Crosswalk for Faculty in Science Labs and Art Studios to Prepare and Comply with Chemical Hygiene Plan, Hazard Communication Plan and Personal Protective Equipment Plan

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1. Chemical Inventory

Use the chemical inventory forms in Appendix 1. Pure reagents and formulated commercial products have different forms. On the forms, list the substances/products and complete as many of the entries as possible.

Chemical inventories are required under OSHA regulations, Resource Conservation and Recovery Act (RCRA) regulations, Superfund Authorization and Reauthorization Act 2 (SARA2) regulations, Toxic Substances Control Act (TSCA), and Uniform Food and Drug Act regulations. Consequently, the inventories are a major tool to demonstrate compliance with federal and state regulations.

2. Material Safety Data Sheets Collection

OSHA requires that *each substance* used in a location have an MSDS available at that location for employees to peruse. Based on the inventory, make sure that each substance has an MSDS. If an MSDS is not available, request an MSDS from the manufacturer/supplier of the substance.

3. Particularly Hazardous Substance Review

Appendix 2 contains a list from OSHA of particularly hazardous chemicals. Review the list and check all that apply. Certain restrictions apply to these substances. Highly toxic or carcinogenic substances require a written approval by the laboratory or studio supervisor for their use. A copy of this list must be submitted to EHS for review.

Certain groups of materials (e.g., Bioterror Act APHIS agents radioactive materials, pharmaceuticals and drug precursors, pesticides etc.) are regulated separately from OSHA. Contact the EHS Committee for information on these specially regulated materials.

4. Standard Operating Procedures (SOPs)

Appendix B of the NMHU **Chemical Hygiene Plan** contains SOPs for certain general activities. Activities not described in Appendix B should have SOPs prepared by supervisors in consultation with the EHS Committee.

Laboratories

The National Academies Press website offers free reading of Prudent Practices in the Laboratory Handling and Disposal of Chemicals, which can be used to access standard operating procedures for common laboratory practices. Each experiment requires an assessment of hazards.

Studios

Art studios will need to produce their own standard operating procedures. Each process (e.g., spraying, kiln operations, welding/metalwork, etc.) requires an assessment of hazards.

5. Hazard Assessments

Appendix 2 contains a form for assessment of general workplace hazards. The following provides guidelines for factors in hazard assessment.

a) Identify the chemicals and the circumstances of their use when planning an experiment. What are the amounts of chemicals that will be used? Will the experiment be performed in an open laboratory, an enclosed apparatus, or a fume hood? Is the experiment to be done once, or, repeatedly? Is it possible that new or unknown substances will be produced by the experiment? Are any of the workers that will perform the experiment pregnant, or likely to become pregnant? Do workers have any known sensitivity (allergy, allergic reaction, idiosyncratic reaction) to any of the chemicals to be used?

b) Examine MSDS or Laboratory Chemical Safety Summary (LCSS) for pertinent information on the hazards and hazard mitigation steps of substances. EHS can assist in this activity.

c) Use the sources of information in "b" above to determine the type of toxicity associated with each chemical used in the experiment. Are any of the chemicals corrosive or acutely toxic? Are any of the chemicals to be used irritants or sensitizers? Are any of the chemicals suspect or known reproductive toxins, or, neurotoxins? Will any chemicals be used that are known or suspect carcinogens? Refer to the National Toxicology Program for a list of known or suspect human carcinogens for this determination.

d) Determine the potential routes of exposure for each substance. The routes of exposure are 1) dermal (sometimes called percutaneous exposure), 2) inhalation, and 3) ingestion. Are the substances gases, or, volatile enough to present a significant risk of exposure through inhalation? If a liquid, can a substance be absorbed through the skin? In some instances, the bulk solvent of a solution can act as a vehicle to carry a solute into skin. Does the experiment pose a risk of inadvertent injection or ingestion?

e) Specify administrative and engineering controls to mitigate or eliminate hazards identified above. Which room is equipped to mitigate or eliminate hazards from an activity with a chemical or biological agent? Do certain procedures require the use of fume hoods or other engineered ventilation systems? Which activities require specialized training of personnel, and, should certain people be restricted from the activity (e.g., people with liver disease, pregnancy, undergraduate students, etc.)? Will there be unattended operations that pose a potential problem in the event of power failures, overheating, ventilation failure, fire, explosion, etc.?

f) Specify Personal Protective Equipment (PPE) requirements. Remember: PPE is the last resort for worker protection. Administrative and engineering controls are the most effective means to protect workers. PPE for hand, eye, foot, and body protection, however, are commonly used to further protect workers. The NMHU Personal Protective Equipment Plan provides guidance on selection of PPE, and, worker training requirements. Will workers require respiratory protection beyond fume hoods or local area ventilation? Will workers be using

sharp instruments (e.g., scalpels, syringes, etc.) that have the potential to cause contaminated wounds? Is a spill that could contaminate a significant body surface area likely to occur with certain substances?

6. Training

Training is a critical activity for:

1) General environmental health and safety orientation for new faculty throughout the university;
2) Undergraduate students in laboratories and studios where hazardous substances are used and hazardous wastes are generated;
3) Graduate teaching assistants in laboratories and studios for undergraduate students;
4) Graduate students undertaking projects that involve chemicals, hazardous processes, or other hazardous activities; and
5) Faculty that supervise laboratories and studios.

Chemical hygiene and hazardous communication plans for laboratories and studios should address items 2 – 4 above. The plans can be used for training and communicating hazards to the various groups.

Training refreshers should occur annually, and, should be incorporated into the **NMHU Chemical Hygiene Plan**.

All training must be documented according to the date of training, training contents and purpose, who was the trainer, and who took the training. The documentation shall be kept with the NMHU Chemical Hygiene Plan.

Training shall include the following elements:

a) The types of hazards (typical and worst-case) that a worker or student may be exposed to. Types of hazards are: high toxicity, reproductive toxins, carcinogens, flammable/combustible materials, explosives or unstable reactive materials, inhalation, skin irritation, etc;
b) Recognition of symptoms and signs of exposure. Recognition of potentially hazardous or catastrophic situations;
c) The means of mitigating or eliminating hazards from activities, including personal protective equipment;
d) Proper chemical/biological materials disposal procedures; and
e) Environmental Health and Safety Committee referral for concern of workers.

Students have the right to refuse to participate in an activity, if they believe that the activity might pose an undue risk to them. Faculty need to be aware of idiosyncratic reactions (allergies, hypersensitivity to chemicals) that are rare, but may be an issue for some students. Pregnant women should always be informed that they have the right to

refuse to participate in an activity that involves the use of reproductive toxins, mutagens, carcinogens, or teratogens.

7. Recordkeeping

Recordkeeping requirements are described in both the NMHU Chemical Hygiene and Hazardous Communication Plans. Records maintenance is a critical aspect of OSHA.

The laboratory or studio Chemical Hygiene Plan must be present in a studio or laboratory so that workers can easily reference it. MSDSs for the largest quantity, and most likely to be used, substances/materials.

8. Chemical Hygiene Plan Preparation

At this juncture, a Chemical Hygiene and Hazard Communication Plan can be prepared for each laboratory and studio. Example plans are provided in Appendix A of the NMHU Chemical Hygiene plan.

Contents of the plan shall include:

1. Studio or laboratory room number;
2. Laboratory or studio supervisor's name;
3. Authorized personnel to work in the studio or laboratory;
4. Work Area Hazard Assessment;
5. Chemical/Physical Hazards – locations and identities, symptoms and signs of exposure;
6. Administrative and Engineering controls on exposures and hazards;
7. Personal protective equipment controls on exposure;
8. Standard operating procedures for common and unique tasks. A critical element here is labeling requirements for containers;
9. Waste Disposal procedures;
10. Spill procedures;
11. Training documentation; and
12. Ancillary information – (Unattended operations, undergraduate student authorization to work after-hours, etc.).

This does not have to be overly complicated to meet the regulations. The major hazard should be identified and common practices that mitigate most hazards are described.

The plans do not have to have contingencies for intentional exposures by workers (e.g., suicide or suicide attempts, solvent "highs" from inhalation, etc.). However, security procedures in laboratories and studios can often prevent these intentional "self-inflicted" wounds.

9. Annual Review and Modification of Plans

Chemical Hygiene and Hazard Communication Plans for a laboratory or studio shall be reviewed annually.

The plan is modified whenever:

a) A new activity or set of substances is introduced into a work area;
b) There is a substantial change in regulations;
c) Work areas are modified;
d) Personnel have changed; and
e) New policies or procedures are introduced at NMHU.

Appendix 1: Chemical Inventory Forms

A. Pure Reagent Chemical Inventory Form (Laboratories)

The following is a template for conducting a chemical inventory of your research lab. At the top please fill in the **room number**, **name** of the inventory taker, **date** of inventory, and **page number**. You may use as many sheets as necessary.

Please be thorough and check every drawer, cabinet, hood, refrigerator, freezer, etc. for chemicals. Please print legibly!

You must fill in the **compound name** exactly as it appears on the label, even if you routinely refer to it by a different name. Please include any specifiers that go along with the name, such as numbers, *cis*-, *trans*-, *o*-, *m*-, *p*-, α-, β-, *R*-, *S*-, **D**-, **L**-, (+), (-), etc. Sometimes the same compound will have a different name from different suppliers, but use the name as it appears on each label, whatever it is. Other information such as purity, physical form, etc. are not necessary for the inventory.

Chemicals do not need to be listed in any particular order. (They will be alphabetized later.) If the chemical **formula** is given on the label please include it. If not, we can supply missing formulae.

The **size** column is for the size of the container, not how much is in it. Even if you have a four-liter bottle with only a few milliliters left in it, put 4 L as the size. This is so that we can more readily locate items based of the size of the container.

Please enter the **CAS Number** if it is given on the label. These numbers often appear in brackets, such as [67-64-1]. The number of digits in the first number varies, but the last two are always two and one digit, respectively. As with formulae, we can provide missing CAS numbers if they aren't given.

The **NMHU ID** is on a separate label or tag (or rarely, hand written on the original label) and consists of CI (inorganic), CO (organic) or CS (stain) followed by five digits, such as CO07484. This is our in-house identification number, and should be on every chemical, although sometimes you may find containers without them. Be sure to give the NMHU ID if it is present. If there is none, leave this item blank. If you have more than one container of the same item, you will need to list them separately, so that we have the NMHU ID for each container. This is important for inventory control.

Manufacturer is the company that sold the chemical. Occasionally chemicals have been locally repackaged and the original manufacturer is not known. In these cases put Unknown in this column.

Finally, the **Comments** column is for additional information such as Fridge to indicate a chemical is kept in a refrigerator, or Carcinogen, Toxic, etc. to indicate a particularly

dangerous compound. If you have any questions about how to conduct a chemical inventory, or about the information we require on the form, please do not hesitate to contact David Glass, the Natural Sciences Chemical Safety Officer, at 505-426-2035 or Room: HSCI-236. It will be much easier to conduct the inventory right the first time, rather than having to go back and fill in missing information later.

Pure Chemical Inventory Form

Room No. _____ Name _____Date _____Page No. _____

Compound Name	Formula	Size	CAS Number	NMHU ID	Manufacturer	Comment
Example: Acetone	C_3H_6O	4 L	67-64-1	CO07484	Spectrum	

B. Industrial Chemical Inventory Form Instructions

The following is a template for conducting a chemical inventory of your industrial chemicals. You may use as many sheets as necessary. Please be thorough and check every closet, cabinet, shelf, etc. for chemicals. Please print legibly! If you have any questions about how to conduct a chemical inventory, or about the information we require on the form, please do not hesitate to contact the David Glass, the Natural Sciences Chemical Safety Officer, at 505-426-2035 or Room: HSCI-236 for assistance. It will be much easier to conduct the inventory right the first time, rather than having to go back and fill in missing information later.

- **Room number**, **name** of the inventory taker, **date** of inventory, and **page number** should be filled in on every page.

- **Preparation name** should be exactly as it appears on the label, even if you routinely refer to it by a different name. Please include any specifiers that go along with the name, such as numbers, letters, etc. Sometimes similar preparations will have different names from different suppliers, but use the name as it appears on each label, whatever it is. Chemicals do not need to be listed in any particular order. (They will be alphabetized later.)

- **Size** refers to the size of the container, not how much is in it. You may give this in either English or metric units, or both. Even if you have a gallon bottle with only a few ounces left in it, put 1 gal as the size. This is so that we can more readily locate items based of the size of the container.

- **Ingredients** are the individual chemical compounds making up the preparation. Please list all of them if they are given, including seemingly trivial ones like water.

- **CAS Registry Numbers** for the ingredients are also often given on the label. These numbers sometimes appear in brackets, such as [67-64-1]. The number of digits in the first number varies, but the last two are always two and one digit, respectively. We can provide missing CAS numbers if they aren't given.

- **Manufacturer** is the company that sold the preparation. Occasionally chemicals have been locally repackaged and the original manufacturer is not known. In these cases put Unknown in this column.

- Under **MSDS** mark either yes or no to indicate whether or not a copy of the applicable MSDS sheets is on file in this location.

Industrial Chemical Inventory Form

Room No. _____ Name _____Date _____ Page No. _____

Preparation Name	Size	Ingredients	CAS Numbers	Manufacturer	MSDS
Example: QC31 Neutral Cleaner	1.3 L 44 oz	Water Linear Alcohol Ethoxylate Polyacrylate Emulsion Mixture Sodium Xylene Sulfonate Sodium Ethylenediamine Tetraacetate	7732-18-5 68551-12-2 None 1300-72-7 64-02-8	Ecolab Airkem	Yes

Appendix 2: Work Area Hazard Assessment

Hazard Assessment and Selection of Personal Protective Equipment Form

Date:	Location:
Assessment Conducted By:	
Specific Tasks Performed at this Location:	

I. Overhead Hazards

Hazards to consider include:
- Suspended loads that could fall
- Overhead beams or loads that could be hit against
- Energized wires or equipment that could be hit against
- Employees work at elevated site who could drop objects on others below
- Sharp objects or corners at head level

Hazards Identified:

Head Protection

Hard Hat:	Yes	No
• If yes, type: • Type A (impact and penetration resistance, plus low-voltage electrical insulation) • Type B (impact and penetration resistance, plus high-voltage electrical insulation) • Type C (impact and penetration resistance)		

II. Eye and Face Hazards

Hazards to consider include:
- Chemical splashes
- Dust
- Smoke and fumes
- Welding operations
- Lasers/optical radiation

- Bioaerosols
- Projectiles

Hazards Identified:

Eye/Face Protection

Safety glasses or goggles	Yes	No
Face shield	Yes	No

III. Hand Hazards

Hazards to consider include:
- Chemicals
- Sharp edges, splinters, etc.
- Temperature extremes
- Biological agents
- Exposed electrical wires
- Sharp tools, machine parts, etc.
- Material handling

Hazards Identified:

Hand Protection

Gloves	Yes	No
Chemical resistant Temperature resistant Abrasion resistant Other (Explain)		

IV. Foot Hazards

- Hazards to consider include:
- Heavy materials handled by employees
- Sharp edges or points (puncture risk)
- Exposed electrical wires
- Unusually slippery conditions
- Wet conditions
- Construction/demolition

Hazards Identified:

Foot Protection

Safety shoes	Yes	No
Types: Toe protection Metatarsal protection Puncture resistant Electrical insulation Other (Explain)		

V. Other Identified Safety and/or Health Hazards:

Hazard	Recommended Protection

Certification

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on _____.

_____
(Supervisor or EHS Signature)

Appendix 3: Particularly Hazardous Chemicals List

Codes: CAR= CARCINOGEN **INH**=ACUTELY TOXIC WHEN INHALED **SKIN**=ACUTELY TOXIC WHEN ABSORBED **RT**=PEPRODUCTIVE TOXIN

Ö ?	CHEMICAL	CAS #	HAZARD	PRIOR APPROVAL
	ACENAPHTHENE, 5-NITRO-	602-87-9	CAR	
	ACETAMIDE, N-(4-(5-NITRO-2-FURYL)-2-THIAZOLYL)-	531-82-8	CAR	
	ACETAMIDE, THIO-	62-55-5	CAR	
	ACETIC ACID, CHLORO-	79-11-8	INH	YES
	ACETIC ACID, METHOXY((l-OXO-2-PROPENYL)AMINO)-, METHYL ESTER	77402-03-0	INH	YES
	ACETIC ACID, NITRILOTRI-	139-13-9	CAR	
	ACETONITRILE, HYDROXY-	107-16-4	SKIN	YES
	ACETONITRILE, PHENYL-	140-29-4	INH	YES
	ACETOPHENETIDIDE, p-	62-44-2	CAR	
	ACETYLAMINOFLURENE, 2-	53-96-3	CAR	
	ACROLEIN	107-02-8	INH	YES
	ACRYLAMIDE	79-06-1	CAR	
	ACRYLIC ACID, 2-(DIMETHYLAMINO)ETHYL ESTER	2439-35-2	INH	YES
	ACRYLIC ACID, ETHYL ESTER	140-88-5	CAR	
	ACRYLONITRILE	107-13-1	CAR	
	ALLYLAMINE	107-11-9	SKIN	YES
	ALUMINUM, CHLORODIISOBUTYL-	1779-25-5	INH	YES
	AMINODIPHENYL,4-	92-67-1	CAR	
	AMMONIUM SULFATE [Is this correct? Not so listed in catalogs. Perhaps sulfide?]	7783-20-2	INH	YES
	ANALINE,((5-CHLORO-8-HYDROXY-3-METHYL-l-OXO-7-ISOCHROMANYL)CARBONYL)-3-PHENYL-,	303-47-9	CAR	
	ANILINE, 4,4'-OXYDI-	101-80-4	CAR	
	ANILINE, 4,4'-THIODI-	139-65-1	CAR	
	ANILINE, N,N-DIMETHYL-p-PHENYLAZO-	60-11-7	CAR	

	ANILINE, P-CHLORO	106-47-8	CAR	
	ANISIDINE, 5-METHYL-,o-	120-71-8	CAR	
	ANTHRACENEDIONE, 1,4,5,8-TETRAAMINO-, 9,10-	2475-45-8	CAR	
	ANTHRAQUINONE, 1,8-DIHYDROXY-	117-10-2	CAR	
	ANTHRAQUINONE, 2-METHYL-1-NITRO-	129-15-7	CAR	
	ANTIMONY OXIDE	1309-64-4	CAR	
	ARSENIC	7440-38-2	CAR/RT	
	AZEPIN-2-ONE, HEXAHYDRO-, 2H-	105-60-2	INH	YES
	AZIRINO(2',3'3,4)PYRROLO(1,2-a)INDOLE-4,7-DIONE,CARBAMATE (ESTER)	50-07-7	CAR	
	AZOBENZENE	1103-33-3	CAR	
	BENZ(A)ANTHRACENE	56-55-3	CAR	
	BENZENAMINE, 4-((4-AMINOPHENYL)(4-IMINO-2,5-CYCLOHEXADIEN-1-YLIDENE)METHYL),MONOHYDROCHLORIDE	569-61-9	CAR	YES
	BENZENE	71-43-2	CAR/RT	
	BENZENE, (DICHLOROMETHYL)-	98-87-3	INH	YES
	BENZENE, 1,3-BIS(l-METHYLETHYL)-2-ISOCYANATO-	28178-42-9	INH	YES
	BENZENE, 2,4-DIISOCYANATO-1-METHYL-	584-84-9	INH	YES
	BENZENE, 4-ALLYL-1,2-(METHYLENEDIOXY)-	94-59-7	CAR	
	BENZENE,HEXACHLORO-	118-74-1	CAR	
	BENZENETHIOL	108-98-5	INH	YES
	BENZIDINE	92-87-5	CAR	
	BENZIDINE, 3,3'-DICHLORO-	91-94-1	CAR	
	BENZIDINE, 3,3'-DIMETHOXY-, DIHYDROCHLORIDE	20325-40-0	CAR	
	BERYLLIUM SULFATE, TETRAHYDRATE (114)	7787-56-6	CAR	
	BIPHENYLOL, 2-	90-43-7	CAR	
	BLEOMYCIN	11116-32-8	CAR	
	BLEOMYCIN, SULFATE	9041-93-4	CAR	
	BORON	7440-42-8	RT	

	BORON TRICHLORIDE	10294-34-5	INH	YES
	BROMIC ACID, POTASSIUM SALT	7758-01-2	CAR	
	BROMINE	7726-95-6	CAR	
	BUTADIENE, 1,3-	106-99-0	INH	YES
	BUTYL-N-NITROSO-1-BUTAMINE, N-	924-16-3	CAR/RT	
	BUTANE, (+-)-1,2,3,4-DIEPOXY-	298-18-0	CAR/INH	YES
	BUTANE, 1,2-EPOXY-	106-88-7	CAR	
	BUTANEDIOL, DIMETHANESULFONATE, 1,4-	55-98-1	CAR	
	BUTEN-2-ONE, 3-	78-94-4	INH	YES
	BUTENE, 1,4-DICHLORO-, (E)-,2-	110-57-6	INH	YES
	BUTENE, 2,3-DICHLOROHEXAFLUORO-, 2-	303-04-8	INH	YES
	BUTYRIC ACID	305-03-3	CAR	
	CADMIUM	7440-43-9	INH/RT	YES
	CADMIUM CHLORIDE	10108-64-2	CAR	
	CADMIUM OXIDE	1306-19-0	INH	YES
	CARBAMIC ACID, METHYL-, 2,3-DIHYDRO-2,2-DIMETHYL-7-BENZOFURANYLESTER	1563-66-2	INH	YES
	CARBAMOYL CHLORIDE, DIMETHYL-	79-44-7	CAR	
	CARBON TETRACHLORIDE	56-23-5	CAR/RT	
	CARBONOCHLORIDIC ACID, METHYL ESTER	79-22-1	INH	YES
	CARBOXYLIC ACID,3-beta,20-alpha-YOHIMBAN-16-beta-	50-55-5	CAR	
	CARRAGEENAN,DEGRADED	9000-07-1	CAR	
	CHLOROFORM	67-66-3	CAR	
	CHLOROMETHYL, METHYL ETHER	107-30-2	CAR/INH	YES
	CHLOROPRENE	126-99-8	RT/SKIN	YES
	CHOROETHYLENE (VINYL CHLORIDE)	75-01-4	CAR/RT	
	CHROMIC ACID, DIPOTASSIUM SALT	7789-00-6	CAR	
	CHROMIC SULFATE	10101-53-8	INH	YES
	CHROMIUM(VI) OXIDE (13)	1333-82-0	CAR	

	CHRYSENE, 5-METHYL-	3697-24-3	CAR	
	CHRYSENE, 6-NITRO-	7496-02-8	CAR	
	CINNAMIC ACID, 3,4-DIHYDROXY-	331-39-5	CAR	
	COBALT(2+) OXIDE	1307-96-6	CAR	
	COBALT(II) CHLORIDE	7646-79-9	CAR	
	COBALT, Dl-mu-CARBONYLHEXACARBONYLDI- , (Co-Co)	10210-68-1	INH	YES
	COUMARIN, 3-(alpha-ACETONYLBENZYL)-4-HYDROXY-	81-81-2	INH	YES
	CYANOGEN BROMIDE	506-68-3	INH	YES
	CYCLOHEXANE, 1,2,3,4,5,6-HEXACHLORO-, GAMMA ISOMER	58-89-9	SKIN	YES
	CYCLOHEXANE, NITRO-	1122-60-7	INH	YES
	CYCLOHEXENE, 4-VINYL-1-	100-40-3	CAR	
	CYCLOPENTA©?FURO(3',2'4,5)FURO(2,3-h)(l)BENZOPYRAN-1,11-DIONE	1162-65-8	CAR	
	CYCLOPENTADIENE, 1,2,3,4,5,5-HEXACHLORO-, 1,3-	77-47-4	INH	YES
	CYCLOSPORIN A	59865-13-3	CAR	
	DECABORANE(14)	17702-41-9	INH	YES
	DECYL ALCOHOL	112-30-1	INH	YES
	DIBENZ(a,h)ANTHRACENE	53-70-3	CAR	
	DIBENZO-p-DIOXIN, 2,3,7,8-TETRACHLORO-	1746-01-6	CAR	
	DIBROMO-3-CHLOROPROPANE,1,2-	96-12-8	CAR/RT	
	DIETHYLAMINE, HYDROCHLORIDE	55-86-7	CAR	
	DIMETHYLAMINE, N-NITROSO-	62-75-9	CAR/INH	YES
	DIMETHYLAMINOAZOBENZENE, 4-	60-11-7	CAR	
	DINITROGEN TETROXIDE	10544-72-6	INH	YES
	DIOXANE, p-	123-91-1	CAR	
	DIOXIN, 2,4,5-T- (TCDD)	1746-01-6	RT	
	DIPROPIONATE, 9-'CHLORO-1 6-beta-METHYL-11 -beta, 17,21-TRIHYDROXY-, 17,21-	5534-09-8	INH	YES
	DIPROPYLAMINE, N-NITROSO-	621-64-7	CAR	

	DISULFIDE, DIMETHYL	624-92-0	INH	YES
	ETHANE, 1,1,1-TRICHLORO-2,2-BIS(p-CHLOROPHENYL)-	50-29-3	CAR/RT	
	ETHANE, 1,1,1-TRICHLORO-2,2-BIS(p-METHOXYPHENYL)-	72-43-5	CAR	
	ETHANE, 1,1,2,2-TETRACHLORO-	79-34-5	CAR	
	ETHANE, 1,1,2-TRICHLORO-	79-00-5	CAR	
	ETHANE, 1,2-DIBROMO-	106-93-4	CAR/RT	
	ETHANE, 1,2-DICHLORO-	107-06-2	CAR	
	ETHANE,HEXACHLORO-	67-72-1	CAR	
	ETHANE, IODO-	75-03-6	INH	YES
	ETHANEDIAMINE, 1,2-	107-15-3	INH	YES
	ETHANOL, 2-CHLORO-	107-07-3	INH	YES
	ETHANOL, 2-FLUORO-	371-62-0	INH	YES
	ETHANOL, N-NITROSOIMINODI-	1116-54-7	CAR	
	ETHER, BIS(2-CHLOROETHYL)	111-44-4	CAR	
	ETHER, METHYL CHLOROMETHYL	107-30-2	CAR	
	ETHYL ISOCYANATE	109-90-0	INH	YES
	ETHYLAMINE,N-METHYL-N-NITROSO-	10595-95-6	CAR	
	ETHYLENE OXIDE	75-21-8	CAR/RT	
	ETHYLENE, 1,1-DICHLORO-2,2-BIS(p-CHLOROPHENYL)-	72-55-9	CAR	
	ETHYLENE, BROMO-	593-60-2	CAR	
	ETHYLENE, TETRACHLORO-	127-18-4	CAR	
	ETHYLENE, TRICHLORO-	79-01-6	CAR/RT	
	ETHYLENEIMINE	151-56-4	CAR	
	FLUORANTHENE, 3-NITRO-	892-21-7	CAR	
	FORMALDEHYDE	50-00-0	INH/CAR/RT	YES ?!
	FORMIC ACID, CHLORO-, ALLYL ESTER	2937-50-0	INH	YES
	FORMIC ACID, CHLORO-, ETHYL ESTER	541-41-3	INH	YES

	FURALDEHYDE, 5-NITRO-, SEMICARBAZONE, 2-	59-87-0	CAR	
	GLUCOPYRANOSE, 2-DEOXY-2-(3-METHYL-3-NITROSOUREIDO)-, D-	18883-66-4	CAR	
	GLUCOPYRANOSIDE, (METHYL-ONN-AZOXY)METHYL-, beta-D-	14901-08-7	CAR	
	GLUTAMIC ACID	59-05-2	CAR	
	GOLD, (1-THIO-D-GLUCOPYRANOSATO)-	12192-57-3	CAR	
	GUANIDINE, 1-METHYL-3-NITRO-1-NITROSO-	70-25-7	CAR	
	HYDANTOIN, 1-((5-NITROFURFURYLIDENE)AMINO)-	67-20-9	CAR	
	HYDANTOIN, 5,5-DIPHENYL-	57-41-0	CAR	
	HYDRAZINE	302-01-2	CAR	
	HYDRAZINE, 1,1-DIMETHYL-	57-14-7	CAR	
	HYDRAZINE, METHYL-	60-34-4	INH	YES
	HYDROGEN PEROXIDE, 30%	7722-84-1	CAR	
	HYDROQUINONE	123-31-9	CAR	
	IMFERON	9004-66-4	CAR	
	IMIDAZOLE-4-CARBOXAMIDE, 5-(3,3-DIMETHYL-1-TRIAZENO)-	4342-03-4	CAR	
	IMIDAZOLIDINETHIONE, 2-	96-45-7	CAR/RT	
	IMIDAZOLIDINONE, 1-((5-NITROFURFURYLIDENE)AMINO)-, 2-	555-84-0	CAR	
	IOSYANATE, T-BUTYL	7188-38-7	INH	YES
	IRON PENTACARBONYL	13463-40-6	INH	YES
	ISOCYANATE, N-BUTYL	111-36-4	INH	YES
	ISOCYANIC ACID, 3,4-DICHLOROPHENYL ESTER	102-36-3	INH	YES
	ISOCYANIC ACID, METHYL ESTER	624-83-9	INH	YES
	ISOCYANIC ACID, METHYLENE(3,5,5-TRIMETHYL-3,1-CYCLOHEXYLENE)ESTER	4098-71-9	INH	YES
	ISOCYANIC ACID, METHYLENEDI-4,1-CYCLOHEXYLENE ESTER	5124-30-1	INH	YES
	ISOCYANIC ACID, METHYLENEDI-P-PHENYLENE ESTER	101-68-8	INH	YES

	ISONICOTINIC ACID HYDRAZIDE	54-85-3	CAR	
	ISOPROPYL ETHANE FLUOROPHOSPHONATE	1943-83-5	INH	YES
	LACTONITRILE	78-97-7	SKIN	YES
	LACTONITRILE, 2-METHYL-	75-86-5	SKIN	YES
	LEAD	7439-92-1	RT	
	MALEIMIDE, N,N'-(m-PHENYLENE)DI-	3006-93-7	CAR	
	MANGANESE	7439-96-5	RT	
	MANGANESE, (ETHYLENEBIS(DITHIOCARBAMATO))-	12427-38-2	CAR	
	MANGANESE, TRICARBONYL METHYLCYCLOPENTADIENYL	12108-13-3	INH	YES
	MELAMINE	108-78-1	CAR	
	MENTHA-6,8-DIEN-2-ONE, (S)-(+)-, p-	2244-16-8	SKIN	YES
	MERCURY	7439-97-6	RT	
	MERCURY, CHLOROMETHYL-	115-09-3	CAR	
	METHANE, BROMO-	74-83-9	CAR	
	METHANE, BROMODICHLORO-	75-27-4	CAR	
	METHANE, CHLORODIBROMO-	124-48-1	CAR	
	METHANE,CHLOROFLUORO-	593-70-4	CAR	
	METHANE, DICHLORO-	75-09-2	CAR	
	METHANE, TETRANITRO-	509-14-8	CAR/INH	YES
	METHANE, TRIBROMO-	75-25-2	CAR	
	METHANE, TRICHLORONITRO-	76-06-2	CAR	
	METHANESULFENYL CHLORIDE, TRICHLORO-	594-42-3	INH	YES
	METHANESULFONIC ACID, ETHYL ESTER	62-50-0	CAR	
	METHANESULFONIC ACID, METHYL ESTER	66-27-3	CAR	
	METHANOINDAN, 1,2,4,5,6,7,8,8-OCTACHLORO-3a,4,7,7a-TETRAHYDRO-, 4,7-	57-74-9	CAR	
	METHANOL, (METHYL-ONN-AZOXY)-, ACETATE (ester)	592-62-1	CAR	
	METHYL ISOTHIOCYANATE	556-61-6	INH/SKIN	YES
	METHYL SULFIDE	75-18-3	INH	YES

	MONOCROTALINE	315-22-0	CAR	
	MORPHOLINE	110-91-8	CAR	
	MORPHOLINE, N-NITROSO-	59-89-2	CAR	
	N-PROPYL ISOCYANATE	110-78-1	INH	YES
	NAPHTHALENEDIAMINE, 1,5-	2243-62-1	CAR	
	NAPHTHALENEDISULFONIC ACID, 1,3-	6459-94-5	CAR	
	NAPHTHALENEDISULFONIC ACID, 2,7-	2429-74-5	CAR	
	NAPHTHALENEDISULFONIC ACID, 3-HYDROXY-4-((4-SULFO-1-NAPHTHYL)AZO)-, TRISODIUM SALT, 2,7-	915-67-3	CAR	
	NAPHTHALENEDISULFONIC ACID, 3-HYDROXY-4-(2,4-XYLYLAZO)-DISODIUM SALT, 2,7-	3761-53-3	CAR	
	NAPHTHOL, 1-(2,4-XYLYLAZO)-, 2-	3118-97-6	CAR	
	NAPHTHOL, 1-(o-TOLYLAZO)-, 2-	2646-17-5	CAR	
	NAPHTHOL, 1-(PHENYLAZO)-, 2-	842-07-9	CAR	
	NAPHTHYLAMINE, 2-	91-59-8	CAR	
	.NAPHTHYLAMINE, alpha-	134-32-7	CAR	
	NAPHTHYLAMINE, beta-	91-59-8	CAR	
	NAPHTHYLAMINE, N-PHENYL-, 2-	135-88-6	CAR	
	NAPHTHYLAMINE,L-	134-32-7	CAR	
	NICKEL	7440-02-0	CAR	
	NICOTINE	54-11-5	SKIN	YES
	NICOTINE, SULFATE (21)	65-30-5	INH	YES
	NITRIC ACID	7697-37-2	INH	YES ?!
	NITRIC OXIDE	10102-43-9	INH	YES
	NITROBIPHENYL, 4-	92-93-3	CAR	
	NITROGEN DIOXIDE	10102-44-0	INH	YES
	NITROSODIMETHYLAMINE, N-	62-75-9	CAR	
	NITROUS ACID, SODIUM SALT	7632-00-0	INH	YES ?!
	NORBORNENE-2,3-DICARBOXYLIC ACID, 1,4,5,6,7,7-HEXACHLORO-,5-	115-28-6	CAR	

	OXABICYCLO(4.1.0)HEPTANE, 3-(EPOXYETHYL)-, 7-	106-87-6	CAR	
	OXETANONE, 2-	57-57-8	CAR/INH	YES
	PEROXYACETIC ACID	79-21-0	INH	YES
	PHENOL	108-95-2	CAR/INH	YES
	PHENOL, (1,1-DIMETHYLETHYL)-4-METHOXY-	25013-16-5	CAR	
	PHENOL, 2,2'-METHYLENEBIS(3,4,6-TRICHLORO-	70-30-4	INH	YES
	PHENOL, 4,4'-ISOPROPYLIDENEDI-	80-05-7	INH	YES
	PHENOL, 4-AMINO-2-NITRO-	119-34-6	CAR	
	PHENOL, P-CHLORO-	106-48-9	INH	YES
	PHENOL, PENTACHLORO-	87-86-5	CAR/INH/ SKIN/EYES	
	PHENOTHIAZINE, 2-CHLORO-10-(3-(DIMETHYLAMINO)PROPYL)-,MONOHYDROCHLORIDE	69-09-0	INH	YES
	PHENYLENEDIAMINE, 4-CHLORO-, m	5131-60-2	CAR	
	PHENYLENEDIAMINE, 4-CHLORO-,o-	95-83-0	CAR	
	PHOSPHINE, PHENYL-	638-21-1	INH	YES
	PHOSPHONIC ACID, (2,2,2-TRICHLORO-1-HYDROXYETHYL)-DIMETHYL ESTER	52-68-6	CAR	
	PHOSPHONIC ACID, (2-CHLOROETHYL)-	16672-87-0	INH	YES
	PHOSPHONIC ACID, DIMETHYL ESTER	868-85-9	CAR	
	PHOSPHONIC DICHLORIDE, METHYL-	676-97-1	INH	YES
	PHOSPHONIUM, TETRABUTYL-, BROMIDE	3115-68-2	INH	YES
	PHOSPHONIUM, TETRABUTYL-, CHLORIDE	2304-30-5	INH	YES
	PHOSPHORANE, PENTACHLORO-	10026-13-8	INH	YES
	PHOSPHORIC ACID	7664-38-2	INH	YES ?!
	PHOSPHORIC TRIAMIDE, HEXAMETHYL-	680-31-9	CAR	
	PHOSPHOROCHLORIDIC ACID, DIETHYL ESTER	814-49-3	SKIN	YES
	PHOSPHOROCHLORIDOTHIOIC ACID, O,O-DIETHYL ESTER	2524-04-1	INH	YES
	PHOSPHORODICHLORIDOTHIOIC ACID, O-ETHYL ESTER	1498-64-2	INH	YES
	PHOSPHOROFLUORIDIC ACID, BIS(I-METHYLETHYL)	55-91-4	INH	YES

	ESTER			
	PHOSPHORUS CHLORIDE	7719-12-2	INH	YES
	PHOSPHORUS OXIDE	1314-56-3	INH	YES
	PHOSPHORYL CHLORIDE	10025-87-3	INH	YES
	PHTHALIC ACID, BENZYL BUTYL ESTER	85-68-7	CAR	
	PICOLINIC ACID, 4-AMINO-3,5,6-TRICHLORO-	1918-02-1	CAR	
	PIPERIDINE, 1-NITROSO-	100-75-4	CAR	
	PLATINUM(II), DIAMMINEDICHLORO-, cis-	15663-27-1	CAR	
	PLUMBANE, TETRAETHYL-	78-00-2	CAR	
	POLYCHLORINATED BIPHENYLS	1336-36-3	CAR	
	POLYVINYL ALCOHOL	9002-89-5	CAR	
	PROPANE, 1,2-DICHLORO-	78-87-5	CAR	
	PROPANE, 1,2-EPOXY-	75-56-9	CAR	
	PROPANE, 1,2-EPOXY-3-PHENOXY-	122-60-1	CAR	
	PROPANE, 1-CHLORO-2,3-EPOXY-	106-89-8	CAR	
	PROPANE, 2-NITRO-	79-46-9	CAR	
	PROPANOL, 2,3-EPOXY-1-	556-52-5	CAR	
	PROPANONE, 1,1,3-TRICHLORO-, 2-	921-03-9	INH	YES
	PROPANONE, 1,3-DICHLORO-, 2-	534-07-6	INH	YES
	PROPANONE, 1-CHLORO-, 2-	78-95-5	INH	YES
	PROPENE, 1,3-DICHLORO-	542-75-6	CAR	
	PROPENE, 1-CHLORO-2-METHYL-	513-37-1	CAR	
	PROPENE, 3-CHLORO-2-METHYL-	563-47-3	CAR	
	PROPENE-1,1-DIOL, 2-METHYL-, DIACETATE, 2-	10476-95-6	SKIN	YES
	PROPYN-1-OL, 2-	107-19-7	SKIN	YES
	PURINE, 6-((l-METHYL-4-NITROIMIDAZOL-5-YL)THIO)-	446-86-6	CAR	
	PYRAZ0LIDINEDIONE, 4-BUTYL-1,2-DIPHENYL-, 3,5-	50-33-9	CAR	
	PYRENE	129-00-0	INH	YES

	PYRENE, 1,3-DINITRO-	75321-20-9	CAR	
	PYRENE, 1,6-DINITRO-	42397-64-8	CAR	
	PYRENE, 1-NITRO-	5522-43-0	CAR	
	PYRIDINE, 2,6-DIAMINO-3-(PHENYLAZO)-, MONOHYDROCHLORIDE	136-40-3	CAR	
	PYROCATECHOL	120-80-9	CAR	
	PYRROLE-2,5-DIONE, 1,1'-(4-METHYL-1,3-PHENYLENE)BIS-, 1H-	6422-83-9	INH	YES
	PYRROLIDINE, 1-NITROSO-	930-55-2	CAR	
	PYRROLIDINONE, 1-CYCLOHEXYL-, 2-	6837-24-7	INH	YES
	QUINOLINE, 2-AMINO-3-METHYL-3H-IMIDAZO(4,5-f)	76180-96-6	CAR	
	QUINOLINOL, 8-	148-24-3	CAR	
	RESORCINOL, DIGLYCIDYL-	101-90-6	CAR	
	SELENIC ACID, DISODIUM SALT	13410-01-0	CAR	
	SERINE, DIAZOACETATE (ESTER)	115-02-6	CAR	
	SILANETRIAMINE, N,N,N',N',N",N"-HEXAMETHYL-	15112-89-7	INH	YES
	SILICA, AMORPHOUS FUMED	112945-52-5	CAR	
	SILICA, CRYSTALLINE – QUARTZ	14808-60-7	CAR	
	SODIUM AZIDE	26628-22-8	SKIN	YES
	SODIUM CHLORITE	7758-19-2	CAR	
	STILBENEDIOL, alpha,alpha'-DIETHYL-, 4,4-	56-53-1	CAR	
	STYRENE	100-42-5	CAR/RT	
	SULFONE, METHYL VINYL	3680-02-2	SKIN	YES
	SULFURIC ACID, DIETHYL ESTER	64-67-5	CAR	
	SULFURIC ACID, DIMETHYL ESTER	77-78-1	INH	YES
	SULFURYL CHLORIDE	7791-25-5	INH	YES
	TANNIC ACID	1401-55-4	CAR	
	TECRAETHYL DITHIOPYROPHOSPHATE	3689-24-5	INH	YES
	TETRETHYL PYROPHOSPHATE	107-49-3	INH	YES
	THIAZOLE, 2-AMINO-5-NITRO-	121-66-4	CAR	

	THIOPHENE, 2,3,4,5-TETRACHLORO-	6012-97-1	INH	YES
	THIOPHOSPHORYL CHLORIDE	3982-91-0	INH	YES
	THIOPYROPHOSPHORIC ACID, TETRAETHYL ESTER	3689-24-5	INH	YES
	TITANIUM CHLORIDE (TiCl4)	7550-45-0	INH	YES
	TOLUENE, alpha,alpha,alpha-TRICHLORO-	98-07-7	INH	YES
	TOLUENE, alpha-CHLORO-	100-44-7	INH	YES
	TOLUENE-2,4-DIAMINE	95-80-7	INH	YES
	TOLUIDINE, 4-(o-TOLYLAZO)-, o-	97-56-3	CAR	
	TOLUIDINE, 5-NITRO-, o-	99-55-8	CAR	
	TOXAPHENE	8001-35-2	CAR	
	TRIAZIN-2(IH)-ONE, 4-AMINO-1-beta-D-RIBOFURANOSYL-, s-	320-67-2	CAR	
	TRIAZINE, 2,4,6-TRIFLUORO-,s-	675-14-9	INH	YES
	TRIAZINE, 2,4,6-TRIS(ALLYLOXY)-, s-	101-37-1	INH	YES
	TRIAZINE, 2-CHLORO-4-ETHYLAMINO-6-ISOPROPYLAMINO-, s-	1912-24-9	CAR	
	TRIAZOLE, 3-AMINO-, s-	61-82-5	CAR	
	TRICHLOROACETYL CHLORIDE	76-02-8	CAR	
	TRICHOTHEC-9-ENE-3-alpha,4-beta,8-alpha,15-TETROL,12,13-EPOXY-	21259-20-1	INH	YES
	TRIETHYLAMINE, 2,2',2"-TRICHLORO-, HYDROCHLORIDE	817-09-4	CAR	
	UCON 50-HB-5100	9038-95-3	INH	YES
	UNDECANOIC ACID, 11 –AMINO-	2432-99-7	CAR	
	URACIL, 5-(BIS(2-CHLOROETHYL)AMINO)-	66-75-1	CAR	
	URACIL, 5-FLUORO-	51-21-8	CAR	
	URACIL, 6-PROPYL-2-THIO-	51-52-5	CAR	
	UREA, 1,1-DIMETHYL-3-(alpha,alpha,alpha-TRIFLUORO-m-TOLYL)-	2164-17-2	CAR	
	UREA, 1-(2-CHLOROETHYL)-3-(4-METHYLCYCLOHEXYL)-l-NITROSO-	13909-09-6	CAR	
	UREA, 1-(2-CHLOROETHYL)-3-CYCLOHEXYL-1-NITROSO-	13010-47-4	CAR	

	UREA, l-ETHYL-1-NITROSO-	759-73-9	CAR	
	UREA, 2-THIO-	62-56-6	CAR	
	UREA, 3-(p-CHLOROPHENYL)-1,1-DIMETHYL-	150-68-5	CAR	
	UREA, N-METHYL-N-NITROSO-	684-93-5	CAR	
	VALINOMYCIN	2001-95-8	SKIN	YES
	XANTHEN-7-ONE, 7H-FURO(3',2'4,5)FURO(2,3-c)	10048-13-2	CAR	
	XYLIDINE, 2,6	87-62-7	CAR	
	ZINC, BIS(DIMETHYLDITHIOCARBAMATO)-	137-30-4	CAR/INH	YES

Criteria used to develop the PHC List

A chemical is considered to be a carcinogen if:

- it has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen or:
- it is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens* by the National Toxicology Program (NTP) or:
- it is regulated by OSHA as a carcinogen

A chemical is considered to be acutely toxic by inhalation if it has a median lethal concentrated (LC50) in air of 200 parts per million by volume or less of gas or vapor or two milligrams per liter when administered by continuous inhalation for one hour to albino rats weighing between 200 and 300 grams.

A chemical is considered to be acutely toxic when absorbed through the skin if it has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours with bare skin of albino rabbits weighing between two and three kilograms each.

A chemical is considered to be a reproductive toxin if it appears on the Florida State University Reproductive Toxin List (1995).

Note: If the literature indicates that a chemical which your are working with should be considered a PHC, but is not included on this PHC list, contact the EHS. This list is not all inclusive. It is a partial list of PHCs that ESH believes likely to be used in NMHU research laboratories. ?! Some of these are extremely unlikely to be used! Who decided which chemicals should require prior approval?

Appendix 4: Health Hazard Definitions

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g., flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees such as shortness of breath, which is a non-measurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data do not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms “acute” and “chronic” are used to delineate between effects on the basis of severity or duration. “Acute” effects usually occur rapidly as a result of short-term exposures and are of short duration. “Chronic” effects generally occur as a result of long-term exposure and are of long duration.

The acute effects, such as irritation, corrosivity, sensitization and lethal dose, referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1988). Although these are important health effects, they do not adequately cover the considerable range of acute effects which may occur as a result of occupational exposure, such as narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity and mutagenicity. These effects are obviously a concern in the workplace, but again do not adequately cover the area of chronic effects, excluding blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy, for example.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and to be protected from them.

For purposes of this section, any chemicals which meet any of the following definitions, as determined by the criteria set forth in (see Section 3.1.b), are health hazards.

However, this is not intended to be an exclusive categorization scheme. If there are available scientific data that involve other animal species or test methods, it must also be evaluated to determine the applicability of the HCS.

1. Carcinogen

A chemical is considered to be a carcinogen if:

a. It has been evaluated by the International Agency for Research on Cancer (IARC) and is found to be a carcinogen or potential carcinogen; or
b. It is listed as a carcinogen or potential carcinogen in the latest edition of the *Annual Report on Carcinogens* published by the National Toxicology Program (NTP); or
c. It is regulated by OSHA as a carcinogen.

2. Corrosive

A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Attachment A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four (4) hours. This term shall not refer to action on inanimate surfaces.

3. Highly Toxic

A chemical is considered to be highly toxic if it falls within any of the following categories:

a. A chemical that has a median lethal dose (LD(50)) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

b. A chemical that has a median lethal dose (LD(50)) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two (2) and three (3)kilograms each.

c. A chemical that has a median lethal concentration (LC(50)) in air of 200 parts per million by volume or less of gas or vapor, or two (2) milligrams per liter or less of mist, fume or dust when administered by continuous inhalation for one (1) hour (or less if death occurs within one (1) hour) to albino rats weighing between 200 and 300 grams each.

4. Irritant

A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact is considered an irritant. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four (4) hours exposure or by other appropriate techniques, it results in

an empirical score of five (5) or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. Sensitizer

A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical is considered a sensitizer.

6. Toxic

A chemical is considered toxic if it falls within any of the following categories:

a. A chemical that has a median lethal dose (LD(50)) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

b. A chemical that has a median lethal dose (LD(50)) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two (2) and three (3) kilograms each.

c. A chemical that has a median lethal concentration (LC(50)) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two (2) milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for one (1) hour (or less if death occurs within one (1) hour) to albino rats weighing between 200 and 300 grams each.

7. Target Organ Effects

The following is a target organ categorization of effects which may occur, including examples of signs, symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. *Hepatotoxins:* Chemicals which produce liver damage *Signs and Symptoms:* Jaundice; liver enlargement *Chemicals:* Carbon tetrachloride; nitrosamines

b. *Nephrotoxins:* Chemicals which produce kidney damage *Signs and Symptoms:* Edema; proteinuria *Chemicals:* Halogenated hydrocarbons; uranium

c. *Neurotoxins:* Chemicals which produce primary toxic effects on the nervous system *Signs and Symptoms:* Narcosis; behavioral changes; decrease in motor functions *Chemicals:* Mercury; carbon disulfide

d. *Agents which act on the blood or hematopoietic system:* Chemicals which decrease hemoglobin function; deprive the body tissues of oxygen *Signs and Symptoms:* Cyanosis; loss of consciousness *Chemicals:* Carbon monoxide; cyanides

e. *Agents which damage the lung:* Chemicals which irritate or damage pulmonary tissue *Signs and Symptoms:* Cough; tightness in chest; shortness of breath *Chemicals:* Silica; asbestos

f. *Reproductive Toxins:* Chemicals which affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis) *Signs and Symptoms:* Birth defects; sterility *Chemicals:* Lead; DBCP

g. *Cutaneous Hazards:* Chemicals which affect the dermal layer of the body *Signs and Symptoms:* Defatting of the skin; rashes; irritation *Chemicals:* Ketones; chlorinated compounds

h. *Eye Hazards:* Chemicals which affect the eye or visual capacity *Signs and Symptoms:* Conjunctivitis; corneal damage *Chemicals:* Organic solvents; acids

Hazard assessment is a process that relies heavily on the professional judgment of the assessor, particularly in the area of chronic hazards. The performance-orientation of the **hazard determination** does not diminish the duty of the chemical manufacturer, importer or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. Carcinogenicity: As determined by the National Toxicology Program and the International Agency for Research on Cancer and OSHA. In addition, all available scientific data on carcinogenicity must be evaluated in accordance with the provisions of the university.

2. Human data: Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. Animal data: Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results.

4. Adequacy and reporting of data: The results of any studies, that are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any Material Safety Data Sheet (MSDS). In vitro studies alone generally do not form the basis for a definitive finding of hazard under the HCS since they have a positive or negative result rather than a statistically significant finding.

   The chemical manufacturer, importer or employer may also report the results of other scientifically valid studies that tend to refute the findings of hazard.

Appendix 5: Guidelines for Choosing Personal Protective Equipment

1. Description and Use of Eye/Face Protectors

a. Safety Glasses. Protective eyeglasses are made with safety frames, tempered glass or plastic lenses, temples and side shields which provide eye protection from moderate impact and particles encountered in job tasks such as carpentry, woodworking, grinding, scaling, etc. Safety glasses are also available in prescription form for those persons who need corrective lenses.

b. Single Lens Goggles. Vinyl framed goggles of soft pliable body design provide adequate eye protection from many hazards. These goggles are available with clear or tinted lenses, perforated, port vented, or non-vented frames. Single lens goggles provide similar protection to spectacles and may be worn in combination with spectacles or corrective lenses to insure protection along with proper vision.

c. Welders/Chippers Goggles. These goggles are available in rigid and soft frames to accommodate single or two eyepiece lenses. Welders goggles provide protection from sparking, scaling, or splashing metals and harmful light rays. Lenses are impact resistant and are available in graduated shades of filtration. Chippers/Grinders goggles provide eye protection from flying particles. The dual protective eye cups house impact resistant clear lenses with individual cover plates.

d. Face Shields. These normally consist of an adjustable headgear and face shield of tinted/transparent acetate or polycarbonate materials, or wire screen. Face shields are available in various sizes, tensile strength, impact/heat resistance and light ray filtering capacity. Face shields will be used in operations when the entire face needs protection and should be worn to protect eyes and face against flying particles, metal sparks, and chemical/biological splash.

e. Welding Shields. These shield assemblies consist of vulcanized fiber or glass fiber body, a ratchet/button type adjustable headgear or cap attachment and a filter and cover plate holder. These shields will be provided to protect workers' eyes and face from infrared or radiant light burns, flying sparks, metal spatter and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electric arc welding and oxyacetylene welding and cutting operations.

2. Head Protection

Head injuries are caused by falling or flying objects, or by bumping the head against a fixed object. Head protectors, in the form or protective hats, must resist penetration and absorb the shock of a blow. The shell of the protective hat is hard enough to resist the blow and the headband and crown straps keep the shell away from the wearer's skull. Protective hats can also protect against electrical shock.

Eye and Face Protection Selection Chart		
Source	**Assessment of Hazard**	**Protection**
IMPACT - Chipping, grinding, machining, drilling, chiseling, riveting, sanding, etc.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shields. For severe exposure, use face shield over primary eye protection.
CHEMICALS - Acid and chemicals handling	Splash Irritating mists	Goggles, eyecup and cover types. For severe exposure, use face shield over primary eye protection Special-purpose goggles
DUST - Woodworking, buffing, general dusty conditions	Nuisance dust	Goggles, eyecup and cover types.
LIGHT and/or RADIATION Welding - electric arc Welding - gas Cutting, torch brazing, torch soldering Glare	 Optical radiation Optical radiation Optical radiation Poor vision	 Welding helmets or welding shields. Typical shades: 10-14 Welding goggles or welding face shield. Typical shades: gas welding 4-8, cutting 3-6, brazing 3-4 Spectacles or welding face shield. Typical shades: 1.5-3 Spectacles with shaded or special-purpose lenses, as suitable.

Protective hats are made in the following types and classes:

- Type I - Helmets with a full brim.
- Type 2 - Brimless helmets with a peak extending forward from the crown.

- Class A - General service, limited voltage. Intended for protection against impact hazards. Used in mining, construction, and manufacturing.
- Class B - Utility service, high voltage. Used by electrical workers.
- Class C - Special service, no voltage protection. Designed for lightweight comfort and impact protection. Used in certain construction, manufacturing, refineries, and where there is a possibility of bumping the head against a fixed object.

3. Foot Protection

There are many types and styles of protective footwear and it's important to realize that a particular job may require additional protection other than listed here. Footwear that meets established safety standards will have an American National Standards Institute (ANSI) label inside each shoe.

a. Steel-Reinforced Safety Shoes. These shoes are designed to protect feet from common machinery hazards such as falling or rolling objects, cuts, and punctures. The entire toe box and insole are reinforced with steel, and the instep is protected by steel, aluminum, or plastic materials. Safety shoes are also designed to insulate against temperature extremes and may be equipped with special soles to guard against slip, chemicals, and/or electrical hazards.

b. Safety Boots. Safety boots offer more protection when splash or spark hazards (chemicals, molten materials) are present:
   - When working with corrosives, caustics, cutting oils, and petroleum products, neoprene or nitrile boots are often required to prevent penetration.
   - Foundry or "Gaiter" style boots feature quick-release fasteners or elasticized insets to allow speedy removal should any hazardous substances get into the boot itself.
   - When working with electricity, special electrical hazard boots are available and are designed with no conductive materials other than the steel toe (which is properly insulated).

4. Hand Protection

Skin contact is a potential source of exposure to toxic materials; it is important that the proper steps be taken to prevent such contact. Most accidents involving hands and arms can be classified under four main hazard categories: chemicals, abrasions, cutting, and heat. There are gloves available that can protect workers from any of these individual hazards or any combination thereof.

- Gloves should be replaced periodically, depending on frequency of use and permeability to the substance(s) handled. Gloves overtly contaminated should be rinsed and then carefully removed after use.

- Gloves should also be worn whenever it is necessary to handle rough or sharp-edged objects, and very hot or very cold materials. The type of glove

materials to be used in these situations include leather, welder's gloves, aluminum-backed gloves, and other types of insulated glove materials.

- Careful attention must be given to protecting your hands when working with tools and machinery. Power tools and machinery must have guards installed or incorporated into their design that prevent the hands from contacting the point of operation, power train, or other moving parts. To protect hands from injury due to contact with moving parts, it is important to:

    a. Ensure that guards are always in place and used;
    b. Always lock-out machines or tools and disconnect the power before making repairs;
    c. Treat a machine without a guard as inoperative; and
    d. Do not wear gloves around moving machinery, such as drill presses, mills, lathes, and grinders.

The following is a guide to the most common types of protective work gloves and the types of hazards they can guard against:

a. Disposable Gloves. Disposable gloves, usually made of light-weight plastic, can help guard against mild irritants.
b. Fabric Gloves. Made of cotton or fabric blends are generally used to improve grip when handling slippery objects. They also help insulate hands from mild heat or cold.
c. Leather Gloves. These gloves are used to guard against injuries from sparks or scraping against rough surfaces. They are also used in combination with an insulated liner when working with electricity.
d. Metal Mesh Gloves. These gloves are used to protect hands form accidental cuts and scratches. They are used most commonly by persons working with cutting tools or other sharp instruments.
e. Aluminized Gloves. Gloves made of aluminized fabric are designed to insulate hands from intense heat. These gloves are most commonly used by persons working molten materials.
f. Chemical Resistance Gloves. These gloves may be made of rubber, neoprene, polyvinyl alcohol or vinyl, etc. The gloves protect hands from corrosives, oils, and solvents. The following table is provided as a guide to the different types of glove materials and the chemicals they can be used against. When selecting chemical resistance gloves, be sure to consult the manufacturers' recommendations, especially if the gloved hand will be immersed in the chemical.

Glove Chart

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

		poor vs. some ketones, esters, amines	
Norfoil (Silver Shield)	Excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Use for Hazmat work

*Trademark of DuPont Dow Elastomers

Rating Key for Glove Type and Chemical Use

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

Chemical	Neoprene	Natural Latex or Rubber	Butyl	Nitrile Latex
*Acetaldehyde	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
*Acetone	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
*Amyl acetate	F	P	F	P
Aniline	G	F	F	P
*Benzaldehyde	F	F	G	G
*Benzene	F	F	F	P
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
*Carbon tetrachloride	F	P	P	G
Castor oil	F	P	F	VG
*Chlorobenzene	F	P	F	P
*Chloroform	G	P	P	P
Chloronaphthalene	F	P	F	F
Chromic Acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
*Dibutyl phthalate	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G

Dioctyl phthalate	G	P	F	VG
Dioxane	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
*Ethyl acetate	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether	VG	G	VG	G
*Ethylene dichloride	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Chemical	Neoprene	Natural Latex or Rubber	Butyl	Nitrile
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
*Furfural	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerine	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Isopropyl alcohol	VG	VG	VG	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG
Lauric acid (36%)	VG	F	VG	VG
Lineoleic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG

Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
*Methyl chloride	P	P	P	P
*Methyl ethyl ketone	G	G	VG	P
*Methyl isobutyl ketone	F	F	VG	P
Methyl methacrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Chemical	Neoprene	Natural Latex or Rubber	Butyl	Nitrile
Naphthalene	G	F	F	G
Naphthas, aliphatic	VG	F	F	VG
Naphthas, aromatic	G	P	P	G
*Nitric acid	G	F	F	F
Nitromethane (95.5%)	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Stryene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65%)	VG	VG	VG	VG

Tetrahydrofuran	P	F	F	F
*Toluene	F	P	P	F
Toluene diisocyanate	F	G	G	F
*Trichloroethylene	F	F	P	G
Triethanolamine	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
*Xylene	P	P	P	F

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

Appendix 6: General Standard Operating Procedures

B.1. Administrative Procedures

a. Chemical Procurement

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

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

b. Prior Approval

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

c. Working Alone - Unattended Operations

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

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

B.2 General Chemical Safety

a. Horseplay

Horseplay of any kind is strictly forbidden in the laboratories.

b. Personal Hygiene

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

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

c. Housekeeping

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

d. Material Transport

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

e. Solvent Storage and Handling

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

f. Glassware and Laboratory Equipment

All broken glassware will be immediately disposed of in a rigid, puncture-resistant container, such as a metal trash can. The container must bear a legible sign that says “SHARPS”. Contaminated glassware should be de-contaminated in an appropriate manner for the chemical or biohazard used, but in such a manner, as to minimize harm from the glass to all present and future handlers.
All laboratory equipment shall be used only for its intended purpose, unless appropriately
The hazards of high pressure systems arise largely from failures caused by leaks, pulsation, vibration, and over pressure. Pressure gauges should be checked and recalibrated on a regular basis.

Safety glasses are required at all times in laboratories and studios with pressure or vacuum modified.

g. Vacuum and Pressure Operations

Extra precautions are necessary when working with vacuum and high pressure devices. If explosion or implosion appears possible, face shields should be worn

to protect the face and neck of the user. If liquefied oxygen is suspected in a vacuum line, evacuate room and seek faculty assistance.

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

h. Sinks and Refrigerators

1. Sinks:

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

2. Refrigerators:

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

i. Compressed Gases

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

j. Fume Hoods

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

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

k. Cryogenic Liquids

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

l. Laboratory Freeze Dryers (Lyophilizers)

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

m. Autoclaves

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

n. Warning Signs and Labels

1. Warning Signs:

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

2. Labels:

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

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

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

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

o. Centrifuges

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

B.3 Waste Disposal

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

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

Any waste material that may, upon contact, present a hazard to one's health or surrounding environment should be treated as a potentially hazardous waste. This includes spent or unused chemicals, cleaning solutions, oils, etc.. If there is any doubt whether a material should be treated as hazardous, contact OEHS at 8-8325. Only aqueous/non-hazardous waste may be disposed in the sewer or trash.
OEHS will pick up properly documented and packaged wastes and will store them prior to their final disposition. Waste is disposed of by contract and is picked up from the University usually twice a year.

a. Labeling Waste Containers

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

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

b. Storing Waste

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

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

c. Having Waste Picked Up for Disposal

Information must be provided to OEHS to adequately characterize and dispose of the waste, prior to having it picked up. This information is provided by the generator to OEHS by using the Pickup Request Form shown in Figure 3.3.3. Pickup requests shall be filled out and sent or faxed to OEHS. Four to five days should be allowed for pickup. OEHS will evaluate the information and if sufficient, will schedule the material for pickup. If insufficient, OEHS will request additional information from the generator. A pickup will not be made until appropriate information is received.

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

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

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

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

d. Potentially Infectious Material Waste

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

1. The following human body fluids: blood,semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly

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

Regulated Medical Waste means liquid or semi-liquid blood or other potentially infectious materials and includes the following:

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

Non-Regulated Waste materials include:

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

Non-regulated waste that is contained in biohazard bags or biohazard sharps containers must first be marked "Treated" on the outside of the container, if the container does not already have an autoclave heat/pressure tape indicator affixed to it, prior to disposing into general trash receptacles.

Potentially infectious material can be disposed of in one of several manners. Rendering the material non-infectious by such means as autoclaving allows the material to be considered a non-regulated waste. See Appendix C for disposal procedures for non-regulated waste. Totally destroying the material through incineration requires that each

department collect the PIM in appropriate containers, store the material, and contact OEHS to pickup the material for incineration in an EPA approved incinerator.
Under no circumstances are any sharps to be discarded into the general trash.
Departments will utilize the following storage requirements for regulated waste prior to treatment or transport off-site.

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

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

Maintain PIM in a nonputrescent state, using refrigeration when necessary.
Lock outdoor storage areas to prevent unauthorized access.

Limit access to on-site storage areas to authorized employees.
Store in a manner that affords protection from animals and does not provide a breeding place or a food source for insects and rodents.

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

- All autoclaving of PIM must be documented. This documentation should include the date, the person conducting the autoclaving, the material autoclaved, and the verification that the material was rendered non-infectious. See appendix C;
- Verification that the autoclave reached the right temperature and pressure for the required amount of time is required. One way to do this is by autoclaving, along with the waste, a jar with spores in it. The jar is to be placed in the center of the waste bags, then if the spores are destroyed, it is feasible that the infectious material has been rendered non-infectious. Once a week a spore test will be required, all other times a heat/pressure tape is required to be placed on the bags; and
- All autoclaves that will be used for this type of work should also be inspected annually by a certified inspector. These inspections are to ensure that the autoclaves are capable of conducting the procedures for which they are being used.

f. Minimizing Waste

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

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

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

Staff wishing to list materials should also contact EHS. Materials should continue to be stored by the listing Department until a user is found. If this is not possible, or if an appreciable amount of time has expired with no result, EHS can pickup the material. Waste generated through scientific classroom instruction has additional reduction options available. These include converting to microscale experiments and incorporating material neutralization or inactivation into experiment procedures. This promotes environmental and product stewardship and could be a valuable theme in course curriculum.

g. Using Sink Drains and the Sewer

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

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

3.4 Special Chemical Safety

a. Corrosive Substances

Biological corrosives attack human tissue and cause irritation, chemical burns, and in severe cases, tissue destruction. In case of skin or eye contact with corrosives, prompt treatment with a physiologically correct buffered saline is important. Consultation with a medical professional is required. Safety showers and eyewash fountains must be provided for this purpose and must be readily available to all lab occupants. In laboratories which do not have safety showers, the nearest location should be posted. All labs should have eyewash stations.

Types of corrosives and examples of each are:

<u>Acids:</u>
Inorganic or mineral acids include sulfuric, nitric, hydrochloric, phosphoric and hydrofluoric. Concentrated solutions of hydrofluoric acid (HF) can

penetrate the skin and soft tissue, causing destruction and intense pain. A neutralizing gel shall be kept in the lab any time HF is used.
Organic acids contain a carboxylic group, (-COOH) and are generally less acidic and corrosive than the mineral acids. Common organic acids include acetic, benzoic, citric, and oxalic.

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

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

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

b. Oxidizers

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

c. Oxygen and Moisture Sensitive Compounds

Many chemical compounds deteriorate when exposed to air. For most of these, oxidation only causes a decrease in purity. But for a few, extreme reactivity with oxygen leads to other effects. Another group of compounds reacts with atmospheric moisture and causes the release of toxic or flammable gases or vapors or the generation of enough heat to cause fires and explosions. In the following information, the threshold limit value (TLV) is the safe amount to which a person can be exposed to without harm.

Examples of Compound Effects

- Aluminum Alkyls React with moisture to generate extremely flammable hydrocarbon vapor.

- Dichlorosilane Forms silicon dioxide and hydrogen chloride on contact with air. Will detonate spontaneously under some conditions.

- Phosphides React with moisture to form highly toxic phosphine (TLV=0.3 ppm)
- Potassium Reacts with moisture to release hydrogen and when combined with oxygen to cause ignition and explosion.

- Selenides Moisture causes release of the extremely toxic hydrogen selenide (TLV=0.05 ppm)

- Sodium Reacts with moisture to release hydrogen. The heat generated may cause a fire.

- Sulfides Hydrogen sulfide (TLV=10 ppm) formed on contact with moist air. These substances should only be handled in a glove box with an inert atmosphere or in special glassware (Schlenk techniques) to avoid the aforementioned effects during experimental work. Storage in special containers with a nitrogen atmosphere is often necessary. Potassium and sodium are usually stored under a non-volatile hydrocarbon liquid to exclude oxygen and moisture.

d. Pyrophoric Compounds

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

Examples of Compound Effects

- Aluminum Alkyls Ignite spontaneously in air. Also react violently with water and with oxygenated and halogenated solvents.

- Bromotrifluoro- Ignites spontaneously in air to form ethylene hydrogen bromide and hydrogen fluoride which are corrosive and toxic.

- Diborane May ignite spontaneously in air and may detonate under some conditions. Extremely toxic vapor (TLV=0.1 ppm)

- Phosphine Its ability to ignite spontaneously in air may depend on purity. Phosphine gas is highly toxic (TLV=0.3 ppm)

- Silane May detonate violently when released in air, but usually it only ignites.

- The use of any of these compounds requires special approval as discussed in Section 7.0. In all cases, a flow restrictive orifice in the cylinder valve is a required precaution. Special piping and fittings are also necessary.

e. Peroxide-Forming Compounds

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

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

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

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

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

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

f. Explosive and Shock-Sensitive Compounds

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

Examples of Compound Types:

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

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

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

g. Incompatible Materials

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

h. Laser Installations

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

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

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

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

i. Formaldehyde

OSHA has singled out formaldehyde for special regulation. This is due, in part, to formaldehyde being implicated as being a sensitizer and carcinogen. OSHA's requirement for a formaldehyde program requires the employer to document

exposure levels, provide training, and in some cases, medical monitoring. Staff that work with formaldehyde should contact OEHS to assure they are in compliance with the standard.

j. Mercury

Mercury and mercury compounds can be highly toxic. Mercury compounds, other than metallic mercury, are extremely difficult to dispose of. There are currently no disposal facilities in the United States capable of taking this type of waste. Staff are therefore encouraged to minimize mercury use and to eliminate it when possible. Elemental mercury should be stored in a non-breakable container in the fume hood.

k. Radioactive Materials

Intentionally left blank for future use.

B.4 General Biological Safety

a. Universal Precautions

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

b. Containers for Contaminated Material

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

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

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

v) Disposable contaminated sharps shall be discarded immediately or as soon as feasible in containers that are:
    i) Closable and puncture resistant
    ii) Leak proof on sides and bottom
    iii) Labeled or color-coded in accordance with Hazard Communication plan section 3.3.

    Contaminated waste other than sharps shall be placed in containers which are:
    i) Closable
    ii) Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping.
    iii) Labeled or color-coded in accordance with Appendix E

c. Work Area Restrictions

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

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

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

d. Biosafety Cabinets

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

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

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EXAMPLE 1:
APPENDIX A
FELMLEY 444

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

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

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

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

LABORATORY STAFF AND USERS

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

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

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

In Hood:

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

Under Hood:

Chloroform (8 L)
Sodium Hydroxide, conc. (1 L)

Nitric Acid, conc. (4 L)
Hydrochloric Acid, conc. (4 L)
Carbon Tetrachloride (4 L)
n-Propyl Alcohol (4 L)

Under South Countertop:

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

In Cabinets on South Wall:

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

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

Special Equipment and Procedures

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

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

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

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

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

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

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

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

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

Date:

Name of Lab Worker:

Example 2: Teaching Laboratory from the University of Illinois

FELMLEY 301 and 302

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

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

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

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

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

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

Dr. Otis Rothenberger
438-5359(w)

OVERVIEW OF LABORATORY OPERATIONS

Lab exercises for the first semester inorganic chemistry students.

LABORATORY STAFF AND USERS

Faculty Name(s)	Office	Work Phone	Home Phone
Dr. Phillip Morse	FHS 207B	438-5595	829-9257
Dr. Gary Clark	FSA 440A	438-2359	454-5937
Dr. James Weber	FHS 207B	438-2604	827-2192
Dr. Richard Reiter	FSA 441B	438-7905	829-3708
Dr. Otis Rothenberger	FSA 438	438-5359	

HAZARDOUS MATERIAL USE

Some of the hazardous materials used in the lab include:

(Extremely hazardous substances are in bold.)

Chemicals stored in the following locations:

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

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

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

EXTEMELY HAZARDOUS MATERIALS

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

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

SPECIAL EQUIPMENT and PROCEDURES

A. Handling Chemicals

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

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

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

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

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

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

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

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

B. Chemical Spills

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

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

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

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

expected to become familiar with its location and proper use.

C. Chemical Disposal

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

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

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

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

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

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

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

D. General Housekeeping

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

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

    b. Replace caps on reagent bottles.

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

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

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

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

g. Keep eyewash stations flushed weekly and sign log.

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

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

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

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

Training Conducted by:

Date:

Name of Lab Worker: