CHEMICAL HYGIENE

PLAN

URSINUS COLLEGE

PRESIDENT'S OFFICE
Ursinus College

FORWARD

On January 31, 1990, the Occupational Safety and Health Administration (OSHA) promulgated a final rule for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on May 1, 1990, is a requirement for all employees covered by the standard to develop and carry out the provisions of a Chemical Hygiene Plan (CHP).

A CHP is defined as a written program which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace. Components of the CHP must include standard operating procedures for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, provisions for permitting requirements, provisions for medical consultation, designation of responsible personnel, and identification of particular hazardous substances.

This plan is the Chemical Hygiene Plan developed for Ursinus College, located on Main Street in Collegeville, PA. This CHP is maintained, readily available to laboratory employees in the Sturgis Library in Pfahler Hall, on the Ursinus College website, in the offices of the Biology and Chemistry Departments, as well as the office of the Environmental Health & Safety Coordinator located in the Facilities building. All laboratory personnel must know and follow the procedures outlined in this plan. All operations performed in the laboratory must be planned and executed in accordance with the enclosed procedures. In addition, each employee is expected to develop safe personal chemical hygiene habits aimed at the reduction of chemical exposure to themselves and co-workers.

This document was developed to comply with paragraph (e) of the referenced OSHA 1910.1450 standard. Ursinus College will maintain the facilities and procedures employed in the laboratory compatible with current knowledge and regulations in laboratory safety. This CHP will be reviewed, evaluated, and updated at least annually and will be readily available to employees, their representatives, and any representative of the Assistant Secretary of Labor for OSHA.

Brock Blomberg
President

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CHEMICAL HYGIENE RESPONSIBILITIES

I. Chief Executive Officer

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

II. Chemical Hygiene Officer(s)

The President has appointed the College Environmental Health and Safety Coordinator as the College Chemical Hygiene Officer. The Biology and the Chemistry Departments have appointed departmental hygiene officers to assist the college officer.

The Chemical Hygiene Officer(s) shall:

A. Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;

B. Monitor procurement and use of chemicals in the laboratory, including determining that facilities and training levels are adequate for the chemicals in use;

C. See that appropriate audits are maintained;

D. Help laboratory supervisors and research project advisors develop precautions and adequate facilities;

E. Maintain current knowledge concerning the legal requirements of regulated substances in the laboratory; and

F. Review and improve the Chemical Hygiene Plan on an annual basis.

III. Laboratory Supervisor or Research Advisor

The laboratory supervisor or research advisor has the overall responsibility for chemical hygiene in the laboratory and shall:

A. Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided;

B. Perform regular, formal chemical hygiene and housekeeping inspections including inspection of emergency equipment;

C. Know the current legal requirements concerning regulated substances;

D. Determine the proper levels of personal protective apparel and equipment, ensuring that it is available and in working order;

E. Ensure that appropriate training and facilities, including waste disposal, have been provided for any material being ordered; and

F. Authorize the entry of visitors into the laboratory.

IV. Laboratory Workers

The laboratory workers are individually responsible for:

A. Planning and conducting each laboratory experiment in accordance with the Ursinus College Chemical Hygiene program, and

B. Developing good personal chemical hygiene habits.

Normally students are not covered by these requirements. However, if a student receives a stipend from the College for the performance of research in the laboratory, the Chemical Hygiene Program applies.

STANDARD OPERATING PROCEDURES FOR LABORATORY CHEMICALS

I. Chemical Procurement

A. Requests for the procurement of new chemicals should be submitted to the department chairperson or to the research advisor for a research grant for approval and then forwarded to the Purchasing Office for ordering. The quantity ordered should be the minimum amount required for current use. The College Chemical Hygiene Officer will supply information on the proper handling, storage, and use of the chemical to the department ordering the material. Normally this information will be in the form of a Safety Data Sheet, SDS. It is the responsibility of the laboratory supervisor/research advisor to ensure that the facilities are appropriate for the use of the chemical. Each department is responsible for maintaining an inventory of SDSs with assistance from the College Chemical Hygiene Officer.

B. All chemicals shall be received in a central location, the shipping/receiving area of Facilities Services. Facilities Services personnel who receive (log in) and deliver shipments of chemicals should be knowledgeable of the proper procedures for the handling of unopened containers of chemicals and the universal precautions employed when dealing with potentially hazardous materials. In accordance with all appropriate regulations no container should be accepted without accompanying labels and packaging. Facilities Services personnel shall not open shipping containers.

C. Upon delivery of the shipment to the designated area in the department ordering the material, the department member ordering the material or designee shall open the package, verify the integrity of the contents, and **place the date of receipt on the label of the container**. Such persons should be aware of the hazards associated with that particular chemical and ensure that these hazards are noted on the exterior of the chemical container. The recipient shall ensure that the chemical is properly entered into the departmental inventory and stored in the appropriate area.

II. Chemical Storage

A. Storeroom/Stockroom:

1. Reagents should be stored in an uncluttered manner on shelves that have a solid back and sides so that the containers cannot be pushed off the shelf.

2. Since shelved chemicals can walk and tip over, chemicals should be prevented from falling by using shelving with antiroll lips along the front edge or a restraining device across the open face of the shelf.

3. Shelving should be securely mounted to the walls, or the floor and the ceiling.

4. Wooden shelves are best suited for general chemical storage since they are less effective heat conductors and they do not corrode. However, metal shelves should be used for flammables to reduce fire hazards.

5. The storage area should be well illuminated with all storage at eye level or below.

6. Chemicals should never be stored on the floor (even temporarily).

7. Chemicals should **never** be stored in alphabetical order only. They should be arranged in compatible families.

8. Chemicals should be stored away from heat and direct sunlight, preferably in a cool dry area.

9. Liquids (especially corrosives) should be stored in resistant trays, pans, or other secondary containers to retain the contents in the case of breakage or spillage.

10. Temperature-sensitive chemicals should be stored in explosion-proof refrigerators. Sparks from the motor or light switch in a conventional home-use or frost-free refrigerator could cause a fire or explosion.

11. All chemicals should be labeled when received from outside vendors. The label should clearly state any hazards or unusual properties. Chemicals that are repackaged should have secure waterproof labels that contain information about the hazards as well as name, date packaged, source, and purity.

12. All chemicals should be dated as received and also when opened. All reagents, solutions, and mixtures should be dated with the date of preparation and bear the name or initials of the person preparing them.

13. Chemicals should not be stored in fume hoods. If the material readily evaporates or produces airborne contaminants, it should be stored in a ventilated cabinet.

14. Toxic substances should be stored in a separate well-identified area with local exhaust ventilation. Highly toxic chemicals should be stored in unbreakable secondary containers. Areas in which toxic chemicals are stored should be labeled with appropriate warning signs, such as

    CAUTION! CANCER-SUSPECT AGENT STORAGE

15. All flammable substances should be stored in dedicated flammable cabinets. Paper or cardboard should not be stored inside the cabinets with the chemicals.

16. Acids should be stored in dedicated acid cabinets. Nitric acid can be stored in the same cabinet with other acids only if it can be isolated from them.

17. All cabinets in which chemicals are stored should have an inventory of the contents posted on the exterior of the cabinet. The laboratory supervisor or research advisor should update this list regularly.

18. All storage areas should be locked when not in use.

19. When chemicals are moved from any storage/stockroom area to a laboratory, they should be placed in a secondary container or bucket.

20. The contents of any area in which chemicals are stored should be examined and inventoried annually. This includes storerooms, stockrooms, laboratories, refrigerators, freezers, and flammable solvent and acid cabinets. A concerted attempt should be made to keep this inventory current by the addition of new chemicals when they are received and the deletion of used or outdated chemicals when they are withdrawn.

B. Laboratory:

1. Every chemical in a laboratory should have a definite storage place and should be returned to that location after use. Storage on shelves above the bench, separate shelving units, or in appropriate safety cabinets is recommended.

2. Storage trays or secondary containers should be used to minimize the spread of the material should the original container break or leak.

3. The National Fire Protection Association (NFPA) has established the following storage provisions for the laboratory storage of flammable liquids: (NFPA 30 and 45). Copies of these standards are located in the office of the Environmental Health & Safety Coordinator, Facilities Services.

   a. No container shall exceed a capacity of 1 gallon.

   b. Not more than 10 gallons of flammable or combustible liquids should be stored outside of a storage room except in safety cans.

   c. Not more than 25 gallons of flammable or combustible liquids should be stored in safety cans outside of a storage room or storage cabinet.

   d. Quantities of flammable and combustible liquids in excess of those set forth in this section should be stored in an inside storage room or storage cabinet.

4. Chemicals known to be carcinogens or highly toxic should be stored in ventilated storage areas in unbreakable, secondary containers, which are resistant to the chemical contained. These storage containers should be labeled with the appropriate hazard label.

5. Laboratory supervisors and/or research advisors should inventory chemicals stored in laboratories annually and return unneeded items to the storeroom/stockroom. Containers having illegible labels should be removed and properly disposed of.

C. Drum Storage: ordering chemicals in fifty-five gallon drums for laboratory use requires approval from the Environmental Health & Safety Coordinator.

1. Fifty-five gallon drums are commonly used to ship flammable liquids, but are not intended for long-term inside storage.

2. It is not safe to dispense from sealed drums exactly as they are received. The bung should be removed and replaced with an approved pressure and vacuum relief vent to protect against pressure buildup due to elevated temperatures.

3. Drums should be stored on metal racks with end bung openings facing an aisle and side bung openings on the top of the drum.

4. The drums, as well as the racks, should be grounded.

D. Safety Cans:

1. These should be kept closed at all times, except when adding or removing liquid.

2. The flame arrester screen should be kept in place at all times and replaced if damaged.

3. Chemicals in safety cans should be stored in storage areas and not in laboratory work areas.

4. When safety cans are being filled with flammable solvents, they should be grounded.

E. Flammable Liquid Cabinets:

The NFPA code specifies that not more than 60 gallons of flammable or 120 gallons of combustible liquids may be stored in a storage cabinet.

F. Refrigerators/Freezers:

1. All containers placed in laboratory refrigerators/freezers should be properly labeled (identification of the contents by name not formula, owner, date of acquisition or preparation, and nature of any potential hazard).

2. Chemicals stored in refrigerators/freezers should be capped to achieve a seal that is both vapor tight and unlikely to permit a spill if the container is tipped. Double bagging with plastic "baggies" helps reduce noxious vapors.

3. A current inventory of the refrigerators/freezers should be maintained on an annual basis. A copy of this inventory should be posted on the exterior of the freezer/refrigerator door.

4. Food and beverages for human consumption should never be stored in laboratory refrigerators or freezers. These refrigerators and freezers should be labeled with the following signage:

NO FOOD-CHEMICAL STORAGE ONLY

III. Chemical Handling

A. Compressed Gas Cylinders:

If compressed gas cylinders are handled incorrectly, they can be a lethal hazard. A broken cylinder valve can cause a cylinder to act like a rocket. Exposure to some gases, such as hydrogen sulfide from a cylinder leak, can be lethal.

1. Cylinders of compressed gases should not be accepted if the name of the contents is missing or illegible or if the color code does not match the printed name. Immediately upon delivery a cylinder tag (FULL, IN SERVICE, or EMPTY) should be affixed to the neck of the cylinder.

2. All cylinders must be stored in an upright position and restrained by individual straps or chains attached to a permanent fixture or in a suitable stand.

3. Cylinders of compressed gases should be stored in well-ventilated dry areas. Where practicable, the storage rooms should be of fire-resistant construction and above ground.

4. Cylinders of flammable gases should not be stored near sources of ignition or where they might be exposed to corrosive chemicals and vapors.

5. Cylinders should never be exposed to temperatures greater than 50° C or stored where heavy objects might strike or fall on them.

6. When cylinders are moved, the protective cap should be in place and the cylinder strapped to a properly designed wheeled cart. Cylinders should never be dragged or rolled.

7. Before opening the main valve, always attach the appropriate CGA valve or regulator. The main cylinder valve should be opened slowly and no more than a full turn. Test the connections for leaks with soapy water.

8. Cylinder valves and regulators should never be tampered with, lubricated, modified, or forced.

9. The main cylinder valve should be closed when the gas cylinder is not in use.

10. Cylinders should never be completely emptied. A slight pressure of gas (30 psi) should be left to prevent contaminants from entering the cylinder.

11. When a cylinder is "empty," the regulator should be promptly removed and replaced with the protective cap. The cylinder tag should be changed to "EMPTY" and the cylinder removed to the storage area where it is restrained by chain or strap attached to a permanent structure.

12. Always wear safety glasses when handling or using compressed gases.

13. When using ACETYLENE, observe the following precautions.

    a. Always store the cylinder in an upright position. Acetylene cylinders are partially filled with acetone. Do not use a cylinder, which has been stored or handled, in a non-upright position until it has remained upright for at least 30 minutes.

    b. The outlet line of an acetylene cylinder should be protected with a flash arrester.

c. The pressure limit, indicated by the red warning line on the acetylene gauge, should never be exceeded.

d. Since copper forms explosive acetylides, copper tubing should NEVER be used to transport gaseous acetylene.

B. Lecture bottles:

Lecture bottles are small gas containers that can become a serious disposal problem. When purchasing gases in lecture bottles, ensure that the unused or empty bottle can be returned to the vendor. Disposal of old, inoperable or unlabeled lecture bottles is very expensive.

To minimize the hazards and cost of lecture bottle disposal:

1. Annually inspect lecture bottles. Examine the bottles for the integrity of their markings, tare weight tags, and for corrosion. Use a soap solution to check for leaking valves. Dispose of all lecture bottles for which no immediate use is envisioned.

2. Store them safely. Lecture bottles should be stored in a separate ventilated cabinet, lying on their sides with their valves pointed toward the ventilation port. They should not be stored with corrosives.

3. Track their use. Attach a tag to the cylinder to record dates of use and the weight of bottle before and after use.

4. Return unwanted or surplus lecture bottles to the vendor. Before purchasing lecture bottles, ask the vendor if it will take back empty or surplus bottles. If the vendor will not accept surplus gases for return, look for an alternate source or contact the College Chemical Hygiene Officer for a list of vendors who accept returned bottles.

C. Cryogenic Liquids:

Cryogenic fluids, such as liquid air, liquid nitrogen or liquid oxygen, are used to obtain extremely cold temperatures below -50ºC. Cryogenic liquids are hazardous because of the physical and chemical characteristics of their super-cooled state. Cryogenic liquids may cause explosions, fires, asphyxiation, tissue destruction, or embrittlement of structural materials. The following are guidelines for use of cryogenic liquids:

1. Always wear eye protection, preferably goggles and a full-face shield. Wear closed-toed shoes and long pants without cuffs that go over the top of the shoes – no shorts, skirts, capris, etc.

2. Since oxygen can be condensed out of the atmosphere during the use of lower boiling nitrogen or helium, cryogenic liquids should be kept away from all sources of ignition.

3. Store cryogenic liquids in a well-ventilated area to avoid buildup of flammable liquids or the displacement of air.

4. Use gloves, which are impervious to the fluid being handled and loose enough to be removed quickly.

5. Handle Dewar flasks carefully and tape them thoroughly to prevent the release of a large number of tiny shards of glass in the event the flask shatters.

6. Select work materials wisely. Cryogenic liquids alter the physical characteristics of many materials.

7. Use extreme care in transporting cryogenic containers.

8. To provide proper ventilation in transferring liquid nitrogen from the large vessel to a Dewar, prop open the door to the room and open the window.

9. Do not store Dewars of liquid nitrogen in cold rooms as there is not sufficient ventilation.

D. Other Chemicals:

Chemicals in any form can be safely stored, handled, and used if their hazardous physical and chemical properties are fully understood and the necessary precautions, including the use of proper safeguards and personal protective equipment, are observed.

1. Packages of reagents should never be opened until the label has been read and completely understood. Know the hazards of the materials you are using.

2. The experimenter should read the MSDS for each chemical involved in the experiment before beginning the experiment.

3. Unless specifically instructed to do so, laboratory workers should **never** attempt to smell or taste a chemical.

4. Mouth suction for pipeting or starting a siphon is prohibited.

5. Skin contact with chemicals should be avoided.

6. Chemicals accidently contacting hands should be rinsed away with cold water before a hot water/soap cleansing. The initial use of hot water tends to open pores, thus providing a ready entrance through the skin.

7. If you have been burned with an acid or an alkali, the area should be flushed with copious amounts of water. If the burn is serious, have someone call for medical assistance and continue to flush with water until the medic arrives.

8. Reactive chemicals (in bottles, beakers, flasks, wash bottles, etc.) should never be placed near the edges of the lab bench. For hoods the recommended distance from the front edge to any object is six inches.

9. A fume hood should be used when working with volatile substances.

10. In all cases of chemical exposure, neither the Permissible Exposure Limits (PEL) of OSHA or the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH) should be exceeded. (29 CFR 1910 subpart Z: Tables Z-1-A, Z-2, and Z-3, Appendix C - http://www.osha.gov/)

11. Specific procedures based on the toxicological characteristics of individual chemicals should be implemented as deemed necessary by the Chemical Hygiene Officer.

12. Employees should not remain in an area where unusually dominant odors of chemicals exist unless they are assured that the gas or vapor is not hazardous. Do not linger where chemicals have been spilled. Close the door, put on the appropriate type of respirator, and attempt to control and/or clean up the spill. Remember that many toxic substances have no odor!

13. Since electrical power failure or shutdown renders the hoods useless, cylinders of toxic or flammable gases must be turned off and reactions producing toxic fumes must be shut down and cooled down to minimize the fumes

CHEMICAL DISPOSAL PROCEDURES

I. ON-SITE SERVICES:

A. Removal of Surplus and Used Chemicals:

The College Chemical Hygiene Officer will contact members of the Biology and Chemistry Departments twice a year to initiate the removal of surplus chemicals and expended materials from satellite accumulation sites in the laboratories to a temporary Accumulation Area (usually Pfahler 314) to await pick-up by a commercial hazardous waste vendor. Materials for disposal, which accumulate in satellite areas (hoods), should be labeled "Hazardous Waste". To facilitate the process, department members shall:

1. Prepare an inventory of items to be removed including location, container size, and identity (name) of the material. If the materials are in solution, the solvent must be listed even if the solvent is water.

2. Ensure that all containers are legibly labeled with the chemical identity (name not formula) of the contents, hazards (e.g. flammable, corrosive), volume of material added, start date of collection, accumulation date the bottle becomes full or accumulation completed, and the initials of person placing the material in the receptacle. Generic identifications such as "Used Halogenated Materials" should be avoided.

3. Place mixtures, aqueous solutions, other liquids, and reaction products in a suitable container. Commingled materials must be chemically compatible to ensure that heat generation or chemical reaction does not occur. Make sure all containers are tightly closed and are compatible with the contents. To facilitate lab packing the container should not have a volume greater than 5 gallons.

   a. Suitable containers for **liquids** include glass bottles with their original screw caps. Plastic milk jugs are NOT suitable for the collection of materials for disposal.

   b. A variety of containers is suitable for **solids** as long as the containers are sturdy, rigid, and can be tightly closed so that the product is well contained. Open flasks or beakers are NOT suitable.

   c. A suitable container for **contaminated labware** is a tightly closed plastic bag (folding the bag and taping it works well) inside a cardboard box. Clearly mark the outside of the box with its contents.

   d. Suitable containers for **wet solids** include (for small amounts) glass bottles with screw tops and (for larger amounts) tightly closed plastic bags inside cardboard boxes. Clearly mark the outside of the box with its contents. No free liquid should be present with wet solids; absorb any free liquid with absorbent paper, kitty litter, or oil dry (do not use vermiculite for an absorbent).

B. Removal of Used Organic Solvents:

Some means must be provided for the segregation of used organic solvents suitable for fuel blending (non-halogenated) from those, which must be commercially incinerated (halogenated). One method of segregation employs different shaped or colored bottles. If the organic solvent is flammable, partially filled containers should be stored in a flammable solvent cabinet.

To comply with the Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (DEP), the contents of all used solvent containers must be noted as the solvent is placed in the container, along with an estimate of the volume. If the wrong type of solvent is placed in the container, please write its name on contents list and notify the departmental Chemical Hygiene Officer.

To prevent problems with waste compatibility and handling, and to ensure safe disposal, do not mix the following chemicals in large used solvent containers:

acetaldehyde
acid chlorides
alkynes
amines with f.w. <98
anhydrides
aziridines
bromine
carbon disulfide
chloroformate esters
chloromethylsilanes
chloropicrin
collodion
cyanohydrins
dienes
formic acid
furan
haloalkynes
α-halocarbonyls
hydrazines
hypochlorite esters
isocyanates
isocyanides
metal halides and oxyhalides
mercaptans
mercury and mercury compounds
metal-containing aqueous solution
mineral acids
monomers (polymerizable)
nitrate esters
nitrite esters
nitrosamines
nitrosoureas
nitrosourethanes
non-metal halides and oxyhalides
organic solids in solution
perfluoroaliphatic acids
peroxides
phosphines
phosphate esters
polychlorinated biphenyls (BCPs)
phosphite esters
polymer solutions
polynitro-substituted compounds
propargyl bromides
pyrocarbonate esters
pyrrole
reactives in solution such as:
- alkaline metal alkyls
- aluminum alkyls and hydrides
- boron alkyls and hydrides

sulfate esters
sulfite esters
sulfonate esters
thallium ethoxide
thiocarbonyls
thiophene

C. Laboratory and Stockroom Cleanouts:

Before leaving the employ of Ursinus College, faculty members are responsible for the clean up of their laboratories, both teaching and research. An inventory of the 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. If no other laboratory accepts the surplus chemicals, the Chemical Hygiene Officer will declare that the surplus chemical is waste and store it according to EPA requirements.

D. EPA Hazardous Wastes:

In this section hazardous waste refers to chemical waste and does not include infectious, biological, or radioactive waste or sharps. These are covered in the Bloodborne Pathogens Program or the Radiation Safety Manual.

EPA regulations focus on industrial waste types. Therefore, EPA does not regulate many laboratory chemical wastes as hazardous wastes. However, many unregulated chemical wastes do merit special handling and disposal procedures, and such materials will be treated as though they are EPA hazardous waste.

EPA hazardous wastes must not be disposed of in the normal trash, not in garbage or refuse, not in recycling bins, glass receptacles, sharps containers, or red bags. Evaporation or dilution is not an acceptable means of disposal for toxic and/or ignitable wastes. Once an EPA hazardous waste, always an EPA hazardous waste.

EPA hazardous wastes exhibit the characteristic of corrosivity, ignitability, or reactivity or fail the toxic characteristic leaching procedure (TCLP) and are listed by the EPA as hazardous waste.

A waste is considered to be corrosive if it is:

1. Aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5 or

2. A liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inch) per year at a test temperature of 55°C (130°F).

A waste is considered to be ignitable if it is:

1. A liquid, other than an aqueous solution containing less the 24% alcohol by volume and has a flash point less than 60°C (140°F);

2. Not a liquid and is capable under standard temperature and pressure of causing a fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited burns so vigorously and persistently that it creates a hazard;

3. An ignitable compressed gas; or

4. An oxidizer.

A waste is considered to be reactive if it:

1. Is normally unstable and readily undergoes violent change without detonating;
2. Reacts violently with water;
3. Forms potentially explosive mixtures with water;
4. Generates toxic gases, vapors, or fumes when mixed with water in a quantity sufficient to present a danger to human health or the environment;
5. Is a cyanide or sulfide bearing waste, which when exposed to pH conditions between 2 and 12.5 can generate toxic gases, vapors, or fumes in a quantity sufficient to endanger human health or the environment;
6. Is capable of detonation or explosive reaction if it is subjected to a strong igniting source or if heated under confinement;
7. Is readily capable of detonation or explosive detonation at standard pressure and temperature; or
8. Is a Class A, Class B, or forbidden explosive.

A waste, which fails the Toxicity Characteristic Leaching Procedure (TLCP), is EPA hazardous waste. If disposable materials are contaminated with the following chemicals, they are regulated as EPA hazardous wastes:

Arsenic	1,4-Dichlorobenzene	Methyl Ethyl Ketone
Barium	1,2-Dichloroethane	Nitrobenzene
Benzene	1,1-Dichloroethylene	Pentachlorophenol
Cadmium	2,4-Dinitrotoluene	Pyridine
Carbon Tetrachloride	Endrin	Selenium
Chlordane	Heptachlor	Silver
Chlorobenzene	Hexachlorobenzene	Tetrachloroethylene
Chloroform	Hexachlorobutadiene	Toxaphen
Chromium	Hexachloroethane	Trichloroethylene
m-Cresol	Lead	2,4,5-Trichlorophenol
o-Cresol	Lindane	2,4,6-Trichlorophenol
p-Cresol	Mercury	2,4,5-TP Silvex
Cresol, total	Methoxychlor	Vinyl Chloride
2,4-D		

Consult Appendix A for an alphabetical compilation of EPA hazardous wastes from non-specific sources and discarded chemical products. These are chemicals exhibiting the characteristics of an EPA hazardous waste.

II. SUMMARY OF COLLECTION PROCEDURES FOR HAZARDOUS MATERIAL:

(For more specific information regarding hazardous waste collection refer to the Ursinus College Hazardous Waste Management Plan.)

A. All materials for off-site disposal should be collected in containers that are appropriate for that type of chemical. The container must be labeled at the onset of collection and have a tight fitting screw type lid. Corks and stoppers are **not** appropriate closure devices.

B. By-products or used materials should not be mixed. Separation facilitates the classification and disposal as well as lowering the cost.

C. If material for disposal is mixed, be sure that the types are compatible.

D. Organic solvents should be collected separately from metal cyanides and other poisons. The solvents can then be disposed of in bulk fashion.

E. Halogenated materials should be collected separately from nonhalogenated. The container label should list the exact chemical contents, including the solvent.

F. Materials for off-site disposal should be removed from the laboratory and taken to a designated storage facility twice a year. Materials become "wastes" when they are moved from the satellite accumulation area to the storage area. (As a small quantity generator Ursinus College can store the wastes for 180 days.) At the time of disposal all bottles should be filled since incompletely filled containers are considered by EPA regulations to be filled. That is to say, the cost of waste removal is based on container size not the mass or volume of the contents.

III. IN-LAB CHEMICAL MANAGEMENT:

There are many chemicals that are most appropriately disposed of by discharge into the sanitary sewer (sink disposal), by discharge into the sanitary sewer after neutralization or other chemical treatment, or directly into the normal trash. Deciding which disposal route is the most appropriate for your material depends upon your expertise, the amount of material, the chemical and toxicological properties of the chemical, its environmental fate, and the capability of your facilities.

A. Sink Disposal:

Most dilute aqueous solutions can be disposed of in the sanitary sewer.

1. If you are sure that the laboratory's drainage system can handle large volumes of water and chemicals, sanitary sewer disposal may be employed. Avoid the use of sinks that are slow running or have a history of easily being plugged.

2. Solutions that contain less than 20% of a water miscible flammable organic solvent, such as acetone, methanol, ethanol, and other water soluble and miscible solvents, can be put down the drain followed by 10 volumes of water. Those, which contain more than 20% of the above solvents or more than 5 liters should be placed in the appropriate organic solvent container for disposal.

3. All corrosive solutions should be neutralized to a pH of 3-10 before pouring them down the drain. (See neutralization below) Dilution of acidic or basic solutions with water is not an acceptable method of changing the pH.

4. Hazardous chemicals, as defined in 29 CFR 1910.1450, should never be poured down the drain.

5. The appropriate personal protective equipment (lab coat or apron, safety goggles, gloves) should be worn and potential contact avoided.

6. First, the disposal of a small amount of material should be attempted, noting reactivity and solubility. To increase solubility try warm water. Do not flush materials that are insoluble.

7. After the disposal of the unwanted chemical, the drain area should be flushed with copious quantities of water (10-20 times the amount).

8. Materials for disposal should never be placed into storm drains.

Soluble organic salts, sugars, amino acids, nucleotides, nucleosides, vitamins, surfactants, and the many metabolic intermediates can all be disposed of in the sanitary sewer. In addition, nonhazardous, **soluble** salt combinations of these ions can be discharged into the sanitary sewer system.

CATIONS	ANIONS
Aluminum	Acetate
Ammonium	Bicarbonate
Bismuth	Bisulfite
Calcium	Borate
Cerium	Bromate
Cesium	Bromide
Cobalt	Carbonate
Gold	Chlorate
Iron	Chloride
Lithium	Cyanate
Magnesium	Iodate
Manganese	Iodide
Potassium	Nitrate
Rubidium	Nitrite
Sodium	Perchlorate
Strontium	Periodate
Tin	Permanganate
	Phosphate
	Silicate
	Stannate
	Sulfate
	Sulfite
	Thiocyanate
	Thiosulfate
	Titanate
	Tungstate
	Vanadate

If the material is water reactive, such as an anhydrous halide of magnesium, aluminum, calcium, or iron, disposal should be performed in a hood sink. The solid should be poured slowly into a large container of water, allowed to dissolve completely, and then poured into a stream of running water for disposal.

If the material is suitable for drain disposal but malodorous, use a hood sink. Pour the material directly into the drain; do not let it pool in the sink. Flush with large volumes of water after disposal.

B. Special Procedures:

1. Neutralization:

Neutralization is the most efficient and least costly way of managing excess acids and bases. **If the procedure is included in the student laboratory experiment, it can be performed at the generation site, thus eliminating storage of the used solutions. Otherwise, excess acids and bases must be disposed of via the hazardous waste vendor.** The EPA considers any neutralization process not part of the experiment as treatment and requires a facility performing neutralization to obtain a permit.

Certain acids are very reactive with water. Do not attempt to treat them in-lab. Dispose of these acids as hazardous materials:

Acid anhydrides and chlorides
Chlorosulfonic Acid
Fuming Nitric Acid
Fuming Sulfuric Acid
Liquid halides of boron, silicon, tin, titanium, and vanadium
Liquid halides and oxyhalides of phosphorus, selenium, and sulfur

2. Mercury Spills:

If the spill is less than 5 mL, first remove the glass and other large debris, and then pick up the spilled mercury. A side arm filtering flask connected to a vacuum pump or water aspirator may be used. Alternatively, the spill can be consolidated using a thin piece of cardboard or plastic. The mercury is then pushed onto another thin piece of cardboard or plastic and transferred into the disposal container. The area is then decontaminated using mercury spill powder, (A mixture of 85 grams of finely powdered sodium thiosulfate and 15 grams finely powdered EDTA which is spread on the spill, wet down, and let stand over night before being cleaned up and disposed of properly), mercury absorbent paper, or a mercury sponge. The mercury should be placed into an airtight container labeled "Waste Mercury." Glassware and other debris, which are free of mercury, may be deposited in the normal trash. Mercury spill kits are available in the Chemistry Stockroom and the Biology Prep Room.

When dealing with a broken thermometer, preserve all sections containing visible mercury, including the bulb. Any sections of the capillary that do not contain mercury, can be discarded in a broken glass box or sharps container. Sections containing mercury should be placed in a labeled, puncture-proof container ("broken thermometers containing mercury") and stored in the Satellite Accumulation Bin for that lab.

For mercury spills greater than 5mL including spills from manometers and barometers, call the EH&S Coordinator. Close off and post the area to prevent mercury or vapors from spreading. After a large spill the air should be monitored to verify that airborne levels of mercury have been reduced to an acceptable level.

PERSONAL WORK PRACTICES

I. Never work alone in the laboratory or chemical storage facility (stockroom). The person accompanying you need not have experience in your particular activity but is there to assist you in the case of emergency. If this is not possible, then Campus Safety should be informed of the presence of the solitary worker and check on her/him at regular intervals.

II. The appropriate eye protection should be worn at all times. When working with chemicals in areas in which they are used or stored, the eye protection should be OSHA or ANSI approved (ANSI Z87.1-2003) . Normal prescription glasses with lenses that shatter and which lack side shields DO NOT afford adequate protection. The use of goggles in all laboratories is strongly recommended. Safety glasses with side shields can be used if spattering of liquids is not anticipated. Contact lens wearers must wear eye protection when required – contact lenses alone are not an acceptable means of eye protection in the laboratory.

III. Chemical goggles should be worn during chemical transfer and handling operations as procedures dictate. Face shields may be mandated under certain circumstances.

IV. Disposable gloves should be worn for operations in which pathogens, blood, sera, or potentially harmful chemicals are used. The gloves should resist penetration by the material being handled and be checked for pinholes, tears, or rips.

V. Eating, drinking, smoking, gum or tobacco chewing, or application of cosmetics in areas where laboratory chemicals are present is prohibited.

VI. Food or beverages must not be kept in any area, including refrigerators or freezers, where chemicals are stored.

VII. Laboratory glassware must not be used as food or beverage containers.

VIII. All employees should wash promptly and thoroughly whenever they have come into contact with a chemical. Before leaving the laboratory, wash well with soap and water; do not wash with solvents.

IX. Practical jokes or other behavior, which might confuse, startle, or distract a coworker, should be avoided.

X. When working with flammable chemicals, employees should be sure that there are no sources of ignition (flames, electrical switches) near enough to cause a fire or explosion. The minimum distance for such a source is ten feet.

XI. All employees should know:

A. The hazards associated with the chemical(s) in use as ascertained from the Material Safety Data Sheet (MSDS) or other sources. When the hazards are unknown, treat the material as hazardous. Material Safety Data Sheets (MSDS) for chemicals in the current inventory are on file in the Sturgis Library in Pfahler Hall, the Biology Department Office in Thomas Hall, the Art Building flammable cabinet and the office and shop of Facilities Services;

B. The appropriate safeguards for using that chemical, including personal protective equipment. This information is usually included in the MSDS.

C. The location and proper use of emergency equipment -- fire extinguisher, spill kits, eye wash, and safety showers;

D. The appropriate procedure for emergencies including spill clean up, proper waste disposal, and evacuation routes;

E. Proper storage of chemicals when not in use; and

F. Proper means of transporting chemicals from one site to another.

XII. The employee should ascertain that all chemicals are labeled properly. Warning signs should be posted on the door to the laboratory and at the site when unusual hazards such as flammable materials are stored or other special circumstances arise.

XIII. Employees should not enter the area of a fire or personal injury unless their help is specifically requested.

XIV. Hazards to the environment should be avoided by following accepted waste disposal procedures.

XV. All visitors (persons who are not authorized to work in the laboratory) must be accompanied or supervised by a department member. Children (under the age of 16) are not allowed in the laboratories except at times authorized by the laboratory supervisor or research advisor for an officially sanctioned activity (e.g. class or open house). Pets are prohibited from laboratories.

PERSONAL PROTECTIVE EQUIPMENT

I. ANSI (American National Standards Institute) approved (ANSI Z87.1-2003) eye or face protection should be worn at all times. No one, visitors as well as employees and students, should enter the areas where chemicals are used or handled without the appropriate eye protection. Face shields, which protect the neck and ears as well as the face, should be worn when working at reduced pressures or when there is a potential for an explosion, implosion, or splashing.

II. Gloves should be worn that will resist penetration by the chemical being handled and that have been checked for pinholes, leaks, and tears. Gloves should be selected on the basis of the materials being handled, the particular hazard involved, and their suitability for the operation being conducted. Many different types of commercial gloves are available. More information about glove selection is provided in Appendix B. Consult the MSDS for specific glove information.

III. Low-heeled shoes should be worn at all times in areas in which chemicals are used or stored. Perforated shoes, sandals, or cloth sneakers should not be worn in laboratories.

IV. Laboratory clothing should be comfortable, but reasonably well fitting. Lab coats or rubber aprons are suggested for regular use in the laboratory. If shorts or short skirts are worn, they should be covered with a lab coat to protect the legs. Long hair and loose clothing should be confined.

SIGNS AND LABELS

Prominent signs and labels of the following types must be posted or affixed:

A. Emergency telephone numbers of laboratory supervisor/research advisor, laboratory workers, and emergency personnel on the door of every laboratory and stockroom.

B. Identity labels showing contents of containers (including used/waste containers) and associated hazards.

1. Purchased materials should always have labels that contain the manufacturer's name, name and/or formula of the material contained, and lot number.

2. Upon receiving purchased materials, the date of receipt should be affixed to the label as well as the appropriate hazard label(s), if they are not already present.

3. Solutions, mixtures, reaction products, and other materials generated on-site should be labeled at the time of preparation. Paper labels affixed to the container are preferred to those written directly on the container. The label should be in ink, not wax pencil, and should contain:

   Name of material(s)
   Name or initials of the person preparing it
   Date prepared
   Course and/or laboratory in which it is to be used
   Hazards: flammable, corrosive, toxic, reactive, etc.

   Such labels should be affixed to the container rather than the lid. All labels should pertain to the current rather than the previous contents. Labels listing prior contents should be removed rather than obliterated before the label for the current contents is affixed. Bottles with permanently etched or glazed names should never be used for contents other than those on that label.

C. Location signs for safety showers, eye wash stations, other safety and first aid equipment, exits, and areas where food and beverage consumption and storage are permitted.

D. Warnings in areas or at equipment where there are special or unusual hazards.

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HOUSEKEEPING

I. Each laboratory worker is directly responsible for the cleanliness of his or her workspace, and jointly responsible for the common areas of the laboratory. Laboratory supervisors and research advisors should insist on the maintenance of housekeeping standards.

II. The following procedures apply to the laboratory housekeeping standards:

A. There should be separate containers for trash, broken glass, and biohazardous material, all of which are appropriately labeled.

B. Access to emergency equipment, showers, eyewashes, electrical disconnects, and escape routes should never be blocked by anything, not even a temporarily parked cart. Fire extinguishers should be placed near an escape route, not in a "dead end."

C. Fire doors (the doors leading to the stairwells and foyers) should **never** be blocked in the open position.

D. All chemical containers must be labeled with at least the identity of the contents, the date of entry into the inventory, and the hazards of the contents to the user. All labels should face front.

E. All work areas, especially laboratory benches, should be kept clear of clutter. The work area should be cleaned up at the end of an operation or at the end of the day. All chemicals should be replaced in their assigned storage areas.

F. Aisles, hallways, and stairs should not be used for the storage of chemicals.

G. All materials for disposal should be properly labeled and kept in their proper containers. At the end of each workday, the contents of all unlabeled containers are to be considered materials for disposal.

H. All benchtops and floors should be cleaned regularly.

I. All spills should be cleaned up immediately using the most effective techniques. The spill and cleanup materials should be disposed of properly. Large spills will necessitate the implementation of the Ursinus College Emergency Action Plan as per OSHA 1910.38 and 1910.120.

EYEWASH FOUNTAINS AND SAFETY SHOWERS

I. All laboratories should be equipped with eyewashes and safety showers. These must be located so that they are accessible from any point in the laboratory as specified in ANSI Z358.1. For both devices the recommended distance is 50 ft. or less from every workstation in the laboratory. Furthermore, showers should be located no more than 25 ft. from the entrance to the laboratory.

II. The functioning of the devices should be tested at regular intervals. Eyewashes with a continuous water supply should be flushed for 3 minutes weekly to minimize amoebae formation. Showers should be checked every month to ensure that the valves open and close properly. The recommended water pressure for an eyewash fountain is 25 lb/in^2. The flow rate for a safety shower should be between 30 and 60 gal/min and the water pressure between 20 and 50 psi.

III. The use of bottle eyewash stations is strongly discouraged due to the ease of bacterial contamination and the need for sterilization of the cup immediately before use. Furthermore, such bottles usually **contain insufficient water to wash the eye properly.**

IV. Access to eyewash fountains and safety showers should not be blocked by temporary storage of objects or in any other way. Painted circles or squares on the floor should indicate the shower locations.

VENTILATION

The function of the laboratory hood or any other local ventilation equipment is to capture gases, vapors, and dusts so that the worker positioned at the front of the hood will not breathe a concentration higher than the threshold level value (TLV). Because the motors are not explosion-proof, biosafety cabinets are not chemical fume hoods.

The general ventilation system should be designed to ensure that the laboratory air is continuously being replaced so that the concentration of odoriferous or toxic substances does not increase during the workday. There should be no fewer than eight air changes per hour. Air from the laboratory system should be exhausted to the exterior of the building and not into the non-laboratory facilities such as hallways, offices, and classrooms. Thus, the air pressure in the laboratories should be less than that in rest of the facility. Air from the general ventilating systems is a source of air for breathing and input air for local ventilating systems and is not usually sufficient to prevent the accumulation of chemical vapors. Experiments employing chemicals which have low air concentration limits or high vapor pressures should be performed in a hood.

A. In laboratories where workers spend most of their time working with chemicals, there should be at least one hood for every two workers, and the hoods should be large enough to provide each worker with 2.5 linear feet of working space at the face of the hood.

B. Fume hoods should have a linear face velocity of 70 to 150 feet per minute, and the flow should be non-turbulent. The face velocity will depend upon the geometry of the hood, the placement of the hood in the laboratory, and the position of the worker relative to the front of the hood. Location of fume hoods near doors, windows, or other sources of drafts often seriously impedes the airflow in the hood.

C. For the most efficient ventilation the apparatus in the hood should be placed on the floor of the hood at least six inches away from the front edge. The hood should not be used to "dispose" of chemicals by evaporation. Thus, apparatus employed in the hood should be equipped with condensers, traps, or other devices for the collection of vapors and fumes.

D. Hoods should not be used for the storage of chemicals or apparatus. Materials stored in them should be kept to a minimum unless the hood has been designated an accumulation area for hazardous materials for disposal and special containers are provided for the collection.

E. When a chemical is inside the hood, the hood must be left "on."

G. Solid materials, such as paper, should not be allowed to enter the hood exhaust ducts.

H. Ventilated storage cabinets, glove boxes, and isolation rooms should be provided as needed. The exhaust air from glove boxes and isolation rooms should be passed through scrubbers before release into the regular exhaust system.

I. Chemical storerooms/stockrooms should be provided with exhaust ventilation in the corner most remote from the door(s). For small stockrooms, 1000ft^3, a blower of 200-300ft^3/min rating should run continuously.

J. Employees should be cognizant of the steps to be taken in the event of a power failure.

K. The quality and quantity of the ventilation should be evaluated upon installation, monitored at least every three months, and reevaluated whenever a change in local ventilation devices is made.

EMPLOYEE INFORMATION AND TRAINING

All employees should be aware of the hazards presented by the chemicals in the laboratories of Ursinus College. Each employee shall receive training at the time of initial assignment to the laboratory where hazardous chemicals are present and also prior to assignments involving new exposure situations, i.e. new hazardous chemicals or new procedures.

The training and information program should be a regular on-going activity. Training programs should be conducted by the Chemical Hygiene Officer and may employ individual classes, commercial programs, individual discussions, posted notices, or booklets. Although OSHA has not mandated the content of the program, it should include methods of detecting the presence or release of hazardous chemicals, physical and health hazards of chemicals in the laboratory, and measures employees can take to protect themselves from these hazards. OSHA requires that if asked by an OSHA inspector, the employee must be able to answer to the issues.

During the training sessions the employee should be informed of:

A. The content, location, and availability of the Ursinus College Chemical Hygiene Plan;

B. The content and requirements of the OSHA Laboratory Standard and its appendices

C. The permissible exposure limits (PEL) for OSHA regulated substances or recommended exposure limits (TLV) for other hazardous chemicals not regulated by OSHA;

D. The signs and symptoms associated with exposure to the chemicals present in the laboratory;

E. The emergency procedures and the location of emergency equipment;

F. The location and availability of MSDS and other reference materials on chemical hygiene.

UNATTENDED OPERATIONS

When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

A. The laboratory supervisor/research advisor will review work procedures to ensure the safe completion of the operation and notify campus safety.

B. An appropriate sign "Reaction in Progress" will be posted in a conspicuous place close to the reaction.

C. The overhead lights in the laboratory or in the hood will be left on.

D. Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.).

E. The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus.

MEDICAL CONSULTATIONS AND EXAMINATIONS

I. Opportunity to receive medical attention is available to all employees who work with hazardous chemicals in the laboratory and is available to employees under the following circumstances:

A. Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination,

B. Where exposure monitoring reveals an exposure level above the action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance programs will be established and/or,

C. Whenever an event takes place in the laboratory such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the employee will be provided an opportunity for medical consultation for the purpose of determining the need for medical examination.

II. Medical consultations and examinations shall be provided without cost to the employees, without loss of pay and at a reasonable time and place.

III. These medical consultations and examinations shall be administered by -- or under the direct supervision of -- a licensed physician. Employees seeking the opportunity of medical consultation can consult their own physician or request a listing of available physicians from the Chemical Hygiene Officer or Personnel Department. Currently, use of the facilities of Phoenixville or Pottstown Hospitals is recommended for emergency situations. For non-emergency situations, use one of the workers' compensation panel of physicians.

SPECIAL PRECAUTIONS

When laboratory procedures change to require the use of additional classifications of chemicals (allergens, embryotoxins, teratogens, carcinogens, etc.), additional special precautions shall be implemented as deemed necessary by the laboratory supervisor/research advisor or Chemical Hygiene Officer.

A. Working with Allergens and Embryotoxins (Special Precautions):

1. Suitable gloves to prevent hand contact shall be worn when exposed to allergens or substances of unknown allergen activity.
2. Women of childbearing age will handle embryotoxins only in a hood with confirmed satisfactory performance and will use protective equipment to prevent skin contact as prescribed by the laboratory supervisor/research advisor or Chemical Hygiene Officer.
3. Embryotoxins will be stored in adequately ventilated areas in unbreakable secondary containers.
4. The laboratory supervisor/research advisor and Chemical Hygiene Officer will be notified of spills and other exposure incidents. A physician will be consulted when necessary.

B. Working with Chemicals of Moderate Chronic or High Acute Toxicity (Special Precautions):

1. Areas where these chemicals are stored and used are of restricted access and have special warning signs.
2. A special hood with a minimum face velocity of 60 linear feet per minute or other containment device will be used. Released vapors should not be discharged with the hood exhaust but should be trapped.
3. Gloves and long sleeves will be worn to avoid skin contact. Hands and arms will be washed immediately after working with these chemicals.
4. Two people will always be present during work with these chemicals.

C. Working with Chemicals of High Chronic Toxicity (Special Precautions):

1. All transfer and work with these substances shall be in a designated area: a restricted access hood, glove box, or portion of laboratory.
2. Approval of the supervisor will be obtained before use.
3. Vacuum pumps must have scrubbers or high efficiency particulate absolute (HEPA) filters.

4. Any contaminated equipment or glassware will be decontaminated in the hood prior to being removed from the designated area.

5. For powders, a wet mop or vacuum with a HEPA filter will be used for cleanup.

6. The designated area will be marked with warning and restricted access signs.

7. Containers will be stored in a ventilated, limited access area in labeled, unbreakable, and chemically resistant secondary containers.

D. **Working with Chemicals of High Chronic Toxicity and Animals (Special Precautions):**

1. For large-scale studies, special facilities with restricted access will be provided.

2. The substance will be administered by injection or gavage when possible rather than by diet. When diet is used, a caging system under negative pressure or under laminar airflow directed toward HEPA filters will be used.

3. Procedures will be used to minimize contaminated aerosol from food, urine, and feces:

   a. Clean with HEPA filtered vacuum equipment.

   b. Moisten contaminated bedding before removal from cage.

   c. Mix diets in closed containers in hood.

4. Plastic or rubber gloves and fully buttoned lab coats will be worn in the animal room.

RECORDS AND RECORDKEEPING

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

II. Accident/incident reports should be written to conform to the proposed format and retained for at least as long as the employees affected are employed by the institution.

III. Exposure records for hazardous chemicals and harmful, physical agents will be maintained for 30 years per 29 CFR 1910.1020.

IV. Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.1020.

V. 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 institution.

VI. Records of inspections of equipment will be maintained for the lifetime of the institution.

VII. Records of employee training will be maintained for at least as long as the employee is associated with the institution.

VIII. In addition to required records, it is often desirable to keep records developed internally that document employee exposure complaints and suspected exposures, regardless of the outcome of the exposure assessment. Other incidents, which might be documented for future reference, are:

A. Major safety suggestions from employees,

B. Near-miss reports,

C. Repair and maintenance records for control systems,

D. Complaints from employees, as well as investigations and outcomes of the same.

IX. The EPA and other Federal and state agencies have special recordkeeping requirements. For example: recordkeeping of allegations and the reporting of suspect hazards from adverse effects of chemical exposure are required under Sections 8(c) and 8(e) of the Toxic Substances Control act; see 40 CFR 716 and 717.

REFERENCES

American Conference of Government Industrial Hygienists - ACGIH - Industrial Hygiene, Environmental, Occupational Health & Safety Resource

American National Standards Institute (ANSI Z87.1-2003 and Z358.1)

Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in laboratories et al. Prudent Practices in the Laboratory. Washington, D.C.: National Academy of Science, 1995.

Environmental Protection Agency Hazardous Waste Lists - http://www.epa.gov/waste/hazard/wastetypes/index.htm

NFPA 30 Flammable and Combustible Liquids Code 2003 Edition

NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals 2004 Edition

OSHA Access to Employee Exposure and Medical Records 29 CFR 1910.1020 - Access to employee exposure and medical records. - 1910.1020

OSHA Laboratory Standard 29 CFR 1910.1450 - Occupational exposure to hazardous chemicals in laboratories. - 1910.1450

OSHA Permissible Exposure Limits (PELS) - TABLE Z-1 Limits for Air Contaminants. - 1910.1000 TABLE Z-1

Ursinus College Hazardous Waste Management Plan - http://www.ursinus.edu/NetCommunity/Document.Doc?id=224

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

These chemicals are listed as EPA hazardous waste because they are either **toxic, reactive, ignitable or corrosive**.

Acetaldehyde
Acetaldehyde, trichloro
Acetamide, *N*-(4-ethoxyphenyl)
Acetamide, *N*-9*H*-fluoren-2-yl
Acetic acid, fluoro, sodium salt
Acetic acid, thallium(I) salt
Acetimidic acid, *N*-[(methylcarbamoyl) oxy]thiomethyl ester
3-(α-Acetonylbenzyl)-4-hydroxycoumarin and salts when present in concentrations ≤ 0.3%
1-Acetyl-2-thiourea
Acrolein
Acrylic acid
Alanine, 3-[*p*-bis(2-chloroethyl)amino] phenyl-, L
Aldrin
Aluminum phosphide
2-Amino-1-methylbenzene
Amitrole
Ammonium picrate
Aniline
Arsenic acid
Arsenic(III) acid
Arsenic pentoxide
Arsine
Auramine
Aziridine
Azirino(2′,3′:3,4)pyrrolo(1,2-*a*)indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxo]methyl]-1,1a,2,8*a*,8*b*-hexahydro-8a-methoxy-5-methyl-[1*aS*(1aα,8β,8*a*α,8*b*α)]
Benzal chloride
1,2-Benzanthracene, 7,12-dimethyl
Benzeneacetic acid, 4-chloro-α-(4-chlorophenyl)-α-hydroxy-ethyl ester
Benzenamine, 4-chloro
Benzenamine, 4-chloro-2-methyl-, hydrochloride
Benzenamine, 2-methyl
Benzenamine, 2-methyl-5-nitro
Benzenamine, 4-methyl
Benzene, 1-bromo-4-phenoxy
Benzene, chloromethyl
2-Benzenedicarboxylic acid, bis(2-ethyl-hexyl)ester
Benzenedicarboxylic acid, diethyl ester
Acetaldehyde, chloro
Acetamide, *N*-(aminothioxomethyl)
Acetamide, 2-fluoro
Acetic acid, ethyl ester
Acetic acid, lead(II) salt
Acetic acid, (2,4,5-trichlorophenoxy)
Acetone
Acetonitrile
Acetophenone
2-Acetylaminofluorine
Acetyl chloride
Acrylamide
Acrylonitrile
Aldicarb
Allyl alcohol
5-(Aminomethyl)-3-isoxazolol
4-Amino-1-methylbenzene
Aminopyridine
Ammonium vanadate
Argentate(1-), bis(cyano-C)-, potassium
Arsenic acid, dimethyl
Arsenic(V) oxide
Arsenic trioxide
Arsonous dichloride, phenyl
Azaserine
Aziridine, 2-methyl
Barium cyanide
Benz[*j*]laceanthrylene, 1,2-dihydro-3-methyl
Benz[c]acridine
3,4-Benzacridine
Benz(a)anthracene, 1,2-benzanthracene
Benzene
Benzenamine
Benzamine, 4,4′-carbonimidoylbis(*N*,*N*-dimethyl)
Benzenamine, N,N′-dimethyl-4-(phenylazo)
Benzenamine, 4,4′-methylenebis(2-chloro)
Benzenamine, 2-methyl-, hydrochloride
Benzenamine, 4-nitro
Benzene, chloro
1,2-Benzenedicarboxylic acid anhydride
1,2-Benzenedicarboxylic acid, dibutyl ester, 1,2-
1,2-Benzenedicarboxylic acid, dimethyl ester, 1,2-

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

Benzenedicarboxylic acid, dioctyl ester
Benzene, 1,3-dichloro
Benzene, (dichloromethyl)
Benzene, dimethyl
1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]
Benzene, hexahydro
Benzene, methyl
Benzene, 1-methyl-2,6-dinitro
Benzene,1,2-methylenedioxy-4-propenyl
Benzene, (1-methylethyl)-
Benzene, pentachloro
Benzenesulfonic acid chloride
Benzenethiol
Benzidine
salts
Benzo[*j*,*k*]fluorene
2*H*-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)- and salts, in concentrations greater than 0.3%
1,2-Benzphenanthrene
Beryllium
(1,1'-Biphenyl)-4,4'-diamine
(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethoxy
Bis(2-chlorethoxy)methane
Bis(dimethylthiocarbomoyl) disulfide
Bromine cyanide
Bromoform
Brucine
1-Butanamine, *N*-butyl-*N*-nitroso
benzene
1-Butanol
2-Butanone, 3,3-dimethyl-1-(methylthio)-*O*-(methylamino)carbonyl oxime
2-Butene, 1,4-dichloro
n-Butyl alcohol
Calcium chromate
Camphene, octachloro
Carbamic acid, methylnitroso, ethyl ester
Carbamide, *N*-methyl-*N*-nitroso
Carbamic chloride, dimethyl
Carbon bisulfide
Carbon oxyfluoride
Carbonic acid dithallium(I) salt
Carbonyl chloride
Chlorambucil
Chlorinated fluorocarbons

Benzene, 1,2-dichloro
Benzene, 1,4-dichloro
Benzene, 1,3-diisocyanatomethyl
1,3-Benzenediol
Benzene, hexachloro
Benzene, hydroxy
Benzene, 1-methyl-2,4-dinitro
Benzene, 1,2-methylenedioxy-4-allyl
Benzene, 1,2-methylenedioxy-4-propyl
Benzene, nitro
Benzene, pentachloronitro
Benzenesulfonyl chloride
Benzene, 1,3,5-trinitro
1,2-Benzisothiazol-3(2*H*)-one, 1,1-dioxide, and

Benzo[a]pyrene
3,4-Benzopyrene
p-Benzoquinone
Benzotrichloride
Benzyl chloride
2,2'-Bioxirane
(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dichloro
(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethyl
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl) phthalate
Bromoacetone
2-Bromophenyl phenyl ether
1,3-Butadiene, 1,1,2,3,4,4-hexachloro
Butanoic acid, 4-[bis(2-chloroethyl)amino]

2-Butanone
2-Butanone peroxide
2-Butenal
Isobutyl alcohol
Cacodylic acid
Calcium cyanide
Carbamic acid, ethyl ester
Carbamide, *N*-ethyl-*N*-nitroso
Carbamide, thio
Carbamimidoselenoic acid
Carbon disulfide
Carbon tetrachloride
Carbanochloridic acid, methyl ester
Chloral
Chlordane, technical
Chlorine cyanide

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

Chlornaphazin
p-Chloroaniline
Chlorobenzilate
1-Chloro-2,3-epoxypropane
Chloroform
Chloromethyl methyl ether
o-Chlorophenol
3-Chloropropionitrile
Chromic acid, calcium salt
Copper cyanides
Cresols
Crotonaldehyde
Cyanides (soluble cyanide salts) n.o.s.
Cyanogen bromide
2,5-Cyclohexadiene-1,4-dione
Cyclohexanone
Cyclophosphamide
Daunomycin
DDT
Diallate
Diamine
Dibenz[*a,h*]anthracene
1,2:7,8-Dibenzopyrene
S-(2,3-Dichloroallyl) diisopropylthiocarbamate
o-Dichlorobenzene
3,3'-Dichlorobenzidine
Dichlorodifluoromethane
Dichloro diphenyl dichloroethane
Dichloro diphenyl trichloroethane
1,2-Dichloroethylene
Dichloromethyl ether
2,6-Dichlorophenol
Dichlorophenyl arsine
1,3-Dichloropropene
1,2:3,4-Diepoxybutane
1,4-Diethylene oxide
O,O-Diethyl *S*-[2-(ethylthio)ethyl]phosphorodithiolate
Diethyl-*p*-nitrophenyl phosphate
O,O-Diethyl *O*-pyrazinyl phosphorthioate
1,2-Dihydro-3,6-pyradizinedione
Diisopropylfluorophosphate (DFP)
2,7:3,6-Dimethanonaphth[2,*3b*]oxirane,
    octahydro, (1aα,2β,2aα,3α,6α,6aβ,7β,7aα)
2,7:3,6-Dimethanonaphth[2,*3b*]oxirane
    octahydro, (1aα,2β,2aα,3β,6β,6aα,7β,7aα)
Chloroacetaldehyde
Chlorobenzene
4-Chloro-*m*-cresol
2-Chloroethyl vinyl ether
Bis(chloromethyl) ether
β-Chloronaphthalene
1-(*o*-Chlorophenyl)thiourea
4-Chloro-*o*-toluidine, hydrochloride
Chrysene
Creosote
Cresylic acid
Cumene
Cyanogen
Cyanogen chloride
Cyclohexane
1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro
2,4-D, salts and esters
DDD
Decachlorooctahydro-1,3,4-metheno-2*H*-cyclobuta[*c,d*]-pentalen-2-one
Daminotoluene
1,2:5,6-Dibenzanthracene
Dibenzo[*a,i*]pyrene
m-Dichlorobenzene
p-Dichlorobenzene
1,4-Dichloro-2-butene
3,5-Dichloro-*N*-(1,1-dimethyl-2-popynyl)
    benzamide
1,1-Dichloroethylene
Dichloroethyl ether
2,4-Dichlorophenol
2,4-Dichlorophenoxyacetic acid, salts and esters
1,2-Dichloropropane
Deldrin
Diethylarsine
N,N'-Diethylhydrazine
O,O-Diethyl-*S*-methyl-dithiophosphate
Diethyl phthalate
Diethylstilbesterol
Dihydrosafrole
Dimethoate
3,3-Dimethoxybenzidine
Dimethylamine
Dimethylaminoazobenzene
7,12-Dimethylbenz[a]anthracene

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

1,4,5,6-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro, (1aα,4α,4aβ,5β,8β,8aβ)
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexaxchloro-1,4,4a,5,8,8a-hexahydro, (1aα,4α,4aβ,5α,8α,8aβ)
O,O-Dimethyl-*O-p*-nitrophenyl phosphothioate
Dimethylnitrosamine
α,α-Dimethylphenethylamine
Dimethyl sulfate
4,6-Dinitro-*o*-cyclohexyl phenol
2,4-Dinitrotoluene
Dinoseb
1,4-Dioxane
Diphosphoramide, octamethyl
Di-*n*-propylnitrosamine
2,4-Dithiobiuret
Endosulfan
Endrin, and metabolites
Ethanal
Ethanamine *N*-ethyl-*N*-Nitroso
1,2-Ethanediamine, N,N-dimethyl-*N′* 2-pyridinyl-*N′*-(2-thienylmethyl)
Ethane, 1,2-dichloro
Ethane, 1,1,1,2,2,2-hexachloro
Ethane, 1,1┴-[methylenebis(oxy)]bis[2-chloro]
Ethane, 1,1′-oxybis
Ethane, pentachloro
Ethane, 1,1,2,2-tetrachloro
Ethane, 1,1,2-trichloro
Ethene, chloro
Ethene, 1,1-dichloro
Ethene, 1,1,2,2-tetrachloro
Ethanol, 2,2*F*-(nitrosimino)bis
Ethanone, 1-phenyl
2-Ethoxyethanol
Ethyl acrylate
Ethyl cyanide
Ethyleneamine
Ethylene dibromide
Ethylene glycol monoethyl ether
Ethylene thiourea
Ethylidine dichloride
3,3′-Dimethylbenzidine
α,α-Dimethylbenzylhydroperoxide
Dimethylcarbamoyl chloride
1,1-Dimethylhydrazine
1,2-Dimethylhydrazine
3,3-Dimethyl-1-(methylthio)-2-butanone-O[(methylamino)carbonyl] oxime
2,4-Dimethylphenol
Dimethyl phthalate
4,6-Dinitro-*o*-cresol, and salts
2,4-Dinitrophenol
2,6-Dinitrotoluene
Di-*n*-octyl phthalate
1,2-Diphenylhydrazine
Dipropylamine
Disulfoton
Dithiopyrophosphoric acid, tetraethyl ester
Endothal
Epinephrine
Ethanamine, 1,1-dimethyl-2-phenyl
Ethanamine, *N*-methyl-N-nitroso
Ethane, 1,2-dibromo
Ethane, 1,1-dichloro
1,2-Ethanediylbiscarbamodithioic acid, salts and esters
Ethanenitrile
Ethane, 1,1′-oxybis[2-chloro]
Ethane, 1,1,1,2-tetrachloro
Ethanethioamide
Ethane, 1,1,-trichloro-2,2-bis(*p*-methoxyphenyl)
Ethene, 2-chloroethoxy
Ethene, *trans*-1,2-dichloro
Ethanimidothioic acid,*N*-[[(methylamino) carbonyl]oxy], methyl ester
Ethanoyl chloride
Ethyl acetate
Ethyl carbamate (urethane)
Ethyl 4,4′-dichlorobenzilate
Ethylenebis(dithiocarbamic acid) salts and esters
Ethylene dichloride
Ethylene oxide
Ethyl ether
Ethyl methacrylate

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

Ethyl methanesulfonate
Ferric dextran
Fluorine
Fluoroacetic acid, sodium salt
Formic acid
Furan
2,5-Furandione
Furfural
D-Glucopyranose, 2-deoxy-2(3-methyl-3-nitrosoureido)
Guanidine, *N*-methyl-*N*'-nitro-*N*-nitroso
Hexachlorobenzene
Hexachlorodibenzo-*p*-dioxin
Hexachlorocyclohexane (γ isomer)
Hexachloroethane
Hexachlorophene
Hexachloropropene
Hydrazine
Hydrazine, 1,2-diethyl
Hydrazine, 1,2-dimethyl
Hydrazine, methyl
Hydrofluoric acid
Hydrogen fluoride
Hydrogen sulfide
Hydroxydimethylarsine oxide
Indeno[*1,2,3-cd*]pyrene
Isobutyl alcohol
Isodrin
3(2*H*)-Isoxazolone, 5-(aminomethyl)
Lasiocarpine
Lead phosphate
Lindane
Maleic hydrazine
Melphalan
Mercury, (aceto-*O*) phenyl
Methanamine, *N*-methyl-
Methane, chloro
Methane, dibromo
Methane, dichlorodifluoro
Methane, oxybis(chloro)
Methane, tetrachloro
Methanethiol, trichloro
Methanethiol
Methane, trichloro
Famphur
Fluoranthene
Fluoroacetamide
Formaldehyde
Fulminic acid, mercury(II) salt
2-Furancarboxaldehyde
Furan, tetrahydro
Furfuran
Glycidylaldehyde
Heptachlor
Hexachlorobutadiene
Hexachlorodibenzofuran
Hexachlorocyclopentadiene
Hexachlorohexahydro-*endo*-*endo*-dimeghanonaphthalene
Hexaethyl tetraphosphate
Hydrazinecarbothioamide
Hydrazine, 1,1-dimethyl
Hydrazine, 1,2-diphenyl
Hydrocyanic acid
Hydrogen cyanide
Hydrogen phosphide
Hydroperoxide. 1-methyl-1-phenylethyl
Imidazolidinethione
Iron dextran
Isocyanic acid, methyl ester
Isosafrole
Kepone
Lead acetate
Lead subacetate
Maleic anhydride
Malononitrile
Mercury
Methacrylonitrile
Methane, bromo
Methane, chloromethoxy
Methane, dichloro
Methane, iodo
Methanesulfonic acid, ethyl ester
Methane, tetranitro
Methane, trichlorofluoro
Methane, tribromo
Methanoic acid

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

4,7-Methano-1*H*-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3*a*,4,7,7*a*-hexahydro
Methanol
Methomyl
Methyl alcohol
2-Methaziridine
Methyl chloride
Methylchloroform
4,4′-Methylenebis(2-chloroaniline)
Methylene bromide
Methylene oxide
Methyl ethyl ketone peroxide
Methyl iodide
Methyl isobutyl ketone
Methyl methacrylate
Methyl parathion
Methylthiouracil
Naphthalene
Naphthalene, 2-chloro
5,12-Naphthacenedione, (8*S*-*cis*)8-acetyl-10-[(3-amino-2,3,6-trideoxy-α-L-lyxo-hexopyranosyl) oxyl]-[7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy
2,7-Naphthalenedisulfonic acid, 3,3′-[3,3′-dimethyl-(1,1′-biphenyl)-4,4′diyl)]bis(azo)bis(5-amino-4-hydroxy)-, tetrasodium salt
Nickel cyanide
Nicotine and salts
p-Nitroaniline
Nitrobenzene
Nitrogen dioxide
Nitroglycerine
2-Nitropropane
N-Nitrosodiethanolamine
N-Nitrosomethylamine
N-Nitroso-*n*-propylamine
N-Nitroso-*N*-methylurea
N-Nitrosopiperdine
5-Nitro-*o*-toluidine
Octamethylpyrophosphoamide
Osmium oxide
7-Oxabicyclo[*2,2,1*]heptane-2,3-dicarboxylic acid
4,7-Methano-1*H*-indene, 1,4,5,6,7,8,8-heptachloro-3*a*,4,7,7*a*-tetrahydro
Methapyrilene
Methoxychlor
Methyl bromide
Methylbutadiene, 1-
Methyl chlorocarbonate
3-Methylcholanthrene
2,2′-Methylenebis(2,4,6-trichlorophenol)
Methylene chloride
Methyl ethyl ketone
Methyl hydrazine
Methyl isocyanate
Methylacetonitrile
N-methyl-*N*′-nitro-*N*-nitrosoguanidine
4-Methyl-2-pentanone
Mitomycin C
2-Naphthalenamine, N,N′-bis(2-chloroethyl)
1,4-Naphthalenedione
2-Naphthylamine
1,4-Naphthoquinone
α-Naphthylamine
1-Naphthylamine
β-Naphthylamine
α-Naphthylthiourea
Nickel carbonyl
Nickel(II) cyanide
Nickel tetracarbonyl
Nitric oxide
Nitrogen(II) oxide
Nitrogen(IV) oxide
p-Nitrophenol
N-Nitrosodi-*n*-butylamine
N-Nitrosodiethylamine
N-Nitrosomethylvinylamine
N-Nitroso-*N*-ethylurea
N-Nitroso-*N*-methylurethane
N-Nitrosopyrrolidine
5-Norbene-2,3-dimethanol, 1,4,5,6,7,7-hexachloro, cyclic sulfite
Osmium tetroxide
1,2-Oxathiolane, 2,2-dioxide

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

2*H*-1,3,2,-Oxazaphosphorin, 2-[bis(2-chloroethyl)
amino]-tetrahydro, 2-oxide
Paraldehyde
Pentachlorobenzene
Pentachlorodibenzofuran
Pentachloronitrobenzene
1,3-Pentadiene
Phenacetin
Phenol
Phenol, 4-chloro-3-methyl
Phenol, 2,4-dichloro
Phenol, 2,4-dimethyl
Phenol, 2-methyl-4,6-dinitro, and salts
Phenol, 4-nitro
Phenol, 2,3,4,6-tetrachloro
Phenol, 2,4,5-trichloro
L-Phenylalanine, 4-[bis(2-chloroethyl)amino]
Phenylmercuric acetate
Phorate
Phosphine
Phosphoric acid, diethyl 2-nitrophenyl ester
ester
Phosphorodithioic acid, *O,O*-dimethyl *S*-
[2-(methylamino)-2-oxoethyl] ester
Phosphorothioic acid, *O,O*-diethyl-
O-(4-nitrophenyl) ester
Phosphorothioic acid, *O,O*-dimethyl *O*-
[*p*-((dimethylamino)sulfonyl) phenyl ester]
Phthalic anhydride
Plumbane
Potassium silver cyanide
1-Propanamine
Propanal, 2-methyl-2(methylthio)-
O-[(methylamino)carbonyl]oxime
Propanenitrile
Propanenitrile, 2-hydroxy-2-methyl
Propane, 2,2′-oxybis[2-chloro]
1,2,3-Propanetriol, trinitrate
1-Propanol, 2,3-epoxy
2-Propanone
Propagyl alcohol
2-Propen-1-ol
Propene, 1,3-dichloro

Oxirane
Oxirane, 2-(chloromethyl)
Parathion
Pentachlorodibenzo-*p*-dioxin
Pentachloroethane
Pentachlorophenols and their chlorophoxy
derivative acids, esters, ethers, amines
and other salts
Phenol, 2-chloro
Phenol, 2-cyclohexyl-4,6-dinitro
Phenol, 2,6-dichloro
Phenol, 2,4-dinitro
Phenol, 2-(1-methylpropyl)-4,6-dinitro
Phenol, pentachloro
Phenol, 2,4,5-trichloro
Phenol, 2,4,6-trinitro, ammonium salt
Phenyl dichloroarsine
N-Phenylthiourea
Phosgene
Phosphoric acid,lead(II) salt
Phosphorodithioic acid, *O,O*-diethyl-*S*-methyl

Phosphorofluoric acid, bis(1-methylethyl)ester
Phosphorothioic acid, *O,O-diethyl*
S-(ethylthio)methyl ester
Phosphorothioic acid, *O,O*-diethyl
O-pyrazinyl ester
Phosphorus sulfide
2-Picoline
Potassium cyanide
Pronamide
1-Propanamine, *N*-propyl
Propane, 1,2-dibromo-3-chloro
Propanedinitrile
Propanenitrile, 3-chloro
Propane, 2-nitro
1,3-Propane sulfone
1-Propanol, 2,3-dibromo, phosphate (3:1)
1-Propanol, 2-methyl
2-Propanone, 1-bromo
2-Propenal
2-Propenamide
1-Propene, 1,1,2,3,3,3-hexachloro

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

2-Propenenitrile
2-Propenoic acid
2-Propenoic acid, 2-methyl, ethyl ester
n-Propylamine
Propylenimine
Pyridinamide
Pyridine hexahydro-*N*-nitroso
Pyridine, 2-methyl
4-(1*H*)-Pyrimidone, 2,3-dihydro-6-methyl-2-thioxo
Pyrophosphoric acid, tetraethyl ester
Reserpine
Saccharin and salts
Selenious acid
Selenium disulfide
L-Serine, diazoacetate ester
Silvex(2,4,5-TP)
Sodium cyanide
Streptozotocin
Strychnidin-10-one, and salts
Sulfur hydride
Sulfuric acid, thallium(I) salt
Sulfur selenide
1,2,4,5-Tetrachlorobenzene
1,1,2,2-Tetrachlorobenzene
Tetrachlorodibenzofuran
2,3,4,6-Tetrachlorophenol derivative
Tetraethyldithiopyrophosphate salts
Tetraethyl lead
Tetrahydrofuran
Tetraphosphoric acid, hexaethyl ether
Thallium(I) acetate
Thallium(I) chloride
Thallium(I) selenide
Thallium(III) oxide
Thiofanox
Thiomethanol
Thiosemicarbazide
Thiourea, (2-chlorophenyl)
Thiourea, phenyl
Toluene
Toluene diisocyanate
p-Toluidine
Toxaphene
2-Propenenitrile, 2-methyl
2-Propenoic acid, ethyl ester
2-Propenoic acid, 2-methyl, methyl ester
Propylene dichloride
2-Propyn-1-ol
Pyridine
Pyridine,(*S*)-3-(1-methyl-2-pyrrolidinyl), and salts
2,4-(1*H*,3*H*)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]
Pyrrole, tetrahydro-*N*-nitroso
Resorcinol
Safrole
Selenium dioxide
Selenourea
Silver cyanide
Sodium Azide
4,4′-Stilbenediol, α,α′-diethyl
Strontium Sulfide
Strychnin-10-one, 2,3-dimethoxy
Sulfuric acid, dimethyl ester
Sulfur phosphide
2,4,5-T
1,1,1,2-Tetrachlorobenzene
Tetrachlorobenzo-*p*-dioxin
Tetrachloroethene (tetrachloroethylene)
Tetrachlorophenol and its chlorophenoxy acids, esters, ethers, amines and other
Tetraethylpyrophosphate
Tetranitromethane
Thallic oxide
Thallium(I) carbonate
Thallium(I) nitrate
Thallium(I) sulfide
Thioacetamide
Thiomidodicarbonic diamide
Thiophenol
Thiourea
Thiourea, 1-naphthalenyl
Thiram
Toluenediamine
o-Toluidine
o-Toluidine hydrochloride
1*H*-1,2,4-Triazol-3-amine

Appendix A - EPA Listed Hazardous Wastes
(P, U, and F listed combined)

1,1,1-Trichloroethane
Trichloroethene
Trichlorofluoromethane
Trichloromethanethiol
Trichlorophenol and its chlorophenoxy derivative acids, esters, ethers, amines and other salts
1,3,5-Trinitrobenzene
Tris(2,3-dibromopropyl)phosphate
Uracil, 5-[bis(2-chloromethyl)amino]
Vanadic acid, ammonium salt
Vanadium oxide
Warfarin and salts, at concentrations ≤ 0.3%
Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy], methyl ester, (3β,16β,17α,18β,20α)
1,1,2-Trichloroethane
Trichloroethylene
1,1,2-Trichloro-1,2,2-trifluoroethane
Trichloromonofluoromethane
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
1,3,5-Trioxane, 2,4,6-trimethyl
Trypan blue
Uracil mustard
Vanadium pentoxide
Vinyl chloride
Xylene
Zinc cyanide
Zinc phosphide

April 21, 1992
Revisions: August 2015; August 21, 2009; July 30, 2004; September 10, 2001; July 15, 1999

Appendix B - Glove Selection Information

Chemical resistant gloves are an important aspect of protection against hazardous materials. It is critical that users select the correct glove material based on the chemicals used and the glove's permeation data. Inappropriate use of glove material may actually injure a worker as chemicals can quickly permeate the barrier. Please review the manufacturer, test data, and glove usage recommendations. Together the information will allow you to select the best glove material for your application. If you have any questions on glove selection, contact the chemical hygiene officer at extension 3221.

Chemical Family	Butyl Rubber	Neoprene	PVC (Vinyl)	Nitrile	Natural Latex
Acetates	G	NR	NR	NR	NR
Acids, inorganic	G	E	E	E	E
Acids, organic	E	E	E	E	E
Acetonitrile, Acrylonitrile	G	E	G	S	E
Alcohols	E	E	NR	E	E
Aldehydes	E	G	NR	S*	NR
Amines	S	NR	NR	F	NR
Bases, inorganic	E	E	E	E	E
Ethers	G	F	NR	E	NR
Halogens (liquids)	G	NR	F	E	NR
Inks	G	E	E	S	F
Ketones	E	G	NR	NR	G
Nitro compounds (Nitrobenzene, Nitromethane)	G	NR	NR	NR	NR
Oleic Acid	E	E	F	E	NR
Phenols	E	E	NR	NR	G
Quinones	NR	E	G	E	E
Solvents, Aliphatic	NR	NR	F	G	NR
Solvents, Aliphatic	NR	NR	F	F	NR

S - Superior, E - Excellent, G - Good, F - Fair, NR - Not Recommended

*Not recommended for Acetaldehyde, use Butyl Rubber

April 21, 1992
Revisions: August 2015: August 21, 2009; July 30, 2004; September 10, 2001; July 15, 1999

The performance of gloves depends on their thickness and conditions of manufacture, as well as their material of construction. It is best to consult the manufacturers' glove selection guides. A few companies are listed below.

Ansell-Edmont - Ansell Industrial, 1300 Walnut St., Coshocton, OH 43812.
From the AnsellPro.com Home Page link to the **Chemical Resistance Guide: Permeation and Degradation Data**, a .pdf file, or, SpecWare, Ansell's interactive chemical resistance and glove recommendations guide to nearly 200 industrial chemicals and mixtures. Links to toxicology information for thousands of chemicals from the National Library of Medicine database is also provided.

ShowaBest Glove (Best Manufacturing Company) - 579 Edison Street, Menlo, GA 30731.
Comprehensive Guide to Chemical-Resistant Best® Gloves - Best Glove Company's chemrest.com dedicated web portal contains all of the information one needs to correctly select the most applicable and protective chemical resistant glove for multiple potentially hazardous applications.

http://www.showabestglove.com/site/chemrest/default.aspx - click on "United States"

Lab Safety Supply - PO Box 1368, Janesville, WI 53547.
Chemical Compatibility Guide for Gloves, EZ Facts Document - Provides general information about OSHA regulations, selection factors and criteria, and types of glove materials. For specific information you can e-mail technical support, techsvc@labsafety.com, or consult the chemical compatibility chart contained in their hard copy catalog.
http://www.labsafety.com/refinfo/ezfacts/ - click on "Personal Protection", and then select 166 and 191.

MAPA Professional - 85 Innsbruck Drive, Buffalo, NY 14227.
Permeation, Degradation and Breakthrough Rates - for 116 chemicals against their Stansolv® Nitrile and StanzoilÆ Neoprene gloves.
www.mapaglove.com - click on "chemical resistance guide"

Safeskin Corporation (now a part of Kimberly Clark) - 12671 High Bluff Drive, San Diego, CA 92130.
Chemical Resistance & Barrier Guide - ratings for Nitrile and Natural rubber gloves against ~150 chemicals and a dozen mixtures.

http://www.kcprofessional.com/us/Safety_Home.asp - click on chemical resistance database

*Portions of the information provided above is from the Dickinson College EH&S website.