must be kept in accordance with the laboratory standard.

VII. APPENDICES

APPENDIX A - CHEMICAL COMPATIBILITY CHART (GLOVES)

APPENDIX B - OSHA LABORATORY STANDARD, 1910.1450

APPENDIX C – CLASSES OF INCOMPATIBLE CHEMICALS

Any Acid	**Any Base**
Alkali & Alkaline earth metals	Water
Carbides	Acids
Hydrides	Halogenated organic compounds
Hydroxides	Oxidizing agents (see footnotes b)
Oxides	Chromates, dichromates
Peroxides	Halogens Halogenating agents Nitric acid, nitrates Perchlorates & chlorates Permanganates Persulfates
Inorganic azides	Acids Heavy metals & their salts Oxidizing agents (see footnote b)
Inorganic cyanides	Acids, strong bases

Inorganic nitrates	Acids Metals Nitrites Sulfur
Inorganic nitrites	Acids Oxidizing agents (see footnote b)
Inorganic sulfides	Acids
Organic compounds	Oxidizing agents (see footnote b)
Organic acyl halides	Bases Organic hydroxy compounds
Organic anhydrides	Bases Organic hydroxyl compounds
Organic halogen compounds	Aluminum metal
Organic nitro compounds	Strong bases
Powdered metals	Acids
Acetylene & monosubstituted acetylene	Halogens Group IB & IIB metals and their salts

Ammonia & ammonia hydroxide	Halogens Halogenating agents Silver Mercury
Carbon, activated	Oxidizing agents (see footnote b)
Hydrogen peroxide	Metals & their salts
Nitric acid	Metals Sulfuric acid Sulfides Nitrites Other reducing agents Chromic acid & chromates Permanganates
Mercury & its amalgams	Ammonia & ammonia hydroxide Nitric acid Acetylene Sodium azide
Oxalic Acid	Silver Mercury

Phosphorus (yellow)	Oxygen Oxidizing agents (see footnote b) Strong bases
Phosphorus pentoxide	Water Halogenating agents
Sulfuric acid	Metals Chlorates Perchlorates Permanganates Nitric acid

[a]Chemicals in columns A and B should be kept separate.

[b]Oxidizing agents include the types of compounds listed in the entry for alkali and alkaline earth metals, etc.

REFERENCE: Prudent Practices For Handling Hazardous Chemicals in Laboratories, NRC (National Research Council)

APPENDIX D - EXAMPLES OF COMMON COMPOUNDS THAT FORM PEROXIDES AND RECOMMENDED MAXIMUM STORAGE TIMES

Classes of Compounds that can form Peroxides upon aging	
Class I: Unsaturated materials, especially those of low molecular weight, may polymerize violently and hazardously due to peroxide initiation.	
Acrylic acid	Tetrafluoroethylene*
Acrylonitrile	Vinyl acetate
Butadiene*	Vinyl acetylene
Chlorbutadiene (chloroprene)*	Vinyl chloride
Chlorotrifluoroethylene	Vinyl pyridine
Methyl methacrylate	Vinylidene chloride
Styrene	
Discard at 12 months	
Class II: The following chemicals are a peroxide hazard upon concentration (distillation/evaporation). A test for peroxide should be performed if concentration is intended or suspected.	
Acetal	Dioxane (p-dioxane)

Cumene	Ethylene glycol dimethyl ether (glyme)
Cyclohexene	Furan
Cyclooctene	Methyl acetylene
Cyclopentene	Methyl cyclopentane
Diacetylene	Methyl-i-butyl ketone
Dicyclopentadiene	Tetrahydrofuran
Diethylene glycol dimethyl ether	Tetrahydronaphthalene
Diethyl ether	Vinyl ethers
Discard at 12 months	
Class III: Peroxides derived from the following compounds may explode without concentration.	
Divinyl ether	Potassium metal
Divinyl acetylene	Potassium amide
Isopropyl ether	Sodium amide (sodamide)
Vinylidene chloride	

Discard at 3 Months
*When stored as a liquid, the peroxide-forming potential increases and the chemical should then be considered a Class III.

[1]University Texas Medical Branch, http://www.utmb.edu/ehs/EPm/Chemical%20Waste/Perioxides.htm

APPENDIX E - CARCINOGEN LIST

International Agency for Research on Cancer "Carcinogenic to humans"

APPENDIX F - DEPARTMENT CHEMICAL HYGIENE OFFICERS

Name	Phone Number	Department	Location
Lindsay Bair	4858	Biology	Biology Stockroom
Chris Corin	3329	Civil & Environmental Engineering	CEER 311
Pritpal Singh	7378	Electrical & Computer Engineering	Tolentine 406
Eydiejo Kurchan	7481	Chemistry	Mendel 312
Edward Ritter	4948	Chemical Engineering	White Hall 319
Chris Townend	4986	Mechanical Engineering	CEER 09A
Jeremy Carlo	3279	Physics	Mendel
Amanda Garzio-Hadzick	7930	Water Resources Lab	Chemical Engr
Kathleen Cooper	3342	Geography and the Environment	Mendel

APPENDIX G - ACRONYMS

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CHP	Chemical Hygiene Plan
CHO	Chemical Hygiene Officer
DOT	Department of Transportation
EHS	Environmental Health & Safety Office
EPA	Environmental Protection Agency
HEPA	High Efficiency Particulate Air
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
OSHA	Occupational Safety & Health Administration
PEL	Permissible Exposure Limit
RCRA	Resource Conservation and Recovery Act
TLV	Threshold Limit Value

APPENDIX H - PROPER ATTIRE FOR INDIVIDUALS IN LABORATORIES

- All employees, faculty, students, and visitors must wear appropriate attire in all laboratory areas to eliminate or minimize contact with chemicals, biological hazards, and other hazards prevalent in labs. (i.e. arms and legs covered).
- Shorts, miniskirts, or any apparel that does not cover the skin above the knee when seated should NOT be worn in the laboratory.
- Open toed shoes, high heels, sandals, ballet flats, or shoes made of loosely woven material should not be worn in the laboratory.
- Loose clothing and jewelry that can be caught in equipment or dipped into hazardous solutions should not be worn in the laboratory. Hair longer than shoulder length should be pulled up in a clip or ponytail.
- Tank tops and sleeveless shirts should not be worn in the laboratory.
- Gloves should be worn whenever there is a potential exposure of the hands. The gloves should have the necessary resistance to the chemical or hazardous material being used. Liquid barrier gloves should be used when handling biological agents or potentially infectious materials.
- Eye protection should be worn during any task where there is potential exposure of the eyes via splashing of material or generation of flying objects. Eye protection may be required for laboratory entry at the discretion of the investigator or department.
- Lab coats provided by Villanova University as specified by Principal Investigator/Lab Manager..
- Specialized protective clothing shall be worn when using materials that are extremely hazardous upon contact. EH&S can be consulted.
- Gloves and all other personal protective equipment must never be worn outside of laboratory areas and are forbidden in public corridors, elevators, stairwells, and break rooms.
- Gloves should be removed prior to use of the telephone, keyboard, equipment controls or doors, if these surfaces are considered "clean" or common.

APPENDIX I – SAMPLE INJURY INVESTIGATION FORMS

Employee Report

Student Report