Highline Community College
Lab Safety Manual

PHONE NUMBERS

For Life-Threatening Emergencies call 9-911
For Non-Life-Threatening Emergencies call 3-911

When reporting an emergency:

- Give the building and room number
- Nature of the emergency
- The number you are calling from (whether cell or extension)
- Your name

OTHER NUMBERS:

Safety/Security	3218 (Direct 206-592-3218)	Chemistry Lab	3272 (Direct 206-592-3272)
Poison Center:	1-800-222-1222	Biology Lab	3021 or 3252 (Direct 206-592-3021)
Drama	3279 (Direct 206-592-3279)	Photography	3386 (Direct 206-592-3218)
Graphic Production	3068 (Direct 206-592-3068)	Ceramic Studio	3887 (Direct 206-592-3887)

Hazardous Waste (Central Services Supervisor) 3928 (Direct 206-592-3928)

Building Maintenance Problems:	3260 (Direct 206-592-3260)	(8 am to 5 pm) Facilities
	3218 (Direct 206-592-3218)	(after hours) Security

I. PURPOSE

Laboratory work is an important component of science, technical applications, the arts, and related education. It is in the laboratory where one learns and observes the application of theory and experimentation. Careful, logical thinking can make laboratory work a joyful and enriching experience. This manual has been written to ensure that this experience is safe and healthy. While there are state and federal safety regulations that apply specifically to employees of Washington State, our intent is to protect everyone's health and wellbeing.

It is required that all individuals read and be familiar with Section II, Mandatory Lab Rules, and Section III, Emergency Procedures, before beginning work in any science lab or studio, whether technical or art. It is suggested that Sections II and III be reviewed by all persons working in the laboratory buildings at the beginning of each quarter. In addition, as an individual gains experience in the labs, the remaining Sections IV through IX will become relevant and important for safe and successful lab work. The Appendices are designed to provide useful detailed information on selected subjects. Safety rules are presented to every beginning lab class and emphasis of the same rules are given at the introduction of each continuing lab class. The Instructors may add more emphasis of their own when necessary for specific disciplines.

Safety communication is mandated by state and federal regulations: Hazard Communication (WAC 296-839-100 through 500) and Occupational Exposures to Hazardous Chemicals in Laboratories (Lab Standard, WAC 296-828-100 through 300). The Hazard Communication Standard establishes the means by which employees are informed of the health and safety hazards associated with products used on the job. The Lab Standard addresses hazards specifically associated with working in laboratories. Any person wanting more information on the two safety regulations can find this information at:

http://www.lni.wa.gov/WISHA/Rules/msds-mids/default.htm (1/6/2011)

and

http://www.lni.wa.gov/WISHA/Rules/labs/default.htm (1/6/2011)

II. MANDATORY LAB AND STUDIO RULES

These rules apply to all individuals utilizing the Labs and Studios at Highline Community College. Violation of any of the following rules is cause for disciplinary action including forfeiture of laboratory use privileges. Everyone is responsible for complying with the safe practices and rules set forth in this manual in addition to complying with all legal regulations governing laboratory work and handling and disposal of chemicals and hazardous materials. If any of these rules are unclear, ask the lab supervisor for clarification.

- Closed-toed shoes are required in lab rooms at all times.
- Food and drink are prohibited in all lab rooms, including gum and chewing tobacco. Do not store food or beverages in the laboratories. You or your food may be removed from the lab if this rule is not followed.
- Mouth pipetting is prohibited.
- Eye protection must be worn when doing chemical work and in chemical handling and storage areas. When there is a possibility of violent reaction, goggles, face shield or portable explosion shield must be used. Wearing contact lenses with goggles or face shields is not recommended.
- Long pants or long skirts are required when working with chemicals.
  You must limit exposed skin as much as possible. If you wear inappropriate clothing for lab, you may not be allowed to participate. Lab coats and protective gloves, as well as goggles, are recommended at all times when handling chemicals.
- Hair that is shoulder length or longer must be pulled back. Long, loose sleeves, jewelry, etc. must also be secured to prevent being caught or dragged. Wash hands thoroughly after working in the lab.
- Backpacks and coats should not be stored on lab tables. Hooks or cubby-hole shelves are provided for storage of personal items in rooms that require this for safety. In order to keep the cubbies clean, no chemicals, glassware, specimens, etc. may be stored in them.
- It is the responsibility of the individual using chemicals or equipment to know the associated hazards of each and to handle them accordingly.
- All chemical containers must be clearly labeled with contents, date, and hazards with applicable HMIS rating label (see Section IV-B and IV-C). When you transfer chemicals, label the new container with your name and date as well as the above information.

- Individuals are responsible for cleaning their workspace and properly storing chemicals, biological specimens, and supplies. Spills and glassware breakage must be dealt with immediately. Storage guidelines must be followed for long and short-term storage of chemicals (see Section V and VI). Gas cylinders in the lab must be strapped or chained to a wall or bench.

- It is the responsibility of anyone performing chemical work to insure proper disposal of their waste. Waste chemicals must never be disposed of in the drain or in the garbage unless permitted by law and deemed environmentally safe. Persons generating waste must abide by the waste disposal guidelines as outlined in Section VIII. If unsure of proper disposal methods, check with your lab staff or instructor/supervisor.

- Unauthorized work is prohibited. This includes working after hours without proper authorization and performing procedures that have not been expressly authorized by laboratory staff or faculty. Performing chemical work while alone in the lab is prohibited. When working in the labs someone must be within shouting range.

- The laboratory staff must approve unattended operations continuing for several hours or overnight. Operations must be fail-safe in the event of a failure in power, water, gas, etc. Room lights must be left on and a warning sign posted.

- All accidents, including personal injuries, no matter how minor, must be reported to the lab staff or Safety Office, and an accident report must be submitted to the Safety Office. This link will provide you with a printable hardcopy of the accident report: **http://www.highline.edu/admin/safety/forms/osha%20301.xls**

- All refrigerator/freezers must be marked for one of the following:

    - FOR CHEMICAL STORAGE ONLY; or FOR STORAGE OF BIOLOGICAL SPECIMENS ONLY.

    - Food is to be stored only in refrigerators located outside of the laboratories, labeled with “FOR FOOD STORAGE ONLY ".

SAFE & RESPONSIBLE LAB PRACTICES

On an individual case-by-case basis, exceptions may be made to the Lab and Studio rules by the supporting lab staff. For example, when using a microscope in a chemistry lab, under certain circumstances safety glasses may be removed. In such instances, it is the responsibility of the individual requesting the exception to demonstrate that the procedure is safe.

It is the responsibility of the person supervising or sponsoring a lab activity to insure that all participants are

- Informed of the lab hazards
- Properly trained in the safe handling of chemicals and equipment
- Are following the Mandatory Lab Rules and using safe procedures.

Anyone working in a laboratory area must be familiar with emergency safety procedures. This includes knowing the location of safety equipment and how to use it, the location of the nearest phone, and specific hazards associated with any equipment and chemicals in use. See Emergency Procedures Section III.

An effort should be made toward recycling and waste reduction. In an attempt to reduce stress on the environment and limit waste and disposal costs, all materials including chemicals, glass, metals, paper and plastics should be reused and/or recycled if possible. See HCC's policy on recycling. Reduction of the scale of chemical procedures is recommended and substitution of less toxic and/or hazardous substances is recommended. Do not reuse chemical bottles for anything but chemicals.

A NOTE TO ARTISTS

Safety applies to all disciplines, including both science and art. Many materials and procedures commonly used by artists are quite hazardous. In addition to the required reading (Section II Lab Rules and Section III Emergency Procedures), Section IV on Chemical Classes and Section VIII on Waste Disposal are important in understanding the safe handling of chemicals commonly used in the arts.

Any chemical, including solvents, dyes, glazes, etc., obtained must have a MSDS (see Section IV) supplied by the manufacturer that describes any hazards of that chemical. This is required whether you obtain it through HCC or another source; MSDS's should be kept on file in each Lab building, as well as the Safety/Security Office. Distributors are required by law to be able to provide an MSDS. There are reference books listing specific hazards associated with different procedures and processes; check the Reference list. *The Artist's Complete Health and Safety Guide* and *The Health & Safety Guide for Film, TV & Theater*, both written by Monona Rossol are recommended. If you don't know or understand something, ask your area's staff or faculty.

In brief, the following practices are recommended:

- Know your hazards.
- Substitute with less hazardous materials, such as when using solvents (paint thinner, cleaners, etc.) whenever possible. Appendix 1 and "The Artist's Complete Health and Safety Guide" have some examples.
- Be properly trained in the use of specialized equipment and emergency procedures specific to that equipment.
- Use appropriate safety apparatus. Personal protection includes:
    - For your eyes and face, use safety glasses and/or face shields. These are available for purchase at the bookstore, or for limited checkout at Lab Stores.
    - For exposed skin, use gloves and wear protective clothing. Gloves should be available in each lab or studio.
    - Protect your hearing from high noise levels. Earplugs are available for purchase at any Pharmacy or Home improvement store (Fred Meyer).
    - For respiratory protection from chemicals and dust, use proper ventilation, hoods. Dust masks are available for purchase at the HCC Bookstore. Respirators must be medically fitted, and are not available for student use.

III. EMERGENCY PROCEDURES

Know the locations and proper use of each piece of emergency equipment in the area:

Spill Kits	Exits
Eye Washes	First Aid Kits
Emergency Showers	Telephone
Fire Extinguishers	Fire Alarms
Emergency Gas Shut Off	

A lab reconnoiter (i.e. exploring in order to gain information) should accompany each Lab Introduction for staff faculty. This exercise will allow you to map out the lab room you are working in, and find emergency equipment, as well as general lab equipment.

III-A. GENERAL EMERGENCY PROCEDURES

If an emergency occurs, the first concern is for the health and safety of people in the area; property damage is secondary.

- Alert co-workers in the area of the danger.
- Assess the severity of the emergency.
- Based upon the severity of the emergency, Call for Help

For Life-Threatening Emergencies call 9-911

For Non-Life-Threatening Emergencies call 3-911

Evacuate the area and discourage people from re-entering before help arrives.

IF UNSURE OF THE SEVERITY, CALL 9-911; THEN CALL 3-911

Don't hesitate to ask for immediate help.

If you are personally involved in an emergency, send someone to a nearby phone to dial 9-911. This person will have to stay on the line to give the operator the building name, the floor, the room number, and the nature of the emergency. Do not attempt to move an unconscious person unless you know the nature of the emergency.

III-B. FIRE

PREVENTION

Fires can be prevented by eliminating the source of ignition. Before working with flammable materials, consider all potential sources of ignition: open flames, sparks, electrical sparks from motors, etc. If an extremely flammable material is being used (HMIS rating of 3 or 4; see Section IV-B for information on HMIS) observe the following procedures:

- Use a fume hood
- Insure no one in the surrounding area is using an open flame

GENERAL - WHEN A FIRE OCCURS

Prompt action may prevent small fires from getting out of control. Alert others in the area of the fire and send someone for help.

Placing an inverted beaker or a watch glass over the fire can smother small fires in glassware.

If the fire is too large to smother, evacuate the area. Only people trained in fire extinguisher use should attempt to fight the fire.

NEVER ATTEMPT TO FIGHT A FIRE ALONE.

When fighting a fire, put yourself between the fire and the exit to ensure a means of escape. If the fire can't be immediately controlled, call the fire department at **9-911**. Pull the alarm located by the exits and stairways in each lab building. Try to contain the fire to the lab area by closing fume hood sashes, windows, and the doors to the lab as you leave.

PEOPLE

If clothing, skin, or hair catches fire, drop to the ground and roll to smother the flames. You may need to help push the person to the ground to prevent them from running and fanning the flames. Safety showers are in or near all lab rooms, and can also be used to put out a fire. Send someone to call for help, **9-911**

METALS

Metal fires **cannot** be extinguished with regular extinguishers. Use a Class D fire extinguisher or sand to smother the fire (CO_2 and dry chemical extinguishers will intensify some types of metal fires). Before starting work with metals such as Sodium, Potassium, or powdered Aluminum or Magnesium, check that there is sand or a Class D fire extinguisher located in your area.

III-C. CHEMICAL SPILLS

Consider what to do in the event of a spill before starting a project. Spills may cause serious health and environmental problems if not handled correctly. Familiarity with chemical hazards and the proper spill control measures will help minimize the effects of a chemical spill. Again, the first concern is for the health and safety of the people in the area; property damage is secondary.

CHEMICAL SPILLS, GENERAL PROCEDURES

Alert co-workers in the area of the danger.

Assess the severity of the emergency. Consider the possibility of exposure through contact, inhalation, and the increased fire hazard associated with flammable materials.

Based upon your best judgment of priorities, and knowledge of the chemical, **Call for Help**

Emergency	**Des Moines Fire Dept.**	**9-911;**
	Safety Office	**3-911**
Evenings and Weekends	**Safety**	**x3218**

If necessary, you may need to pull the fire alarm, and/or evacuate the area and keep people from re-entering before help arrives.

The person spilling the chemical is responsible for contacting lab staff/faculty as soon as the severity of the spill allows. Minor spills not involving human contact should be contained whenever possible. Depending on the hazard and size of the spill, lab staff/faculty will either direct the person responsible to clean up the spill or perform the cleanup themselves.

Anyone noticing a leak or spill is also responsible for contacting lab staff/faculty to initiate the cleanup process.

Spill kits are located in every lab or preparation room. These should be found in the lab reconnoiter exercise that accompanies the safety quiz. Before any chemical experiment begins, learn how to use the spill kits: that is, the proper absorbent and the proper neutralizer for the type of spill.

CHEMICAL SPILLS ON PEOPLE

If a chemical is spilled on a person, IMMEDIATELY rinse the exposed area of the body and continue rinsing for 15 minutes. Use an eyewash station, emergency shower, or the sink to rinse the exposed area. Consult the MSDS for information on any delayed bodily reactions. Notify the person in charge to fill out an Accident Report.

Eyes are extremely susceptible to chemical burns. Prompt and continued rinsing (for 15 minutes) can prevent severe eye damage. If your lab partner has a chemical splashed in their eye, you should assist them to the eyewash and ensure they rinse for the full 15 minutes, even if it is uncomfortable. Seek medical attention as soon as possible, and bring the MSDS with you to the emergency room or physician's office.

In the event the spill contaminates clothing, remove all contaminated clothing and rinse the exposed area for 15 minutes. If extra clothing is not available, give the victim a lab coat or other covering.

If the exposure is severe, someone in the area must call 9-911 to get paramedics on the scene. Be sure to continue rinsing the exposed areas until directed to stop by the paramedics.

In the case of minor exposures: rinse affected areas for a minimum of 15 minutes, seek medical attention, and bring the MSDS with you.

FLAMMABLE MATERIALS

If flammable materials have been spilled, immediately eliminate all sources of ignition. Unplug all electrical devices, extinguish open flames, etc. Absorb the material quickly with the appropriate spill absorbent, and then contact your supervisor.

IV. CHEMICAL CLASSES AND SAFE HANDLING

Safe handling of chemicals requires an understanding of the reactions and hazards associated with each chemical. General chemical behaviors can be predicted and grouped into chemical classes. Section IV-A describes the general behaviors of chemical classes and some specific hazards of common laboratory chemicals. Additional detailed information may be obtained from such sources as the Merck Index, Aldrich Catalogue, and Material Safety Data Sheets (see References for additional sources).

The **Material Safety Data Sheet (MSDS)** is a form produced by the chemical manufacturer. The MSDS lists the physical, chemical, and physiological hazards associated with the product. Federal and State agencies (OSHA and WISHA) require that MSDS's be available for all chemicals that all employees encounter in their jobs. The MSDS's are filed in each Lab or studio, and the Safety Office (see Appendix 2 for an example of an MSDS), or are available online at www.hazard.com, or at the manufacturer's website.

In addition to the MSDS's, The Biology and Chemistry Labs also maintain a labeling system called **Hazardous Materials Information System (HMIS)** for all chemicals to summarize the hazards (see Section IV-B for Labeling System).

Many of the acronyms and terms used in MSDS's and other sources are defined in the GLOSSARY.

IV-A. DESCRIPTION AND CLASSIFICATION OF CHEMICAL PROPERTIES

REACTIVE

Reactive chemicals have any of the following properties:

- Unstable and readily undergo violent change with or without detonation, such as anhydrous potassium perchlorate or anhydrous picric acid.
- React violently with water, form potentially explosive mixtures with water, or generate toxic gases when mixed with water, such as sodium metal, or calcium carbide.
- Produce toxic fumes or gases when exposed to pH conditions between 2 and 12.5, such as potassium cyanide, or sodium sulfide.

FLAMMABLE

Combustion involves a chemical change, especially oxidation, which is accompanied by the production of heat and light. **Combustible materials** are typically categorized by flash point (FP) characteristics. The **flash point** is the lowest temperature at which the vapors present above the surface of a liquid will ignite if an ignition source is introduced.

High fire hazard – FP below 23C (73F)

Moderate fire hazard – FP between 23 and 60C (73 and 140F)

Slight fire hazard – FP above 60C (140F)

Flammable liquids often will give off dangerous amounts of flammable vapors well below normal room temperature. The vapor pressure of a liquid is a measure of this effect: high vapor pressure means high potential flammability, low vapor pressure means low potential flammability. A vital point in flammable liquid safety is preventing the accumulation of explosive concentrations of vapors by proper ventilation and temperature control.

EXAMPLES:	FLASH POINT		VAPOR PRESSURE
	°C	°F	at room temp (torr)
Ether (anhydrous):	-45	-49	442
Acetone:	-18	0	181
Ethanol:	16	60	47
Water:	none		24

EXPLOSIVE

An **explosive** chemical is any compound or mixture that reacts with a substantial and instantaneous release of gas or heat. Common examples are organic peroxides and any of the following that may contain appreciable amounts of organic peroxides: aldehydes, ethers, p-dioxane, or ketones. Many peroxides are more sensitive to shock than TNT. As a class, they are quite sensitive to heat, friction, impact, light, and are strong oxidizers and reducers.

OXIDIZERS

An **oxidizer** is a substance that gains electrons thereby facilitating the loss of electrons from another substance (**reduction**). Many oxidizers yield oxygen readily and thereby stimulate the combustion of organic matter. Oxidizers can promote vigorous reactions when combined with chemicals that readily accept oxygen (**reducers**). Common oxidizers are chlorates, permanganates, and inorganic nitrate. In the case of flammable liquids, the atmosphere can often be the oxidizing source. See Appendix 3 for more examples.

REDUCERS

A **reducer** is a substance that donates electrons thereby facilitating a gain of electrons by another substance (**oxidation**). Many reducers accept oxygen readily. Common reducers are hydrogen and zinc. See Appendix 3 for more examples.

CORROSIVE

A **corrosive** substance is a liquid or solid that causes visible destruction to human skin at the site of contact, or severely corrodes metal. Examples include strong acids and bases.

TOXIC

A **toxic material** can damage or interfere with the metabolism of living tissue. A toxin can have an acute and/or chronic effect. An **acutely** toxic substance can cause damage as the result of a single or short-duration exposure. Examples of acute toxins are HCN (hydrogen cyanide) and H_2S (hydrogen sulfide). A **chronically** toxic substance causes damage after repeated or long-duration exposure, or the damage becomes evident only after a long latency period. Examples of chronic toxins are Hg (mercury) and gasoline vapors. Toxins include poisons and carcinogens.

- **Poisons** are substances that are dangerous to life in very small amounts and may be gas, liquid, or solid. Routes of entry can be through skin absorption, inhalation, and oral intake. The qualifications for a substance to be a Class B poison (Class A poisons are more toxic) are:
    - Skin contact: A chemical that has a LD50 of 200 mg/kg or less from continuous contact for 24 hours with the bare skin.
    - Inhalation: A chemical that has a LC50 of 200 ppm or less when inhaled continuously for 1 hour or less.
    - Oral: A chemical that has an LD50 of 50 mg/kg or less when administered orally.
- **Carcinogens** are substances capable of inducing cancer. Certain materials and chemicals have been shown, through epidemiological studies in select population groups, to act as cancer-inducers in humans. Many substances can be co-carcinogens; substances that do not exhibit mutagenic capabilities by themselves, yet when combined with other specific substances will then possess carcinogenic capability. Appendix 4 lists some known or suspected carcinogens. This list is by no means complete. Many compounds have not yet been investigated, and the list continues to change. Examples are benzene and lead (II) compounds.

SPECIFIC HAZARDS AND SAFE HANDLING OF SOME COMMON CHEMICALS

ACIDS and BASES

Concentrated acids and bases are very corrosive. Protective eye wear and appropriate gloves must be used. When diluting, **always add acid to water**, watching for excess heat that is produced. Water added to concentrated acid creates enough heat to cause spattering and eruptions. A useful mnemonic is:

"DO LIKE YOU OUGHT-TER, ADD ACID TO WATER"

Notify faculty or staff immediately for all concentrated acid or base spills.

- **Hydrofluoric acid (HF)** exposure may not be immediately recognized and has a delayed, severely corrosive effect upon contact with skin, eyes, etc. It is also a systemic poison (absorbed through the skin), possibly resulting in death. An HF antidote is available at Lab Stores, or where HF is stored or used.
- **Nitric acid (HNO_3)** and **Sulfuric acid (H_2SO_4)** are strong oxidizers and must be stored separately from organic compounds.
- **Perchloric acid ($HClO_3$)** is a strong oxidizer that may react violently with organic compounds and can form explosive anhydrous perchloric acid upon dehydration. It must be used only in a specially designed fume hood (Lab II, 3221), with proper training from staff or faculty. Prevent dehydration during use: use a reflux setup; ensure there is sufficient water added during an experiment; do not heat with just sulfuric acid - add water. Organic matter should be digested with nitric acid before contact with $HClO_3$.
- **Picric acid** on dehydration becomes explosive, and should be stored under water.
- Mixing **hydrochloric acid (HCl)** and **sulfuric acid (H_2SO_4)** produces poisonous **chlorine gas**. Also, mixing **bleach (sodium hypochlorite)** and **ammonia** produces **chlorine gas**. Use in a hood when mixing.

SOLVENTS

Most common solvents are flammable, volatile, narcotic, or systemic poisons. Keep them away from ignition sources and oxidizers, use with good ventilation, use small quantities, wear gloves, and store with a tight-sealed cap or stoppered in the appropriate facilities (see Sections IV and IX-B).

- **Ethyl ether** (anhydrous ether) is particularly volatile and flammable, and should be refrigerated when not in use. Do not evaporate to dryness; it can form explosive peroxides.
- Many **halogenated hydrocarbons**, such as **chloroform**, are toxic and/or carcinogenic. Use proper gloves and fume hoods.
- **Aldehydes, ethers, ketones,** and **alkenes** can form explosive peroxides. Do not evaporate to dryness. These compounds need to be carefully inventoried and monitored. If an old or suspicious container is found, DO NOT MOVE IT - call Lab Stores.

REACTIVE CHEMICALS

- Certain **heavy metal salts** can be explosive. Disposal in the sewer system is illegal for most heavy metal salts and also poses an explosion hazard by accumulation in drain pipes.
- **Peroxides** are violently reactive or explosive. These compounds need to be carefully monitored and inventoried and used only after specific training by staff or faculty. If an old or suspicious container is found, DO NOT MOVE IT - call Lab Stores.

TOXINS (POISONS, CARCINOGENS)

Many toxins are absorbed through the skin or through inhalation. Use appropriate gloves and work in a fume hood.

- **Mercury (Hg)** is a cumulative poison present in some high temperature thermometers, which are easily broken. Spills must be made non-volatile by sprinkling with zinc dust or other commercial product such as Resisorb. Once collected, the mercury may be stored safely by covering with water. Leftover traces of spilled mercury can be checked with a powdered mercury indicator.
- **Formaldehyde** is often used for preservation of biological specimens. It is volatile, can cause permanent damage to the eyes and upper respiratory tract, and is a suspected human carcinogen. Formaldehyde must be used in a certified hood. Use eye protection, gloves, and protective clothing when using this chemical. **Alternative preservatives are recommended.**
- **Hydrocarbons** like **turpentine** and **gasoline** are a systemic poison and narcotic. Use gloves, and work in a hood or under a snorkel hood.

COMPRESSED GASES

- Cylinders containing compressed gases are under high pressure and are therefore potentially explosive. Compressed gases may cause toxic, irritant, or anesthetic effects, burns, asphyxiation, explosions, or frostbite (from cryogenic liquids).
- Wear safety glasses and know the particular hazards of the compressed gas used.
- The cylinders must be stored (Section VI) and transported (Section VI) correctly, chained or strapped to a bench or wall, and kept capped when not in use.
- Appropriate regulators must be used with each gas cylinder.
- Never direct compressed air or gases at a person, or use them to blow away dirt and dust.
- Know the location of shut-off valves or switches.

RADIOACTIVE MATERIALS

By law, radioactive materials must be routinely monitored and controlled to prevent any unnecessary radiation exposure to those who are working with these hazardous materials. Before undertaking any project involving the use of radioactive materials, you must contact the Radiation Safety Officer in order to set up an evaluation and control program. Waste disposal of radioisotope-contaminated material must be arranged prior to any project. A copy of "Procedures for Working with Radioisotopes" is available in Lab Stores.

All radioactive materials, as well as the room and designated areas where these materials are being used are labeled with this symbol:

IV-B. LABELING SYSTEMS FOR CHEMICALS

Chemical labeling systems are used to both standardize and summarize hazard information about a chemical. Labeling must provide enough information so one can discern the proper hazard class and general handling requirements of a chemical. The labeling system used on campus is the **HMIS** or **Hazardous Materials Information System**. The system gives a numerical rating (0 as none, to 4 as severe) to Health Hazard, Flammability, Reactivity, and Personal Protection.

The rating definitions in the Health, Flammability, and Reactivity categories are as follows:

HEALTH HAZARD

0. MINIMAL HAZARD - No significant risk to health
1. SLIGHT HAZARD - Irritation or minor reversible injury possible
2. MODERATE HAZARD - Temporary or minor injury may occur

3. SERIOUS HAZARD - Major injury likely unless prompt action is taken and medical treatment is given

4. SEVERE HAZARD - Life threatening major or permanent damage may result from single or repeated exposures

FLAMMABILITY HAZARD

0. MINIMAL HAZARD - Materials which are normally stable and will not burn unless heated

1. SLIGHT HAZARD - Materials that must be preheated before ignition will occur. Flammable liquids in this category will have flash points at or above 94C (200F). (NFPA Class IIIB)

2. MODERATE HAZARD - Material which must be moderately heated before ignition will occur, including flammable liquids with flash points between 60C (100F) and 94C (200F). (NFPA Class II & Class IIIA)

3. SERIOUS HAZARD - Materials capable of ignition under almost all normal temperature conditions, including flammable liquids with flash points below 23C (73F) and boiling points above 100F as well as liquids with flash points between 23C (73F) and 60C (100F). (NFPA Classes IB and IC)

4. SEVERE HAZARD - Very flammable gases or very volatile flammable liquids with flash points below 23C (73F) and boiling points below 60C (100F). (NFPA Class IA)

REACTIVITY HAZARD

0. MINIMAL HAZARD - Materials which are normally stable, even under fire conditions, and do not react with water.

1. SLIGHT HAZARD - Materials which are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy violently.

2. MODERATE HAZARD - Materials which in themselves are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water.

3. SERIOUS HAZARD - Materials which are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before ignition, or materials which react explosively with water.

4. SEVERE HAZARD - These materials are readily capable of detonation or explosive decomposition at normal temperatures and pressures.

PERSONAL PROTECTION

0. MINIMAL HAZARD – No Personal Protection equipment required.

1. SLIGHT HAZARD – Safety glasses and gloves recommended.

2. MODERATE HAZARD – Safety glasses and gloves required. Chemical apron or lab coat and fume hood ventilation recommended.

3. SERIOUS HAZARD – Safety glasses or splash goggles and gloves required. Fume hood ventilation required, and chemical apron or lab coat recommended.

4. SEVERE HAZARD – Splash goggles, fume hood, and protective clothing required. Depending on the hazard, blast shield or face shield recommended.

As an example, a HMIS label for acetone with a rating of H=2, F=4, R=1, and a MSDS number of 5014 would look like:

At HCC, the labels we use on our chemicals are technically HMIS labels, but we often use the J.T. Baker SAF-T-DATA Labeling system to assign the numerical ratings.

The J.T. Baker SAF-T-DATA Labeling system is very nearly interchangeable with the HMIS system. When using a J.T. Baker SAF-T-DATA Labeling system, we use both health and contact to come up with the HMIS health rating.

CHEMICAL HANDLING

Other rating systems exist and also provide useful information. Different systems are used by different chemical manufacturers and may be present in addition to the HMIS label that TESC adds to all chemicals. Some of these are the National Fire Protection Association system (NFPA), the Department of Transportation placards (DOT), the United National Labeling System, and the American National Standards Institute (ANSI) labeling system.

NFPA - This system rates hazardous materials with respect to fire hazard. It employs a diamond divided into 4 smaller colored diamonds: red (flammability), blue (health) and yellow (reactivity). Three of these diamonds contain a numerical rating (0 to 4) for health hazard, flammability, and reactivity, with the fourth diamond for Special Notice.

DOT - This system uses diamond-shaped placards combining words, pictures, and colors to identify hazardous materials being transported in trucks or trains.

United National Labeling System - This system offers a pictorial representation of the hazard. It does not offer any information on personal protection or level of hazard. Example: a skull and crossbones represents poisons.

ANSI - This system attempts to standardize narrative warning systems by setting definitions of key words. For example, a label may have DANGER!, WARNING! or CAUTION! printed at the top followed by a description of the hazard.

OSHA - This system requires chemicals to be labeled with the contents as well as appropriate hazard warnings, which may include words or pictures to convey general hazards associated with the chemical.

IV-C. LABELING

All chemicals must be thoroughly labeled with safety information including a numerical hazard rating system and cautionary words. You should label the container immediately when you put the chemical in it to avoid any confusion later on.

Each chemical must be labeled with the following information:

- **NAME OF CHEMICAL**
- **CONCENTRATION** (if applicable)
- **DATE**
- **YOUR NAME**

For long-term storage, you must also have the following information:

- **MOLECULAR WEIGHT AND/OR CHEMICAL STRUCTURE**
- **HAZARDS AND HANDLING PRECAUTIONS**
- **HMIS LABEL WITH THE MSDS NUMBER AND HAZARD RATINGS**

It is best to label the container with a numerical rating supplemented by cautionary words. For example, a compound labeled with the rating H=3, F=0, R=3 is certain to be a health hazard and a compound you wouldn't want on your skin, but if you know it is concentrated sulfuric acid and it is labeled CORROSIVE, CONCENTRATED ACID, CAUSES SEVERE BURNS, you could make some additional educated decisions about how to handle it. You know that it will react with certain classes of materials (you wouldn't store it in a metal container) and you should know how to handle strong acids and acid spills. The label information however, does not replace reading the MSDS or other reference material.

V. BIOLOGICAL MATERIALS

HUMAN BODY FLUIDS

Guidelines for handling human body fluids are detailed and enforced by WISHA (Washington Industrial Safety and Hygiene Administration), as recommended by the Centers for Disease Control. A complete copy of the Universal Codes, *Infection Control Guidelines and Standards,* is available at

http://infectioncontrol.ucsfmedicalcenter.org/html/ICManual.html

- **There will be no experimenting on human subjects except for simple evaluation**.
- Gloves must be worn when handling another person's fluids.
- All sharp instruments, including blood lancets, needles, scalpels, razor blades, etc., must be placed in a special container for disposal (red plastic "Sharps" container). Full containers will be shipped for appropriate disposal by lab staff.
- Any lab ware (beakers, blunt instruments), equipment, or areas (bench tops, floors, etc.) in contact with body fluids must be sterilized after use, as directed by staff or faculty.
- Sterilization may be accomplished by any of the following methods:
    - Autoclaving
    - Soaking or thoroughly washing with a quaternary disinfectant cleaner
    - Soaking in a dilute (3 M) acid bath for at least 15 minutes.

NON-PRESERVED SPECIMENS

The person obtaining the specimen is responsible for:

- obtaining permission to store the specimen
- proper storage of the specimen
- final and proper disposal of the specimen

Carcasses must be wrapped in plastic bags and labeled with your name, date, program or

faculty, and specimen description. The carcasses must be stored in a refrigerator or freezer that is labeled "FOR BIOLOGICAL SPECIMENS ONLY". Check with Lab Coordinators for current, proper disposal methods.

All instruments used in dissection work must be sterilized before being returned to storage locations.

PRESERVED SPECIMENS

Any specimen preserved with a chemical must be treated at the same safety level as that chemical.

If that chemical is toxic, such as formaldehyde, then appropriate safety measures such as eye protection, exposed skin protection, and proper hood use must be followed. In addition to being a suspected carcinogen, formaldehyde is corrosive; specimens must be stored in a non-metal container. For disposal, the specimen must be treated as regulated hazardous waste. Formaldehyde treated specimens and any other hazardous preserved specimens must be properly bagged and labeled, and then disposal arranged with lab staff (see section IV-A for additional recommendations regarding use of formaldehyde).

Most specimens are now stored in an alcohol that is much less toxic than formaldehyde.

LIVE ANIMALS

The specific Lab Coordinator must approve all experimentation involving live animals.

It is the responsibility of the sponsoring faculty/staff to ensure that the animals are kept and released in a safe, secure, and humane manner. Care and handling of animals must be in accordance with IACUC guidelines (www.iacuc.org)

MICROBIOLOGICAL ORGANISMS

Any pathogenic organisms must be destroyed by any of the sterilization methods listed under the Human Body Fluids heading in this section before disposal.

VI. CHEMICAL STORAGE

A properly designed chemical storage area must first address safety and legal issues and then provide a convenient way to organize over 5000 chemicals used in the science labs. First, chemicals are separated by solids, liquids, and gases. Incompatible chemicals are segregated and hazardous chemicals are stored in special systems designed to prevent and control their hazards, such as explosion-proof refrigerators, ventilated flammables cabinets, acid cabinets, etc. Incompatible chemicals are chemicals that have potential for a violent reaction with each other (examples of specific incompatible chemicals are listed in Appendix 6). Hazardous chemicals (for storage definition) are chemicals with any HMIS category rating greater than 2.

General Guidelines:

- Date all chemicals when received and opened.
- Inventory annually, checking dates, condition, and amounts. Check particularly for ethers and peroxide forming materials, and discard within one year of opening.
- Avoid storing hazardous chemicals above eye level.
- Do not store chemical containers on the floor.
- Open shelves must have lips or doors to prevent bottles from slipping off.
- Any chemicals left unattended for ANY length of time must be stored in a closed container and properly labeled with name, date, program, chemical name(s), and concentration.
- Keep incompatible chemicals separated.
- Select an appropriate container (see Section IX-B and Appendix 7).
- Store away from heat and direct sunlight.
- For temporary storage, non-hazardous chemicals should be stored at the rear of a counter or in the center of an island.
- Hazardous chemicals are to be stored in a fume hood or vented cabinet.
- Volatiles and flammables requiring refrigeration must be stored in an explosion-proof refrigerator.
- All chemicals must be returned to their permanent designated storage areas.

Hazardous chemicals are segregated into the following special classes and storage facilities:

- **FLAMMABLES** such as **acetone** and **hexane** must be stored in a flammables' cabinet. There are restrictions on the total quantity of flammables that can be stored and in what type of containers. See Appendix 7 for details.
- **INORGANIC ACIDS** such as **hydrochloric acid** and **sulfuric acid** (excluding nitric and perchloric acid) must be stored in designated cabinets. Store hydrofluoric acid in plastic containers.
- **NITRIC ACID** must be stored in a separate, dedicated cabinet with spill trays.
- **PERCHLORIC ACID** must be stored in a separate, dedicated cabinet.
- **ORGANIC ACIDS**, such as **acetic acid**, must be stored in designated cabinets.
- **BASES**, such as **sodium hydroxide** and **ammonia,** must be stored in designated cabinets. Store strong bases (NaOH) in plastic containers.
- **REFRIGERATED FLAMMABLES** and **VOLATILES** including **ether** and **epoxides,** must be stored in explosion-proof refrigerators.
- **OTHER REFRIGERATED NON-VOLATILE, NON-FLAMMABLE CHEMICALS** such as **water samples** or **vitamins** can be stored in a standard refrigerator labeled "FOR CHEMICALS ONLY".
- **REFRIGERATED BIOLOGICAL SAMPLES**, including **preserved specimens**, should be stored in a refrigerator labeled "FOR BIOLOGICAL SAMPLES ONLY".
- **ORGANIC POISONS, TOXINS, CARCINOGENS** such as **benzene** should be stored in a secured area.
- **INORGANIC POISONS, TOXINS, CARCINOGENS** such as **mercury** should be stored in a secured area with spill containers.
- **WATER REACTIVE CHEMICALS**, including **sodium metal** and **hydrides** must be stored under kerosene or away from water.
- **COMPRESSED GASES** such as **helium** and **oxygen** should be stored in a dry, well ventilated, and secured area. Cylinders must be stored in a secured, upright position with caps on. Gases are separated from each other by hazard classes (oxidizers, etc.).

VII. TRANSPORTING CHEMICALS

The level of care and protection needed to transport a chemical must match the potential hazards of the chemical. This requires knowledge of the hazards associated with the chemical in transport and knowledge of protective measures.

BOTTLES AND JARS

Secondary containment containers should be available for transportation. Acid buckets, carts, and plastic tubs are available In the Chemistry Lab's preparation room. All chemicals must be placed in secondary containment while in transport. Transport incompatible chemicals separately; place incompatible chemicals in separate carriers. All concentrated acids and bases must be carried in acid carriers. Use care when crossing the thresholds between buildings.

Do not ride the elevator when transporting volatile chemicals. Label the cart "Do not ride with this elevator," send the cart up the elevator, and walk up the stairs to meet it. **If the elevator breaks down, you do not want to be trapped in a small space with volatile and hazardous chemicals.**

GAS CYLINDERS

Never transport cylinders with the regulator on. Before moving gas cylinders, insure that the valve cap is on. Use a gas cylinder hand truck for transport, and secure the cylinder to the truck with strap or chain. If the cylinder cart is collapsible, make sure you always push the cart instead of pull. The yellow carts can collapse when pulled over a threshold if you are not careful. Secure the cylinder to a counter or table before removing the valve cover.

Never ride the elevator with self-venting gas tanks (typically gases in liquid form). You could suffocate if trapped in the elevator with the tank.

DRY ICE

When transporting dry ice in a vehicle, keep it cool in the trunk, and **keep the windows open at all times.** The solid CO_2 is constantly subliming and could potentially suffocate you.

VIII. WASTE DISPOSAL

INTRODUCTION

A hazardous waste is a solid, liquid, or gas that poses a danger to human health or the environment. The generation and proper disposal of hazardous chemical waste is an issue of important legal and moral concern for this college. The college has an obligation to provide a safe environment for students and employees and to ensure that our hazardous waste is safely disposed of or treated.

REGULATORY BACKGROUND

Several federal, state, and local agencies may regulate laboratory hazardous wastes. These agencies could include the federal Environmental Protection Agency, the state Department of Ecology and Department of Labor and Industries, local fire department, and local sewer district.

Laboratories in non-compliance with hazardous waste regulations can be assessed significant fines and penalties. The college has established and supports a laboratory waste management policy. The Central Services Supervisor has the responsibility for coordinating hazardous materials management and ensuring regulatory compliance.

All generators of hazardous waste at the college should adopt management practices, which ensure careful management of chemicals and waste liquids. Staff and faculty can greatly reduce the quantity of waste generated through substitution of less hazardous chemicals and/or reduction of quantities used. In-lab treatments of waste by methods such as evaporation, separation, and neutralization can also help reduce the quantity of waste.

HAZARDOUS WASTE

In a lab program, the lab staff will decide whether waste must be collected for hazardous waste disposal. If you are involved in a project, you will determine what needs to be done with the waste before you start the project. When your experiment is completed or when the waste container is full, Store safely for pick up. Make sure your waste is well labeled at all times.

Pack your waste in a labeled, clean, non-leaking, capped container suitable for each particular waste product. Don't use stoppers (rubber or ground glass) or corks. Solid waste may be stored in a properly labeled Ziploc freezer bag. Waste is accumulated and temporarily stored in the waste lab. All waste must be labeled with the type of waste, quantity (volume), date, and the initials of the person placing the waste in the container. When sufficient quantities are in hand, it is packaged for disposal by a commercial waste disposal vendor.

IX. SAFE LAB TECHNIQUES

Safe lab technique requires knowledge of the correct type and use of equipment along with proper procedures. While each experiment will have specific procedures and cautions, some common equipment and techniques are listed here. Always know the proper techniques BEFORE starting any experiment.

IX-A. EQUIPMENT

Lab glassware is either SOFT or HARD glass. Below are characteristics of each:

SOFT GLASS

- Also called Flint glass
- Made from straight silicate
- Susceptible to thermal shock
- Softens easily in flame
- Costs less
- Should never be heated
- Best for chemical storage
- Comes in clear or brown
- Easily recycled

HARD GLASS

- Also called Pyrex or Kimax
- Made from boro- or alumino-silicate
- Resistant to thermal shock
- Needs oxygen-gas flame to manipulate
- Costs more
- Can be heated safely
- Best for lab work
- Generally comes in clear only
- Cannot be recycled

****See Appendix 8, "COMMON GLASSWARE," for further information.**

TYPES OF PLASTIC AND RUBBER

PLASTICS

The two most common plastics used in lab ware are polyethylene (PE, LDPE, HDPE) and polypropylene (PP). Other plastics sometimes used in lab ware are polycarbonate (PC), polystyrene (PS), Teflon (PTFE) and polyallomer (PPCO). Both PE and PP are resistant to most common lab chemicals. See Appendix 9 and resistance charts or online (one example: http://www.millerplastics.net/chemical_resistance_chart.html for more complete information.

AUTOCLAVABLE PLASTICS

Not all types of plastics are autoclavable. Generally for experiments that require the sterilization of your plastic containers, use polypropylene (PP). A useful mnemonic is that, for autoclaving, **"Polypropylene is proper".**

Not only is Teflon chemically resistant to most everything, it can be heated up to around 200 °C. It is used for such things as cap liners, special bottles, beakers for digestions, and sealer in gas lines. However it is significantly more expensive than other plastics.

Polycarbonate and Mylar can also be autoclaved, but polystyrene, Polyvinyl chloride (PVC), and most other plastics will melt at 121°C.

RUBBER/LATEX

Rubber in the lab is found primarily in the following five places:

- Gloves
- Flexible tubing
- Rubber stoppers
- Gaskets and septa
- Bottle-cap liners

The most common rubber and plastic compounds used in the lab are the following:

- Natural rubber – Black, Red, or Amber (most often called Latex)
- Nitrile – Blue, Purple, Green, or Black
- Neoprene – Blue or Black

- Poly Vinyl Chloride or PVC – Clear; PVC tubing also known as Tygon

It is imperative that you choose carefully which compounds to use in each situation. Latex gloves, for instance, will dissolve in many organic liquids (solvents); the wrong time to discover this is as it is happening to you. Similarly, PVC tubing or polyvinyl bottle-cap liners might not be the best materials to use with your chemical compounds. See Appendix 9 and the resistance charts for more information.

IX-B. SELECTION AND USE OF EQUIPMENT

- Know your equipment
- Know your procedure
- Take your time
- Don't compromise the safety of yourself or your equipment

ASSEMBLING APPARATUS

- Know all pieces you are using and be sure they are compatible with each other.
- Properly clamp and support all pieces of equipment.
- Do not place equipment on the floor.
- Choose an appropriate location for your set-up, ensuring there is sufficient space and access to needed facilities (such as water lines, air lines, etc.) and safety equipment.
- Assemble in a hood and/or use explosion shields for any hazardous operations. Use hood if any flammable or toxic vapors are generated.
- Plan for utilities failure and fluctuations. Secure by wiring on water tubing lines; anticipate a power failure and surge.

HEATING

- Use hot plate/stirrers, heating mantles, sand baths, and/or water baths for heating. Avoid using Bunsen burners. DO NOT use Bunsen burners when flammable materials (including vapors) are present.
- Use only hard glass, (Pyrex or Kimax). Make sure it is the appropriate size, is stable or clamped, and that it is properly vented. Wide mouthed containers such as beakers allow quicker and less violent evaporation
- Use hood if evolved products are flammable, explosive, or toxic.
- Use boiling chips or stones to prevent bumping and spattering. Check that the chips are compatible with your solution - some types CANNOT be used with certain strong acids, etc.

MIXING

- Use a container such as a beaker, Erlenmeyer flask, or round bottom flask for mixing and/or heating.
- Volumetric glassware, such as volumetric flasks, are designed only for measuring. Heating volumetric glassware may compromise the accuracy of the calibration.
- Volumetric glassware should not be used with anything that could scratch its inner surfaces such as glass stirring rod.

STORING

- Chemical resistance charts will help determine proper storage containers.
- Don't store solutions in volumetric glassware.
- Use plastic-coated glass safety bottles when storing strong acids or especially hazardous chemicals.
- Always ensure that the lid or stopper is made of material resistant to attack by the stored chemical. Don't use metal-foil lined lids when storing strong acids, or plastic lids when storing xylene.
- Standard taper ground glass stoppers stick easily in bottles, especially when used with strong bases or concentrated salts.

WEIGHING

- Use a container that will not react with what you are weighing.
- Use a completely clean container.
- If weighing a hazardous chemical (HMIS > 2), use a balance in a hood, along with appropriate eye protection and gloves.
- When weighing a volatile compound, be sure container is covered.

USING REDUCED PRESSURE (VACUUM)

- PROTECT YOUR EYES! LAB GLASSES TOGETHER WITH A FULL-FACE SHIELD ARE BEST.
- Inspect glassware before using, looking for star cracks and lines.
- Use thick-walled containers and vacuum tubing. This will make implosion less likely.
- Glassware can be wrapped in heavy tape to minimize hazards in the event of implosion.
- Always use a vacuum trap with a vent. This will protect your sample from contamination, and will minimize the likelihood of blowback.
- Always secure the apparatus with lab clamps.
- Know when it is necessary to use lubricating grease, keeping in mind the compatibility of the grease with chemicals being used.
- Consider working behind an explosion shield or in a hood if necessary, especially if explosive chemicals are involved.
- For larger volumes, a round bottom flask is recommended rather than an Erlenmeyer due to greater structural strength.

USING HIGH PRESSURE

- PROTECT YOUR EYES! LAB GLASSES TOGETHER WITH A FULL-FACE SHIELD ARE BEST.
- Inspect glassware before using, looking for star cracks and lines.
- Use thick-walled containers.
- Use reinforced-wall tubing.
- Use plastic if possible. It's less strong than glass, but won't shatter.
- ALWAYS SECURE THE APPARATUS, INCLUDING TUBING, WITH LAB CLAMPS.

USING A FUME HOOD

- If you are unfamiliar with any of the hood functions, request instruction from your faculty or staff.
- Be sure the hood is working, and if the flow rate for the velocity controller is adjustable, set it at the normal rate of 100 ft/min.
- A sash height of 18 inches is the maximum recommended. Keep the sash opening height as low as possible for maximum user safety.
- Never put your head into the hood for any reason while working.
- To conserve energy, close the sash when not in use. If you can adjust the velocity controller, set it to 50 ft/min.

ELECTRICAL

- Electrical equipment must be properly grounded.
- Do not use electrical wires as supports.
- Inspect all equipment before use, checking for plugs and cords in good condition (not frayed), and that plugs are three wire grounded.
- Be aware of sources of sparks and static electricity when around or using any flammable materials and vapors. These sources include equipment with switches and running motors. If you need to turn equipment off under these conditions, unplug it.

CENTRIFUGE

- Students must be trained by faculty or lab staff before using floor models.
- Use centrifuge tubes (not test tubes) and balance them properly by placing balance tubes of equal weight on opposite sides of the sample tubes.
- Do not open centrifuge lid during operation. DO NOT open lid until centrifuge rotor has come to a complete stop.
- Be sure rotor is properly attached and secured with retaining nut.
- Turn off centrifuge immediately if it starts to vibrate or move across the table.
- Clean the centrifuge chamber after use, if needed. Ice or oil collects quickly in some centrifuges.

AUTOCLAVE

- Students must be trained by faculty or lab staff before using.
- Only use appropriate containers, hard glass, and polypropylene. See Appendix 9.
- Only autoclave items in wire racks or PP tubs (no loose loads).
- Report all spills or steam leaks to the Lab Coordinator.

UV LAMPS

UV lamps produce radiation that is damaging to the eye and skin and can cause severe sunburns. These lamps also can get hot and can cause burns.

- Wear goggles or glasses with side shields and brow bar. Be sure they are approved for UV use.
- Intense UV lamps produce ozone and must be used in a ventilated area.
- Do not touch glass portions of UV lamps. The oils from your skin can cause the lamps to overheat and crack.

LASERS

- Never look directly into the beam or pump source. Be sure you know what type of laser you are using (visible or invisible).
- Beware of objects that will reflect laser beam. Never point the laser into the room or out a window (lasers reflect off glass).
- Keep room light level HIGH. Low levels dilate pupils and increase eye damage hazard.

APPENDIX 1

COMMON SOLVENT PROPERTIES

SOLVENT CLASS	TLV /TWA	Flash Point	Boiling Point	HMIS Ratings			HAZARDS,TOXICITY
	ppm	°F	°F	F	H	R	
ALCOHOLS (most polar)							
Ethanol: Grain alcohol, ethyl alcohol	1000	60	173	1	3	1	Flammable
Isopropyl alcohol	400	53	82	1	3	1	Flammable
Isoamyl alcohol	100	109	270	2	2	1	Flammable
Methanol: Wood alcohol, wood naphtha	200	54	149	3	3	1	**POISON**, Flammable
KETONES / ESTERS							
Acetone	750	0	133	2	4	1	**VERY FLAMMABLE**
Ethyl acetate	400	24	171	2	3	0	Flammable
Ethyl ether: Ether, anhydrous ether	400	-49	95	2	4	2	**VERY FLAMMABLE**
Methyl ethyl ketone(MEK)	200	20	176	2	4	2	**VERY FLAMMABLE**
Dimethyl formamide (DMF)	10	136	307	3	2	1	**POISON**
CHLORINATED HYDROCARBONS							
Chloroform	10	NA	142	3	0	1	PROBABLE CARCINOGEN
Methylene chloride	50	NA	104	3	1	1	PROBABLE CARCINOGEN
Carbon tetrachloride	5	NA	171	3	0	1	PROBABLE CARCINOGEN

AROMATICS							
Toluene	100	40	232	2	3	0	Flammable
Xylene	100	80	279	2	3	0	Flammable
Benzene	10	12	176	4	3	0	**KNOWN CARCINOGEN**, Flammable
HYDROCARBONS (least polar)							
Gasoline (may contain benzene)	300	-45	102	2	4	1	**VERY FLAMMABLE**
Hexane	50	-7	156	1	3	0	Flammable
Heptane	400	25	208	1	3	0	Flammable
Kerosene ~80% paraffins, ~20% aromatics	200	100	170-300	1	2	0	
Mineral spirits Heavier fractions: ~80% saturate hydrocarbons, ~20% aromatics and olefins**.** Benzin, benzine, benzoline, canadol, ligroin, mineral thinner, mineral turpentine, painter's naphtha, refined solvent naphtha, solvent naphtha, Stoddard solvent, VM&P naphtha, white spirits. There are further divisions of minerals spirits based on F.P. and B.P.	300	100-120	250-350	2	2	0	
Petroleum spirits Lighter fractions of hydrocarbon mixtures - mostly pentanes and hexanes. Light ligroin, petroleum naphtha, petroleum distillate, petroleum ether.	400	-50 to -20	30-90	1	4	0	**VERY FLAMMABLE**
Limonene Terpene hydrocarbon; "Citra-safe"	NA	NA	176	2	1	1	
Turpentine Gum spirits	100	90-115	310-340	1	2	0	
Linseed oil	NA	252	343	0	1	1	

When selecting a solvent, choose one that minimizes hazards. To substitute, select one that is in the same solvent class, or is close to that solvent class in polarity: alcohols are most polar, then ketones/esters, chlorinated hydrocarbons, aromatics, and hydrocarbons as the least polar.

APPENDIX 2

EXAMPLE OF A MATERIAL SAFETY DATA SHEET (MSDS)

Material Safety Data Sheet

Methanol

ACC# 14280

Section 1 - Chemical Product and Company Identification

MSDS Name: Methanol
Catalog Numbers: AC167830000, AC167830025, AC167835000, AC176840000, AC176840010, AC176840025, AC176840250, AC176845000, AC177150000, […abbreviated]
Synonyms: Carbinol; Methyl alcohol; Methyl hydroxide; Monohydroxymethane; Wood alcohol; Wood naptha; Wood spirits; Columbian spirits; Methanol.
Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
67-56-1	Methanol	> 99	200-659-6

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: APHA: 10 max clear liquid. Flash Point: 12 deg C.
Danger! Poison! May be fatal or cause blindness if swallowed. Vapor harmful. **Flammable liquid and vapor.** Harmful if swallowed, inhaled, or absorbed through the skin. Causes eye, skin, and respiratory tract irritation. May cause central nervous system depression. Cannot be made non-poisonous.
Target Organs: Eyes, nervous system, optic nerve.

Potential Health Effects
Eye: May cause painful sensitization to light. Methanol is a mild to moderate eye irritant. Inhalation, ingestion or skin absorption of methanol can cause significant disturbances in vision, including blindness.
Skin: Causes moderate skin irritation. May be absorbed through the skin in harmful amounts. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis. Methanol can be absorbed through the skin, producing systemic effects that include visual disturbances.
Ingestion: May be fatal or cause blindness if swallowed. Aspiration hazard. Cannot be made non-poisonous. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause cardiopulmonary system effects.
Inhalation: Methanol is toxic and can very readily form extremely high vapor concentrations at room temperature. Inhalation is the most common route of occupational exposure. At first, methanol causes CNS depression with nausea, headache, vomiting, dizziness and incoordination. A time period with no obvious symptoms follows (typically 8-24 hrs). This latent period is followed by metabolic acidosis and severe visual effects which may include reduced reactivity and/or increased sensitivity to light, blurred, double and/or snowy vision, and blindness. Depending on the severity of exposure and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects.
Chronic: Prolonged or repeated skin contact may cause dermatitis. Chronic exposure may cause effects similar to those of acute exposure. Methanol is only very slowly eliminated from the body. Because of this slow elimination, methanol should be regarded as a cumulative poison. Though a single exposure may cause no effect, daily exposures may result in the accumulation of a harmful amount. Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations that did not produce significant maternal toxicity.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for a t least 15 minutes. Get medical aid.
Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.
Ingestion: Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by

mouth to an unconscious person. If vomiting occurs naturally, have victim lean forward. **Inhalation:** If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician: Effects may be delayed.

Antidote: Ethanol may inhibit methanol metabolism.

Section 5 - Fire Fighting Measures

General Information: Ethanol may inhibit methanol metabolism. As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Use water spray to keep fire-exposed containers cool. Water may be ineffective. Material is lighter than water and a fire may be spread by the use of water. Vapors are heavier than air and may travel to a source of ignition and flash back. Vapors can spread along the ground and collect in low or confined areas.

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or alcohol-resistant foam. Water may be ineffective. For large fires, use water spray, fog or alcohol-resistant foam. Do NOT use straight streams of water.

Flash Point: 12 deg C (53.60 deg F)

Auto ignition Temperature: 455 deg C (851.00 deg F)

Explosion Limits, Lower:6.0 vol %

Upper: 31.00 vol %

NFPA Rating: (estimated) Health: 1; Flammability: 3; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Use water spray to disperse the gas/vapor. Remove all sources of ignition. Absorb spill using an absorbent, non-combustible material such as earth, sand, or vermiculite. Do not use combustible materials such as sawdust. Use a spark-proof tool. Provide ventilation. A vapor suppressing foam may be used to reduce vapors. Water spray may reduce vapor but may not prevent ignition in closed spaces.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Ground and bond containers when transferring material. Use spark-proof tools and explosion proof equipment. Avoid contact with eyes, skin, and clothing. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep container tightly closed. Do not ingest or inhale. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose empty containers to heat, sparks or open flames. Use only with adequate ventilation. Keep away from heat, sparks and flame. Avoid use in confined spaces.

Storage: Keep away from heat, sparks, and flame. Keep away from sources of ignition. Store in a cool, dry, well-ventilated area away from incompatible substances. Flammables-area. Keep containers tightly closed.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Methanol	200 ppm TWA; 250 ppm STEL; Skin - potential significant contribution to overall exposure by the cutaneous route	200 ppm TWA; 260 mg/m3 TWA 6000 ppm IDLH	200 ppm TWA; 260 mg/m3 TWA

OSHA Vacated PELs: Methanol: 200 ppm TWA; 260 mg/m3 TWA

Personal Protective Equipment

Eyes: Wear chemical splash goggles.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Clear liquid

Appearance: clear, colorless - APHA: 10 max

Odor: alcohol-like - weak odor

pH: Not available.

Vapor Pressure: 128 mm Hg @ 20 deg C

Vapor Density: 1.11 (Air=1)

Evaporation Rate:5.2 (Ether=1)

Viscosity: 0.55 cP 20 deg C

Boiling Point: 64.7 deg C @ 760 mmHg

Freezing/Melting Point:-98 deg C

Decomposition Temperature: Not available. **Solubility:** miscible

Specific Gravity/Density:.7910 g/cm3 @ 20EC

Molecular Formula:CH4O

Molecular Weight:32.04

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures. **Conditions to Avoid:** High temperatures, ignition sources, confined spaces. **Incompatibilities with Other Materials:** Oxidizing agents, reducing agents, acids, alkali metals, potassium, sodium, metals as powders (e.g. hafnium, raney nickel), acid anhydrides, acid chlorides, powdered aluminum, and powdered magnesium.
Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide, formaldehyde.
Hazardous Polymerization: Will not occur.

Section 11 - Toxicological Information

RTECS#:
CAS# 67-56-1: PC1400000
LD50/LC50:
CAS# 67-56-1:

Draize test, rabbit, eye: 40 mg Moderate;
Draize test, rabbit, eye: 100 mg/24H Moderate;
Draize test, rabbit, skin: 20 mg/24H Moderate;
Inhalation, rabbit: LC50 = 81000 mg/m3/14H;
Inhalation, rat: LC50 = 64000 ppm/4H;
Oral, mouse: LD50 = 7300 mg/kg;
Oral, rabbit: LD50 = 14200 mg/kg;
Oral, rat: LD50 = 5600 mg/kg;
Skin, rabbit: LD50 = 15800 mg/kg;

.
Human LDLo Oral: 143 mg/kg; Human LDLo Oral: 428 mg/kg; Human TCLo Inhalation; 300 ppm caused visual field changes & headache; Monkey LDLo Skin: 393 mg/kg. Methanol is significantly less toxic to most experimental animals than humans, because most animal species metabolize methanol differently. Non-primate species do not ordinarily show symptoms of metabolic acidosis or the visual effects which have been observed in primates and humans.
Carcinogenicity:
CAS# 67-56-1: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information found
Teratogenicity: There is no human information available. Methanol is considered to be a potential developmental hazard based on animal data. In animal experiments, methanol has caused fetotoxic or teratogenic effects without maternal toxicity.
Reproductive Effects: See actual entry in RTECS for complete information.
Mutagenicity: See actual entry in RTECS for complete information.

Neurotoxicity: ACGIH cites neuropathy, vision and CNS under TLV basis.
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Fathead Minnow: 29.4 g/L; 96 Hr; LC50 (unspecified)Fish: Goldfish: 250 ppm; 11 Hr; resulted in deathFish: Rainbow trout: 8000 mg/L; 48 Hr; LC50 (unspecified)Fish: Rainbow trout: LC50 = 13-68 mg/L; 96 Hr.; 12 degrees CFish: Fathead Minnow: LC50 = 29400 mg/L; 96 Hr.; 25 degrees C, pH 7.63Fish: Rainbow trout: LC50 = 8000 mg/L; 48 Hr.; Unspecified Bacteria: Phytobacterium phosphoreum: EC50 = 51,000-320,000 mg/L; 30 minutes; Microtox test No data available.
Environmental: Dangerous to aquatic life in high concentrations. Aquatic toxicity rating: TLm 96>1000 ppm. May be dangerous if it enters water intakes. Methyl alcohol is expected to biodegrade in soil and water very rapidly. This product will show high soil mobility and will be degraded from the ambient atmosphere by the reaction with photochemically produced hydroxyl radicals with an estimated half-life of 17.8 days. Bioconcentration factor for fish (golden ide) < 10. Based on a log Kow of -0.77, the BCF value for methanol can be estimated to be 0.2.
Physical: No information available.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 67-56-1: waste number U154 (Ignitable waste).

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	METHANOL	METHANOL
Hazard Class:	3	3
UN Number:	UN1230	UN1230
Packing Group:	II	II

Additional Info:		FLASHPOINT 11 C

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 67-56-1 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 67-56-1: 5000 lb final RQ; 2270 kg final RQ **SARA**

Section 302 Extremely Hazardous Substances None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 67-56-1: immediate, fire.

Section 313

This material contains Methanol (CAS# 67-56-1, > 99%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.

Clean Air Act:

CAS# 67-56-1 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.

None of the chemicals in this product are listed as Priority Pollutants under the CWA.

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 67-56-1 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T F

Risk Phrases:

R 11 Highly flammable.
R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25 Toxic : danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.

Safety Phrases:

S 16 Keep away from sources of ignition - No smoking.
S 36/37 Wear suitable protective clothing and gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 7 Keep container tightly closed.

WGK (Water Danger/Protection)

CAS# 67-56-1: 1

Canada - DSL/NDSL

CAS# 67-56-1 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of B2, D1B, D2B.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 67-56-1 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/21/1999
Revision #14 Date: 9/05/2006

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

APPENDIX 3

COMMON OXIDIZING AND REDUCING AGENTS

OXIDIZING AGENTS	REDUCING AGENTS
Bleach	Alkali metals
Chromates	Diborane
Dichromates	Hydrogen
Halates	Magnesium
Halogens	Metal hydrides ($NaBH_4$, $LiALH_4$)
Hydrogen peroxide	Nickel (finely divided)
Hydroperoxides	Organometal hydrides
Nitrates	Phosphorous (white)
Nitric acid	Zinc
Nitrites	
Oxygen	
Ozone	
Perchloric acid	
Perhalates	
Permanganates	
Peroxides	
Persulfates	
Sulfuric acid	
Cleaning solutions such as alcoholic KOH	

APPENDIX 4

SOME KNOWN OR SUSPECTED CARCINOGENS

Taken from: http://ptcl.chem.ox.ac.uk/MSDS/carcinogens.html

A-alpha-C (2-Amino-9H-pyrido[2,3-b]indole)
Acetaldehyde
Acetamide
Acetochlor
2-Acetylaminofluorene
Acifluorfen
Acridine
Acrolein
Acrylamide
Acrylonitrile
Actinomycin D
Adriamycin (Doxorubicin hydrochloride)
AF-2;[2-(2-furyl)-3-(5-nitro-2-furyl)]acrylamide
Aflatoxins
Agaritine
Alachlor
Aldrin
Allyl chloride
Allyl glycidyl ether
Allyl isothiocyanate
Allyl isovalerate
Aluminium products
2-Aminoanthraquinone
p-Aminoazobenzene
o-Aminoazotoluene [solvent yellow 3]
4-Aminobiphenyl (4-aminodiphenyl)
3-Amino-9-ethylcarbazole hydrochloride
1-Amino-2-methylanthraquinone
Amitrole
Ammonium dichromate
Analgesic mixtures containing phenacetin
Androgenic (anabolic) steroids
Aniline
ortho-Anisidine
ortho-Anisidine hydrochloride
para-anisidine
anthanthrene
Antimony oxide (antimony trioxide)
Aramite
Arsenic (inorganic arsenic compounds)
Asbestos
Auramine
Azaserine
Azathioprine
Azacitidine
Azobenzene
Azathioprine

Benz[a]anthracene
Benzene
Benzidine [and its salts]
Benzidine-based dyes
Benzo[b]fluoranthene
Benzo[j]fluoranthene
Benzo[k]fluoranthene
Benzofuran
Benzo[a]pyrene
Benzotrichloride
Benzyl chloride
Benzyl violet 4B
Beryllium and beryllium compounds
Bis(2-chloroethyl)ether N,N-Bis(2-chloroethyl)-2- naphthylamine (Chlornapazine) Bischloroethyl nitrosourea (BCNU) (Carmustine)
Bis(chloromethyl)ether and technical-grade chloromethyl methyl ether
Bitumens, extracts of steam-refined and air refined
Bleomycins
Bracken fern
Bromodichloromethane
2-bromoethyl ether
Bromoform
1,3-Butadiene
1,4-Butanediol dimethanesulfonate (Busulfan, myleran)
Butylated hydroxyanisole (BHA)
t-butyl methyl ether
beta-Butyrolactone

Cadmium and cadmium compounds
Caffeic acid
Captafol
Captan
Carbazole
Carbon tetrachloride
Carbon-black extracts
Carrageenan, degraded
Ceramic fibers (airborne particles of respirable size)
Chlorambucil
Chloramphenicol
chlorbenzilat
Chlordane
Chlordecone (Kepone)
Chlordimeform
Chlorendic acid
Chlorinated Parrafins
alpha-Chlorinated toluenes
p-Chloroaniline
Chlormadinone aceate
Chlornaphazine[n,n-bis(2-chloroethyl)-2-naphthylamine]
Chlorodibromomethane
Chloroethane (ethyl chloride)
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU) (Lomustine)
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)
Chloroform
Chloromethyl methyl ether
3-Chloro-2-methylpropene
4-Chloro-ortho-phenylenediamine
p-Chloro-o-toluidine
Chlorophenols
Chlorophenoxy herbicides
Cloroprene
Chlorothalonil
Chlorozotocin
Chromium
Chromium (hexavalent compounds)
Chrysene
C.I. Acid Red 114
C.I. Basic Red 9 monohydrochloride
Ciclosporin (Cyclosporin A; Cyclosporine)
Cinnamyl anthranilate
Cisplatin
Citrus Red No. 2
Clofibrate
Coal gasification products
Coal-tars and pitches
Cobalt metal powder
Cobalt [II] oxide
Conjugated estrogens
Copper acetoarsenite
Creosotes
Crystal violet
para-Cresidine
Cupferron
Cycasin
Cyclamates
1,4-cyclohexadiene
Cyclophosphamide (anhydrous)
Cyclophosphamide (hydrated)

D&C Orange No. 17
D&C Red No. 8
D&C Red No. 9
D&C Red No. 19
Dacarbazine
Daminozide
Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone)
dapsone
Daunomycin
DCM

DDD (Dichlorodiphenyldichloroethane)
DDE (Dichlorodiphenyldichloroethylene)
DDT (Dichlorodiphenyltrichloroethane)
DDVP (Dichlorvos)
Decabromodiphenyl ether
N,N'-Diacetylbenzidine
2,4-Diaminoanisole
2,4-Diaminoanisole sulfate
4,4'-Diaminodiphenyl ether (4,4'-Oxydianiline)
2,4-Diaminotoluene
Diaminotoluene (mixed)
Dibenz[a,h]acridine
Dibenz[a,j]acridine
Dibenz[a,h]anthracene
7H-Dibenzo[c,g]carbazole
Dibenzo[a,e]pyrene
Dibenzo[a,h]pyrene
Dibenzo[a,i]pyrene
Dibenzo[a,l]pyrene
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane
2,3-Dibromo-1-propanol
p-Dichlorobenzene
3,3'-Dichlorobenzidine
3,3'-Dichlorobenzidine dihydrochloride
1,4-Dichloro-2-butene
3,3'-Dichloro-4,4'-diaminodiphenyl ether
1,1-Dichloroethane
1,2-Dichloroethane
Dichloromethane (Methylene chloride)
1,2-Dichloropropane
1,3-Dichloropropene
Dieldrin
Dienestrol
Diepoxybutane
Di(2-ethylhexyl)phthalate
1,2-Diethylhydrazine
Diethyl sulfate
DES, Diethylstilbestrol
Diglycidyl resorcinol ether (DGRE)
Dihydrosafrole
Diisopropyl sulfate
3,3'-Dimethoxybenzidine (ortho-Dianisidine)
3,3'-Dimethoxybenzidine dihydrochloride (ortho-dianisidine dihydrochloride)
para-Dimethylaminoazobenzene
4-Dimethylaminoazobenzene
trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]-1,3,4-oxadiazole
7,12-Dimethylbenz(a)anthracene
3,3'-Dimethylbenzidine (ortho-Tolidine)
3,3'-Dimethylbenzidine dihydrochloride
Dimethylcarbamoyl chloride
1,1-Dimethylhydrazine (UDMH)
1,2-Dimethylhydrazine
Dimethyl sulfate
Dimethylvinyl Chloride
2,4-dinitrofluorobenzene
1,6-Dinitropyrene
1,8-Dinitropyrene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
1,4-Dioxane
1,2-diphenylhydrazine (hydrazobenzene)
Diphenylhydantoin (Phenytoin)
Diphenylhydantoin (Phenytoin), sodium salt
Direct Black 38
Direct Blue 6
Direct Brown 95
Disperse Blue 1

Epichlorohydrin
Erionite
Estradiol 17B
Estrogens (not conjugated)

- Estradiol-17
- Estrone
- Ethinylestradiol
- Mestranol

Estrone
Ethinylestradiol
Ethyl acrylate
Ethyl methanesulfonate
Ethyl-4,4'-dichlorobenzilate
Ethylene dibromide
Ethylene dichloride (1,2-Dichloroethane)
N-Ethyl-N-nitrosourea
Ethylene oxide
Ethylene thiourea
Ethyleneimine

Folpet
Formaldehyde (gas or aqueous solution)
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl) thiazole
Furan
Furazolidone
Furmecyclox
Fusarin C

Glasswool fibers (airborne particles of respirable size)
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3', 2'-d]imidazole)
Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'-d]imidazole)
Glycidaldehyde
Glycidol
Griseofulvin
Gyromitrin (Acetaldehyde methylformylhydrazone)

HC Blue 1
Heptachlor Heptachlor epoxide
Hexachlorobenzene
Hexachlorocyclohexanes
Hexachlorodibenzodioxin
Hexachloroethane
Hexamethylphosphoramide
Hydrazine
Hydrazine dihydrobromide
Hydrazine sulfate
Hydroquinone
Hydroxybutyric acid lactone

Indeno [1,2,3-cd]pyrene
Indium trichloride
IQ (2-Amino-3-methylimidazo[4,5-f]quinoline)
Iron dextran complex
Isosafrole

Kepone (Chlordecone)

Lactofen
Lasiocarpine
Lead
Lead acetate Lead phosphate
Lindane and other hexachlorocyclohexane isomers

Mancozeb
Maneb
Me-A-alpha-C (2-Amino-3-methyl-9H-pyrido[2, 3-b]indole)
Medroxyprogesterone acetate
MeIQ(2-Amino-3,4-dimethylimidazo[4,5-f]quinoline)
MeIQx(2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline)
Melphalan
Merphalan
Mestranol
2-Methylaziridine (Propyleneimine)
Methylazoxymethanol
Methylazoxymethanol acetate
3-Methylcholanthrene
5-Methylchrysene
4,4'-Methylene bis(2-chloroaniline) (MOCA)
4,4'-Methylene bis(N,N-dimethyl)benzenamine
4,4'-Methylene bis(2-methylaniline)
4,4'-Methylenedianiline
4,4'-Methylenedianiline dihydrochloride
Methylhydrazine and its salts
Methyl chloromethyl ether
Methyl-CCNU
Methyl iodide
Methyl methanesulfonate
2-Methyl-1-nitroanthraquinone
N-Methyl-N'-nitro-N-nitrosoguanidine (MNNG)
N-Methyl-N-nitrosourea
N-Methylolacrylamide
Methylthiouracil
Metiram
Metronidazole
Michler's ketone
Mineral Oils, untreated and mildly treated
Mirex
Mitomycin C
MOPP
Monocrotaline
5-(Morpholinomethyl)-3-[(5-nitro-

fufurylidene)-amino]-2-oxazolidinone
Mustard gas

Nafenopin
1-Naphthylamine
2-Naphthylamine
3-Naphthylamine
Nickel and certain nickel compounds
Nickel carbonyl
Nickel subsulfide
Niridazole
Nitrilotriacetic acid
Nitrilotriacetic acid, trisodium salt monohydrate
5-Nitroacenaphthene
5-Nitro-o-anisidine
o-Nitroanisole
4-Nitrobiphenyl
6-Nitrochrysene
Nitrofen
2-Nitrofluorene
Nitrofurazone
1-[(5-Nitrofurfurylidene)amino]-2-imidazollidinone
1-[(5-Nitrofurfurylidene)-N-[4-(5-Nitro-2-furyl)-2 thiazolyl]acetamide
Nitrogen mustard (Mechlorethamine)
Nitrogen mustard hydrochloride (Mechlorethamine hydrochloride)
Nitrogen mustard N-oxide
Nitrogen mustard N-oxide hydrochloride
2-Nitropropane
4-Nitropyrene
N-Nitrosodi-n-butylamine
N-Nitrosodiethanolamine
N-Nitrosodiethylamine
N-Nitrosodimethylamine
p-Nitrosodiphenylamine
N-Nitrosodiphenylamine
N-Nitrosodi-n-propylamine
N-Nitroso-N-ethylurea
3-(N-Nitrosomethylamino)propionitrile
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)
N-Nitrosomethylethylamine
N-Nitroso-N-methylurea
N-Nitroso-N-methylurethane
N-Nitrosomethylvinylamine
N-Nitrosomorpholine
N-Nitrosonornicotine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
N-Nitrososarcosine
Norethisterone (Norethindrone)

Ochratoxin A
Oestrogen, nonstreoidal
Oestrogen, steroidal
Oil Orange SS
4,4'-Oxydianiline
Oxadiazon
Oxymetholone
Oxazepam

Panfuran S
Pentachlorophenol
Perylene
Phenacetin
Phenazopyridine hydrochloride
Phenesterin
Phenobarbital
Phenolphthalein
Phenoxybenzamine
Phenoxybenzamine hydrochloride
Phenyl glycidyl ether
Phenylhydrazine and its salts
o-Phenylphenate, sodium
2-phenylphenol
Phenytoin
PhiP(2-Amino-1-methyl-6-phenylimidazol[4,5-b]pyridine)
Polybrominated biphenyls
Polychlorinated biphenyls
Polychlorinated dibenzo-p-dioxins
Polychlorinated dibenzofurans
Polycyclic aromatic hydrocarbons
Polygeenan
Ponceau MX
Ponceau 3R
Potassium bromate
Potassium dichromate
Procarbazine
Procarbazine hydrochloride
Procymidone
Progesterone
Progestins
1,3-Propane sultone
Progargite
beta-Propiolactone
Propylene oxide
Propylthiouracil
Pyridinium chlorochromate

Radionuclides
Radon
Reserpine
Residual (heavy) fuel oils
Rhodamine 101

Saccharin
Saccharin, sodium
Safrole
Selenium sulfide
Shale-oils
Silica, crystalline (airborne particles of respirable size)
Sodium chromate tetrahydrate
Sodium dichromate
Sodium hexafluoroarsenate(V)
Sodium ortho-phenylphenate
Sterigmatocystin
Streptozotocin
Strontium chromate
Styrene
Styrene oxide
Sulfallate
Sulfur trioxide
Sulphur trioxide N,N-dimethylformamide complex

Talc containing asbestiform fibers
Terrazole
Testosterone and its esters
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)
1,1,2,2-Tetrachloroethane
Tetrachloroethylene (Perchloroethylene)
p-a,a,a-Tetrachlorotoluene
3,3',5,5'-tetramethylbenzidine
Tetranitromethane
Thioacetamide
4,4'-Thiodianiline
Thiourea
Thorium dioxide
Tobacco, oral use of smokeless products
Tobacco smoke
Toluene diisocyanate
p-toluenesulphonic acid
ortho-Toluidine
ortho-Toluidine hydrochloride
para-Toluidine
Toxaphene
Treosulfan (Tresoluphan)
Trichlormethine (Trimustine hydrochloride)
2,4,6-Trichlorophenol
1,2,3-Trichloropropane
Triphenyltin hydroxide
Trichloroethylene
Tris(aziridinyl)-para-benzoquinone (Triaziquone)
Tris(1-aziridinyl)phosphine sulfide (Thiotepa)
Tris(2-chloroethyl) phosphate
Tris(2,3-dibromopropyl)phosphate
TRIZMA base
Trp-P-1 (Tryptophan-P-1) (3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole)
Trp-P-2 (Tryptophan-P-2) (3-Amino-1-methyl-5H-pyrido[4,3-b]indole)
Trypan blue

Uracil mustard
Urethane (Ethyl carbamate)

Vinyl bromide
Vinyl chloride
4-Vinyl-1-cyclohexene diepoxide (Vinyl cyclohexene dioxide)
n-vinyl pyrollidone
Vinyl pivalate
Vinyl trichloride (1,1,2-Trichloroethane)

2,6-Xylidine (2,6-Dimethylaniline)

Zineb

This list is by no means complete and is continually being tested and updated.

APPENDIX 5

EXAMPLES OF INCOMPATIBLE CHEMICALS IN STORAGE FACILITIES

In general, chemicals with the following functional groups are prone to instability:

O-O peroxide	-N= imino	-ONO_2 nitrate ester
-NO_2 nitro	-N_3 azide	-$NHNO_2$ nitramine
-N=N- Azo	-N=O nitroso	-N-NO_2 nitroamine

CHEMICAL	CHEMICALS INCOMPATIBLE TO STORE WITH
Acetic acid	Nitric acid, peroxides, permanganates, ethylene, glycol, hydroxyl compounds, perchloric acid, or chromic acid
Acetone	Concentrated sulfuric and nitric acid
Acetylene	Bromine, chlorine, fluorine, copper, silver, mercury and their compounds
Alkali metals	Carbon tetrachloride, carbon dioxide, water, halogens
Aluminum or magnesium metal (powdered)	Carbon tetrachloride, or other chlorinated hydrocarbons, halogens, carbon dioxide
Ammonia, liquid	Mercury, hydrogen fluoride, calcium hypochlorite, chlorine, bromine
Ammonium nitrate	Acids, flammable liquids, metal powders, sulfur, chlorates, any finely divided organic or combustible substance.
Aniline	Nitric acid and hydrogen peroxide
Bromine, chlorine	Ammonia, petroleum gases, hydrogen, sodium, benzene, finely divided metals
Carbon, activated	Calcium hypochlorite and all oxidizing agents

Chlorates	Ammonium salts, acids, metal powders, sulfur, and finely divided organic or combustible substance
Copper	Acetylene and hydrogen peroxide
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, sodium peroxide, nitric acid, and the halogens
Hydrocarbons (hexane, gasoline)	Fluorine, chlorine, bromine, sodium peroxide and chromic acid
Hydrofluoric acid	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Most metals and their salts, alcohols, organic substances, any flammable substance
Hydrogen sulfide	Oxidizing gases, fuming nitric acid
Iodine	Acetylene, ammonia, hydrogen
Mercury	Acetylene, ammonia
Nitric acid (concentrated)	Acetic acid, hydrogen sulfide, flammable liquids and gases, aniline
Oxygen	Oils, grease, hydrogen, flammable liquids, solids and gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohols, paper, wood, and other organic material
Phosphorus pentoxide	Water
Potassium chlorate	Sulfuric and other acids, any organic material
Potassium permanganate	Sulfuric acid, glycerine, ethylene glycol
Silver	Acetylene, ammonia compounds, oxalic acid, tartaric acid
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, carbon disulfide, glycerine, ethylene glycol, ethyl acetate
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate, similar compounds of other metals

APPENDIX 6

MAXIMUM ALLOWABLE CONTAINER CAPACITY FOR FLAMMABLE LIQUIDS

	Flammable Liquids			Combustible Liquids
CLASS:	**IA**	**IB**	**IC**	**II and IIIA**
Flash Point Range (°C):	fp <23	fp <23	fp 23-38	fp >38
Boiling Point Range (°C):	bp <38	bp >38	bp --	bp --

CONTAINER TYPE MAXIMUM ALLOWABLE CAPACITY

CLASS:	IA	IB	IC	II & IIIA
Glass	0.5 L	1 L	4 L	4 L
Metal (other than DOT drum) or Approved Plastic	4 L	20 L	20 L	20 L
Safety cans	7.5 L	20 L	20 L	20
Metal Drums (DOT)	Not allowed	225 L	225 L	225 L

APPENDIX 7

COMMON GLASSWARE

Beaker:
Material type: Hard glass
Common sizes: 50-2000ml
Common uses: Heating, mixing, dissolving, pouring.

Erlenmeyer:
Material type: Hard glass
Common sizes: 50-2000ml
Common uses: Mixing; dissolving.

Filter flask:
Material type: Hard glass
Common sizes: 125-2000ml
Common uses: Vacuum filtration; vacuum trap.

Round Bottom Boiling flask: Material type: Hard glass
Common sizes: 50-5000ml; 1-, 2-, or 3-hole type
Common uses: Refluxing, distillations.

Graduated cylinder:
Material type: Hard glass
Common sizes: 10-1000ml
Common uses: Measuring with moderate accuracy.

Volumetric flask: Material type:
Hard glass Common sizes: 1.00 -
2000.00ml
Common uses: Measuring with great accuracy;
predetermined volume.

Volumetric pipette: Material
type: Hard glass Common
sizes: 1.00 - 50.00ml
Common uses: Accurate measurement of single volume.

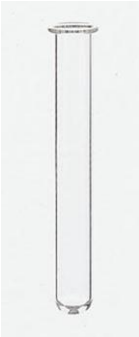
Serological pipette:
Material type: Hard glass, soft glass, or plastic
Common sizes: 0.1 -10ml
Common uses: Transferring solutions; moderately accurate measurement.

Pasteur pipits :(

disposable) Material type:

Hard glass

Common sizes: 5.25", 9"
Common uses: Non-accurate transfer of small volumes.

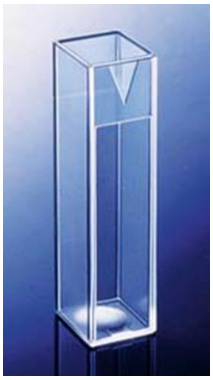


Test tube:
Material type: Hard glass
Common sizes: 10x100-15x175mm (width x length)
Common uses: Mixing small amounts; temporary storage of small volumes.

Centrifuge tubes:
Material type: Hard glass; plastic
Common sizes: 3-500ml; thicker walled than test tubes
Common uses: Separating components of sample with centrifuge.

Culture tube:
Material type: Soft glass, hard glass, plastic
Common sizes: (6x50)-(20x200)mm (width x length)
Common uses: Growing cultures; general purpose small containers.

Petri dish:
Material type: Hard glass; plastic
Common sizes: 60x15-150x15mm (diameter x height)
Common uses: Growing cultures.



Cuvettes:
Material type: Glass, quartz, UV-transparent plastic
Common sizes: 1-10mm path length
Common uses: Spectrophotometric analysis.

Glass tubing:
Material type: Hard glass; soft glass
Common sizes: 0.5-35mm I.D.; 4-37mm O.D.
(I.D.=Inside Diameter, O.D.=Outside Diameter)
Common uses: Constructing special-use apparatus.

Glass rod:
Material type: Soft glass
Common sizes: 6" to 12"
Common uses: Stirring, transferring.

APPENDIX 8

CONTAINER CHEMICAL RESISTANCE CHART

Taken from: http://www.vp-scientific.com/Chemical_Resistance_Chart.htm

PTFE = Polytetrafluoroethylene (Teflon®)						
SS = Stainless Steel			**E** = Excellent			
LDPE = Convenional Polyethylene			**G** = Good			
HDPE = Rigid Polyethylene			**F** = Fair			
PP = Polypropylene			**N** = Not Recommended			
PVC = Polyvinylchloride						
Chemical	**PTFE**	**SS**	**LDPE**	**HDPE**	**PP**	**PVC**
Acetaldehyde	E	E	G	G	G	G
Acetamide	E	E	E	E	E	N
Acetic Acid, 5%	E	E	E	E	E	E
Acetic Acid, 50%	E	E	E	E	E	E
Acetone	E	E	E	E	E	E
Aluminum Hydroxide	E	E	E	E	E	E
Ammonia	E	E	E	E	E	E
Ammonium Hydroxide	E	E	E	E	E	E
Ammonium Oxalate	E	E	E	E	E	E
n-Amyl Acetate	E	E	G	E	G	F
Amyl Chloride	E	--	N	F	N	N

Aniline	E	E	E	E	G	N
Benzaldehyde	E	--	E	E	E	N
Benzene	E	E	F	G	G	N
Benzoic Acid, Sat.	E	E	E	E	E	E
Benzyl Acetate	E	--	E	E	E	F
Boric Acid	E	F	E	E	E	E
Bromine	E	N	N	F	N	G
Bromobenzene	E	--	N	F	N	F
n-Butyl Acetate	E	F	G	E	G	N
sec-Butyl Alcohol	E	--	E	E	E	G
Butyric Acid	E	E	N	F	N	G
Calcium Hypochlorite	E	F	E	E	E	G
Carbazole	E	--	E	E	E	N
Carbon Disulfide	E	E	N	N	E	N
Carbon Tetrachloride	E	G	F	G	G	G
Chlorine	E	G	G	G	G	E
Chloroacetic Acid	E	F	E	E	E	F
Chloroform	E	E	F	G	G	N
Chromic Acid	E	G	E	E	E	E
Citric Acid	E	E	E	E	E	G
Cresol	E	E	N	F	E	N
Cyclohexane	E	E	G	E	G	G
Decalin	E	--	G	E	G	E
o-Dichlorobenzene	E	--	F	F	F	G
p-Dichlorobenzene	E	--	F	G	E	N

Diethyl Benzene	E	--	N	F	N	N
Diethyl Ether	E	--	N	F	N	F
Diethyl Ketone	E	--	G	G	G	N
Diethyl Malonate	E	--	E	E	E	G
Dimethyl Formamide	E	--	E	E	E	F
Ether	E	E	N	F	N	F
Ethyl Acetate	E	E	E	E	E	F
Ethyl Benzene	E	--	F	G	F	N
Ethyl Benzoate	E	--	F	G	G	N
Ethyl Butyrate	E	--	G	G	G	N
Ethyl Chloride, Liquid	E	E	F	G	F	N
Ethyl Cyanoacetate	E	--	E	E	E	NF
Ethyl Lactate	E	--	E	E	E	F
Ethylene Chloride	E	E	G	G	G	N
Ethylene Glycol	E	E	E	E	E	E
Ethylene Oxide	E	--	F	G	F	F
Fluorine	G	--	F	G	G	N
Formic Acid, 50%	E	F	E	E	E	G
Formic Acid, 90-100%	E	N	E	E	E	F
Fuel Oil	E	E	F	G	E	E
Gasoline	E	E	F	G	E	G
Glycerine	E	E	E	E	E	E
n-Heptane	E	E	F	G	E	F
Hexane	E	E	N	G	E	G
Hydrochloric Acid, 1-5%	E	N	E	E	E	E

Hydrochloric Acid, 35%	E	N	E	E	E	G
Hydrofluoric Acid, 4%	E	N	E	E	E	G
Hydrofluoric Acid, 48%	E	N	E	E	E	G
Hydrogen	E	--	E	E	E	E
Hydrogen Peroxide	E	F	E	E	E	E
Isopropyl Acetate	E	--	G	E	G	N
Isopropyl Benzene	E	--	F	G	F	N
Kerosene	E	E	F	G	G	E
Lactic Acid, 3%	E	G	E	E	E	G
Lactic Acid, 85%	E	F	E	E	E	G
Magnesium Salts	E	G	E	E	E	E
Methoxyethyl Oleate	E	--	E	E	E	N
Methyl Ethyl Ketone	E	E	E	E	E	N
Methyl Isobutyl Ketone	E	E	G	E	G	N
Methyl Propyl Ketone	E	--	G	E	G	N
Methylene Chloride	E	E	F	G	F	N
Nitric Acid, 50%	E	G	E	G	G	G
Nitric Acid, 70%	E	N	E	G	G	F
Nitrobenzene	E	E	F	G	F	N
n-Octane	E	--	E	E	E	F
Orange Oil	E	--	F	G	G	F
Perchloric Acid	E	--	G	G	G	G
Perchloroethylene	E	E	N	N	N	N
Phenol, Crystals	E	E	G	G	G	F
Phosphoric Acid, 1-5%	E	E	E	E	E	E

Phosphoric Acid, 85%	E	G	E	E	E	E
Potassium Hydroxide	E	G	E	E	E	E
Propane Gas	E	E	N	F	N	E
Propylene Glycol	E	E	E	E	E	F
Propylene Oxide	E	--	E	E	E	F
Resorcinol	E	--	E	E	E	F
Salicylaldehyde	E	--	E	E	E	F
Sulfuric Acid, 1-6%	E	F	E	E	E	E
Sulfuric Acid, 20%	E	N	E	E	E	E
Sulfuric Acid, 60%	E	N	E	E	E	E
Sulfuric Acid, 98%	E	N	E	E	E	N
Sulfur Dioxide, Liq.	E	E	N	F	N	F
Sulfur Salts	E	E	F	G	F	N
Tartaric Acid	E	G	E	E	E	E
Tetrahydrofuran	E	E	F	G	G	N
Thionyl Chloride	E	--	N	N	N	N
Toluene	E	E	F	G	G	F
Trichloroethane	E	E	N	F	N	N
Trichloroethylene	E	E	N	F	N	N
Turpentine	E	E	F	G	G	G
Vinylidene Chloride	E	--	N	F	N	N
Xylene	E	E	G	G	F	N
Zinc Salts/Stearate	E	G	E	E	E	E

APPENDIX 9

Lab Rules & Contracts handouts

This Appendix contains copies of handouts used for the Biology and Chemistry Departments. They are for reference only although they being implemented in their respective areas at the time this document was written. Please peruse the copies on the next few pages and consider using similar documentation in other areas of discipline

Biology Laboratory Safety Rules and Recommendations

For all students, faculty and staff using the Life General Sciences Department (Biology Lab, Building #12)

No food or drink is allowed in any science building.

Due to the particular activities we do in the Biology Lab, it is very important for your personal health that all food and beverages should be left either outside the lab or in your bags and backpacks. These items should not be placed under the table out of sight, because this will not stop possible contamination.

Children are not allowed in the building.

The Biology Lab is not a safe place for children, either preschool or school age. Please refrain from bringing them in for any reason. We do make one exception, but with controls. There are a number of animals that call this lab their home. You may want to show these to the young ones in your life. Please see the Lab Supervisor beforehand to make arrangements for such a visit. At no time should a child be in the lab rooms!

Open toes shoes are not allowed in lab.

Always be prepared to wear the appropriate footwear the days you have lab. Open toes shoes invite serious injury. We want to avoid an unnecessary problem to yourself or others.

All A&P paraphernalia will remain in the A&P lab (no exceptions).

Anatomy & Physiology labs require the use of many microscope slides and microscopes, bones, and other models. There are several classes and more than enough students using this equipment on a regular basis, both due to lab time and open study time allowed in that particular classroom. At no time should any item leave this room. There are just too many students using too many items to allow this. Please do not ask – you will be told NO!

All equipment will be returned to original position and/or location.

When you use a piece of equipment, such as a microscope, beakers of solution, racks of test tubes, etc., it should be returned to where you first found it; and it should also be put back together if necessary. This is especially important in the A&P labs when you are using any of the many models. You may consider even placing it back in its proper location even when you did not find it there in the first place.

All broken glassware or sharp metal pieces should be placed in "sharps" boxes.

If perchance, you break a test tube or beaker, microscope slide or other glass item; or if you find a stray razor blade or straight pin left over from a dissection lab, please place these in the red Sharps box located either in the front of the room by the door or if you are in room 106, in the bucket located in the fume hood. If the glass has sharp pointed edges, please let the instructor know so either he/she or the lab technician can clean it up. We don't want you to get hurt. If you break a piece of glass in a sink, please DO NOT take it out. We will take care of it for you.

Chemical wastes should never be placed in a sink drain unless instructed otherwise.

Many of the lab experiments require the use of different solutions and reagents. Most of the time these solutions will remain in their respective beakers or flasks for use in other lab classes. Yet, there are times when you will make up your own mixtures and solutions. Please do not place anything down the drain unless authorized by your instructor. It is unlikely that doing so would cause any damage, but we do not want to jeopardize the delicate good bacteria of our local Utility Waste Water plant. The City of Des Moines would not be happy with us.

Media with microorganisms (liquid or solid) should be placed in a Biohazard bag.*

Some of the lab experiments we do in lab require the use of personal saliva, chewing gum, spitting into a cup or blowing through a straw. Any item that has a biological factor to it should be disposed of into a Biohazard bag, which will be provided. This in turn, will be sterilized before being placed in the trash.

All glassware should be rinsed after use and test tubes placed upside down in racks provided.*

There are several lab experiments that require the use of glassware. Please be considerate of others by rinsing out your own group's glassware and placing same into racks upside down and/or on top of paper towels to air dry. The technician's

responsibility is to set up and take down lab supplies and equipment. Please make clean up yours for the sake of students coming to lab after you.

Slides and coverslips should be placed in a beaker of water and disinfectant (also provided).

When you use microscopes, you will be making your own slides, called wet mounts. These should be placed into a beaker of soap and disinfectant that will be provided. At no time should a commercially prepared slide be placed in this beaker.

Human blood is not to be extracted or used in Highline laboratories.

We only use sterilized animal blood in Highline's Biology Lab. When we do, we treat it as if it is potentially pathogenic. This means that we require the use of goggles and gloves which will be provided.

Mouth pipetting or drinking of solutions is strictly prohibited.

We use a special tool called a pipette for transferring solutions from one container to another. Back when dirt was invented, we used to suck on these pipettes instead of using pumps for doing this. The pumps we attach to the pipettes are called pipettors (go figure). Please – never use a pipette like a straw!

Know the locations and operation of all safety equipment.

This includes fire extinguishers, eye washes, body showers, first aid kits, and the nearest exit from the room. This will be discussed in each lab at the beginning of each quarter!

All book bags, books, personal items do not go on the lab tables at any time. All tables will be disinfected before class AND after class.

*** These rules will be modified for Microbiology labs.**

HIGHLINE COMMUNITY COLLEGE LIFE OCEAN AND GENERAL SCIENCES DEPARTMENT

INFORMED CONSENT STATEMENT

Class_____ Term/Yr_____ Instructor_____

As a student, I am aware that instruction in the Life, Ocean and General Sciences comprises lecture and/or lab activities, which may involve some exposure to potential risks. These include, but may not be limited to: contact with glassware, sharp instruments, chemicals, hot objects or liquids, flame, exposure to infectious agents, and dissection of preserved specimens.

In addition, it is my understanding that these activities involve important techniques, procedures, principles, concepts, and facts in support of my learning. I agree that these will benefit my educational experience as a student in the biological and health sciences.

I am aware that instruction and laboratory procedures will provide guidance and precautions to enhance safety. It is my understanding that all activities will be in accordance with applicable laws, regulations, and safety standards.

When instructions are provided I will be attentive to them, and respond accordingly. I will carefully follow all laboratory procedures, written or oral, and will exercise appropriate care and safety in the laboratory or classroom. In addition, I agree to be responsible for the appropriate use and care of all laboratory instruments and supplies provided to me.

As a student, I will inform the instructor immediately should any safety-related problem occur during any classroom or laboratory activity. I have the right to decline to participate in, or to discontinue participation in, any such activity if I have reason to believe such participation would likely result in personal harm. My grade will not be adversely affected should I decline to participate in such activity, provided I complete alternative assignments as determined by my instructor.

I understand that I may revoke this consent in writing at any time.

Signed_____ Witness_____

Printed Name_____ Printed Name_____

Date_____

HIGHLINE COMMUNITY COLLEGE – CHEMISTRY DEPARTMENT

SAFETY AGREEMENT

1. I understand that neither food nor beverages are permitted in the lab.
2. I understand that access to the lab prep room is reserved to Highline instructors and staff only.
3. I will obtain approved safety goggles and I will wear them at all times in the lab even when I am not handling chemicals.
4. I am familiar with the location and proper operation of the safety shower, the eyewash stations, the fire extinguisher, and the first aid box.
5. I will obey all instructions concerning the safe performance of experiments. I will use the hood when required, dispose of all chemicals and other materials as instructed, and promptly return all chemicals and reagents to their appropriate place when finished. I will not allow reagents or chemicals to become contaminated.
6. I will protect myself by wearing appropriate clothing in the lab. I realize that I must wear shoes in the lab (neither sandals nor open-toed shoes are permitted).
7. I will not attempt any unauthorized experiments nor will I work in the lab without proper supervision.
8. I will properly label all of my products that I place in the hood or in my equipment drawer. My label will include my Name, Date, and the name of the chemical.
9. I understand that it is my responsibility to make sure that all of my equipment is kept clean and organized in my equipment drawer and that anything missing at the end of the quarter is my responsibility to replace clean and dry.

I UNDERSTAND THAT I WILL BE EJECTED FROM THE LAB AND MAY RECEIVE A FAILING GRADE FOR THE EXPERIMENT IF I FAIL TO ABIDE BY THE RULES.

Signature: _____

Date: _____

Print Name: _____

Course: _____

Section: _____

Instructor: _____

APPENDIX 10

Highline Community College

Biology Lab

Reconnoiter Treasure Hunt

Description	**Location(s)**
Emergency phone in each room/area:	101
102	103
104/105	106
108	109
List of Emergency Procedures in each room/area	101
102	103
104/105	106
108	109
Nearest (and safest) exits	
Fire extinguishers	
First Aid kit	
Chemical shower(s)	
Eye Wash station(s)	
Chemical Spill kits	
Material and Safety Data Sheet (M.S.D.S.)	
Biology Lab Bible (catalog of inventory)	
Proper lab attire when and where applicable:	
lab coat	
goggles	
gloves	
other P.I.P. (list)	
Disinfectant and absorbent paper towels	
Glassware	
General chemicals	
Flammable chemicals	
Corrosive chemicals	
Dissecting and other lab tools	

GLOVE RESISTANCE CHART

Taken from: http://www.abcsafetymart.com/workgloves/chem.html

E - Excellent: Fluid has very little degrading effect.				
G - Good: Fluid has minor degrading effect.				
F - Fair: Fluid has moderate degrading effect.				
P - Poor: Fluid has pronounced degrading effect.				
Nr - Not Recommended: for work with this chemical.				
GLOVE RESISTANCE CHART				
	Nitrile	**Neoprene**	**PVC**	**Latex**
Acetaldehyde	P	E	Nr	E
Acetic Acid, Glacial	G	E	F	E
Acetone	Nr	G	Nr	E
Acrylonitrile	F	G	F	G
Ammonium Fluoride, 40%	E	E	E	E
Ammonium Hydroxide, Conc	E	E	E	E
Amyl Acetate	E	Nr	P	P
Amyl Alcohol	E	E	Nr	E
Aniline	Nr	G	F	G
Animal Fats	E	E	G	P
Aqua Regia	F	G	G	G
Banana Oil	E	Nr	P	P
Benzaldehyde	Nr	Nr	Nr	F
Benzene	P	Nr	Nr	Nr
Benzol	P	Nr	Nr	Nr
Butyl Acetate	F	Nr	Nr	P
Butylene	E	E	F	F

	Nitrile	Neoprene	PVC	Latex
Carbon Disulfide	G	Nr	Nr	Nr
Carbon Tetrachloride	G	Nr	F	Nr
Castor Oil	E	E	E	E
Cello Solve	G	E	P	E
Cellosolve Acetate	F	G	Nr	G
Chlorobenzene	Nr	Nr	Nr	Nr
Chloroform	Nr	Nr	Nr	Nr
Chloronaphthalene	P	Nr	Nr	Nr
Chlorothene Vg	F	Nr	P	Nr
Chromic Acid, 50%	F	Nr	G	Nr
Citric Acid, 10%	E	E	E	E
Coal Tar Distillate	G	F	F	P
Cotton Seed Oil	E	G	G	P
Creosote	G	G	F	G
Cutting Oil	E	E	G	F
Cyclohexanol	E	E	E	E
Di-Isobutyl Ketone	E	P	P	P
Di-Isocyanate	G	G	F	P
Dibutyl Phthalate	G	F	Nr	G
Dichlorethane	F	P	P	Nr
Diethylamine	F	P	Nr	Nr
Dimethyl Formamide, Dmf	Nr	G	Nr	E
Dimethyl Sulfoxide, Dmso	E	E	Nr	E
Dioctyl Phthalate, Dop	G	G	Nr	F
Dioxane	Nr	N	Nr	F
Electroless Copper	E	E	E	E

	Nitrile	Neoprene	PVC	Latex
Electroless Nickel	E	E	E	E
Epoxy Resins, Dry	E	E	E	E
Ethyl Acetate	Nr	F	Nr	G
Ethyl Alcohol	E	E	G	E
Ethyl Ether	E	E	Nr	Nr
Ethyl Formate	G	G	P	F
Ethylene Dichloride	Nr	N	Nr	P
Ethylene Glycol	E	E	E	E
Formaldehyde	E	E	E	E
Formic Acid, 90%	F	E	E	E
Freon, Tf	E	E	Nr	Nr
Freon, Tmc	Nr	N	Nr	Nr
Furfural	Nr	G	Nr	E
Gasoline (White)	E	Nr	P	Nr
Glycerine	E	E	E	E
Grain Alcohol	E	E	G	E
Hexane	E	E	Nr	Nr
Hydraulic Fluid, Ester	G	E	P	P
Hydraulic Fluid, Petrol	E	G	F	P
Hydrazine, 65%	E	E	E	G
Hydrochloric Acid, 10%	E	E	E	E
Hydrofluoric Acid, 48%	E	E	G	G
Hydrogen Peroxide, 30%	E	E	E	E
Hydroquinone, Saturated	E	E	E	G
Iso-Octane	E	E	P	Nr
Isobutyl Alcohol	E	E	F	E

	Nitrile	Neoprene	PVC	Latex
Isopropyl Alcohol	E	E	G	E
Kerosene	E	E	F	E
Lacquer Thinner	G	G	F	F
Lactic Acid, 85%	E	E	E	E
Lauric Acid, 36%/etoh	E	E	F	G
Linoleic Acid	E	E	G	P
Linseed Oil	E	G	F	P
Maleic Acid, Saturated	E	E	G	E
Methyl Alcohol	E	E	G	E
Methyl Ethyl Ketone, Mek	Nr	P	Nr	G
Methyl Isobutyl Ketone, Mibk	P	N	Nr	F
Methyl Methacrylate	P	N	Nr	P
Methylamine	E	G	E	E
Methylene Bromide	Nr	Nr	Nr	Nr
Methylene Chloride	Nr	Nr	Nr	Nr
Mineral Oils	E	E	F	F
Mineral Spirits, Rule 66	E	G	F	Nr
Monoethanolamine	E	E	E	E
Morpholine	Nr	P	Nr	E
Muriatic Acid	E	E	E	G
Naphtha vm&p	E	G	F	Nr
Nitric Acid, 10%	E	E	G	G
Nitric Acid, 70%	Nr	G	F	Nr
Nitrobenzene	Nr	N	Nr	F
Nitromethane, 95.5%	F	E	P	E
Nitropropane, 95.5%	Nr	G	Nr	E

	Nitrile	Neoprene	PVC	Latex
Octyl Alcohol	E	E	F	E
Oleic Acid	E	E	F	F
Oxalic Acid, Saturated	E	E	E	E
Paint & Varnish Removers	G	G	P	F
Paint Thinner	G	G	F	F
Palmitic Acid, Saturated	G	E	G	G
Pentachlorophenol	E	E	F	Nr
Pentane	E	E	Nr	P
Perchloric Acid, 60%	E	E	E	F
Perchloroethylene	G	N	Nr	Nr
Permachlor	G	G	Nr	P
Petroleum Spirits	E	E	P	F
Phenol	Nr	E	G	E
Phosphoric Acid	E	E	G	G
Phosphoric Acid, Conc	E	E	G	G
Pickling Acid	E	E	G	G
Picric Acid, Sat./Etoh	E	E	E	G
Pine Oil	E	E	G	P
Plating Solutions	E	E	E	E
Potassium Hydroxide/koh 50%	E	E	E	E
Printing Inks	E	E	F	G
Propyl Acetate	F	P	Nr	F
Propyl Alcohol	E	E	F	E
Propylene Oxide	Nr	Nr	Nr	P
Rubber Solvent	E	G	Nr	Nr
Silicon Etch	Nr	G	F	Nr

	Nitrile	Neoprene	PVC	Latex
Skydrol 500	P	P	P	F
Sodium Hydroxide/naoh, 50%	E	E	G	E
Stearic Acid	E	E	G	E
Stoddard Solvent	E	E	F	Nr
Styrene	Nr	Nr	Nr	Nr
Sulfuric Acid, 10%	G	E	G	E
Sulfuric Acid, 95%	Nr	F	G	Nr
Tannic Acid, 65%	E	E	E	E
Tetrahydrofuran, thf	Nr	Nr	Nr	Nr
Toluene	F	Nr	Nr	Nr
Toluene Di-isocyanate, tdi	Nr	Nr	Nr	Nr
Toluol	F	Nr	Nr	Nr
Trichlorethylene, tce	Nr	Nr	Nr	Nr
Tricresyl Phosphate, tcp	E	F	F	E
Triethanolamine, 85% tea	E	E	E	G
Trinitro Toluol	E	G	G	P
Triptane	E	E	P	P
Tung Oil	E	E	F	P
Turpentine	E	Nr	P	Nr
Vegetable Oils	E	G	F	F
Wood Alcohol	E	E	G	E
Wood Preservative, penta	G	G	F	F
Xylene	G	Nr	Nr	Nr

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GLOSSARY

DEFINITIONS and ACRONYMS OF COMMON SAFETY ITEMS

AGENCIES and CODES

ACGIH - American Conference of Governmental Industrial Hygienists

CFR - Code of Federal Regulations

FDA - U.S. Food and Drug Administration

IARC - International Agency for Research on Cancer

OSHA - U.S. Occupational Safety and Health Administration

NFPA - National Fire Protection Association

NFPA Code - A numerical code that rates chemicals under fire conditions, exists for a limited number of chemicals and doesn't represent hazard under normal laboratory use.

NIOSH - National Institute for Occupational Safety and Health

NIOSH -RTECS - Registry of Toxic Effects of Chemical Substances-Found in major libraries

WISHA - Washington Industrial Safety and Hygiene Administration (State equivalent of OSHA)

DEFINITIONS

ALC - The Approximate Lethal Concentration in air for experimental animals: The test animal and the test condition should be specified; the value is expressed in mg/liter, mg/m3, or ppm.

HMIS/HMIG - Hazardous Materials Identification System/Guide - A chemical label system utilizing a numerical code rating of chemicals for health, flammability, and reactivity hazards, and designating personal protective equipment.

IDLH - Immediately Dangerous to Life or Health level representing a maximum concentration from which one could escape within 30 minutes without any escape impairing symptoms or any irreversible health effects

LC - Lethal Concentration, a measure of acute inhalation toxicity.

LC50 - The concentration in air that causes death of 50% of the test animals: The test animal and the test conditions should be specified; the value is expressed in mg/liter, mg/m3, or ppm. The higher the number, the lower the toxicity.

LD - Lethal Dose, a measure of acute oral and dermal toxicity.

LD50 - The quantity of material that when ingested, injected, or applied to the skin as a single dose will cause death of 50% of the test animals: The test conditions should be specified; the value is expressed in g/kg or mg/kg of body weight. The higher the number, the lower the toxicity.

MSDS - Material Safety Data Sheet. A form produced by the chemical product's manufacturer that list the physical, chemical, and physiological hazards of that chemical.

OEL - Occupational Exposure Limit is the allowable exposure to a substance for a specified amount of time.

PEL - Permissible Exposure Limits over an 8 hour time-weighted average to which any employee may be exposed without adverse effects. It is set by regulation and enforced by OSHA; most of these limit values were originally set by consensus by ACGIH to assist industrial hygienists in implementing exposure control programs.

STEL - Short Term Exposure Limit (15 minutes unless otherwise noted) which should not be exceeded during a work day.

TLV (TWA) - The Threshold Limit Value established by ACGIH: The Time Weighted Average concentration for a normal 8-hour workday or 40-hour workweek to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Carcinogenic - Causing malignant (cancerous) tumors. OSHA, NIOSH, and FDA consider any tumor to be either a cancer or a precursor of cancer.

Embryotoxic - Poisonous to an embryo (without necessarily poisoning the mother).

Experimental Carcinogen - A substance that has been shown by valid, statistically significant experimental evidence to induce cancer in animals.

Human Carcinogen - A substance that has been shown by valid, statistically significant epidemiological evidence to be carcinogenic to humans.

Mutagenic - Causing a heritable change in gene structure

Oncogenic - Causing tumors

Teratogenic - Producing a malformation of the embryo

Tumorigenic - Causing tumors

AGENCIES DEALING WITH CHEMICAL HAZARDS

FEDERAL

OSHA - Occupational Safety and Health Administration - regulates worker exposure.

RIGHT-TO-KNOW (RTK) or **FEDERAL HAZARD COMMUNICATION STANDARD** -a set of rules to carry out the Worker Right to Know Act updated 1987. Ensures employers evaluate chemical hazards, distribute proper information.

EPA - Environmental Protection Agency - regulates chemicals in air, water, and land, under the following Acts of Congress:

RCRA - Resource Conservation and Recovery Act of 1976, as amended (Federal Hazardous Waste Laws).

CERCLA -Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Superfund Laws).

SARA - Superfund Amendments and Reauthorization Act (1986). SARA Title III is also known as the Emergency Planning and Community Right-to-Know Act (CRTK).

DOT - Dept. of Transportation - shipping, transport on public roads.

STATE

L & I - Department of Labor and Industries - will help you meet the requirements of the Hazard communication Standard (RTK).

DOE - Dept. of Ecology - administers the Community Right-to-Know Act (CRTK) -- administers the Hazardous Waste Laws (RCRA).

DSHS - Dept. of Social and Health Services - Environmental Health

For student safety, the DSHS administers The School Safety **WAC** (248-64-350) which provides guidelines for safety in the lab.

HOT LINE/INFORMATION PHONE NUMBERS

POISON CONTROL	800-222-1222
HAZARDOUS SUBSTANCE/WASTE (DOE)	425-649-7000 NW Reception
WORKER RIGHT TO KNOW (L&I)	800-423-7233
WASTE REDUCTION & RECYCLING (DOE)	425-649-7000
RECYCLE	206-296-4466
COMMUNITY RIGHT TO KNOW (Title III/SARA) (DOE)	800-562-6108
ASBESTOS	206-343-8800
CHEM TREC - Chemical Transportation Emergency Center	800-262-8200