Laboratory Safety

The responsibility for lab safety rests with each and every student in the laboratory. You must use common sense and work carefully to avoid chemical spills, broken glassware, and fires. This ensures not only your own safety, but also that of your lab mates. Know the hazards of each chemical you use so that you will know what level of caution to use when handling it. If you do this, you will not be exposed to a harmful amount of any chemical during your year in organic chemistry lab.

If an accident does happen, you must take steps to prevent further injury. Most accidents are minor, and methods of dealing with them are detailed in the sections below. In the event of a serious accident, remember that injured people are often in shock and are unable to help themselves. You should be prepared to help your neighbor in case of an accident. A matter of seconds can be critical.

Chemical Safety

One goal of the organic chemistry teaching lab staff is to teach each student how to safely handle organic chemicals. Not only is this necessary for you to have a safe experience in organic lab, it is useful knowledge for almost any job you have after college, as well as for handling cleaning solvents and other chemicals in your home.

Special health problems

If you are aware that you have allergies to specific chemicals or drugs, or to UV light, or if you have asthma or other health problems, you may want to consult your doctor before taking organic chemistry lab. Feel free to discuss any questions you may have with the Laboratory Coordinator. **You may not take organic chemistry lab if you are pregnant without written approval from your doctor. On request, I will provide a list of chemicals we will be using.**

Personal Protection Equipment (PPE)

Personal protection equipment in the teaching laboratory includes safety goggles, gloves, and lab coats and aprons. In industrial situations, PPE might include full suits of protective clothing, including boots and a face/head shield. Respirators are used when handling very toxic chemicals. If you are required to use a respirator, you will need to be trained in its use. Chemical labels specify the type of PPE required when handling a particular chemical.

Gloves

If you would like to use gloves, **you must supply your own**. These may be purchased at local hardware stores, or grocery stores. They may be stored in your locker

Goggles and Eye Safety

You must wear chemical spill protection safety goggles whenever anyone in the lab room is handling chemicals. They must be flexible fitting, hood ventilation goggles, according to ANSI chemical splash standards. The Cerritos college bookstore sells this type of goggle. You may not use “Visorgogs”.

Do not wear contacts in the labs, even under goggles. Soft lenses can be affected by solvent vapors, possibly even fusing them to your eye. Contacts also make it difficult to rinse your eyes quickly and properly if you spill something in them.

If you spill a chemical in your eye:

If you get any chemical at all in your eye, immediately begin rinsing it in the eyewash, holding your eye open. Your instructor or another student will come to your assistance and help you ascertain the seriousness of the exposure.

Hazard and Physical Data for Compounds

It is essential that you know the safety precautions and physical data for each chemical that you use in the organic labs. This information is contained in several places, including the bottle label, the Material Safety Data Sheet (MSDS), a book or an online source.

Chemical Hazard Information for a Specific Compound

The CRC, Merck Index, and/or Aldrich Catalogues are excellent printed sources for physical and hazard data on compounds.

CRC Handbook of Chemistry and Physics (especially Section C: "Physical Constants of Organic Compounds"), available at the reference desk in the library and in the Chemistry Stockroom (only to be used in the chemistry building).

The **Merck Index** is available at the reference desk in the library and in the Chemistry Stockroom.

The **Aldrich Catalog** Handbook of Fine Chemicals is available in the Stockroom. This is commonly used in research, but not readily loaned in our stockroom (ask your instructor)

MSDS's: All chemicals used in our labs have a MSDS on file in the chemistry stockroom. Websites are too numerous to list here, so they can be found on my webpage: **MSDS page**

Safety: Whether or not it's a hazard or carcinogen.

Envirofacts Warehouse Especially good, detailed safety information at http://www.epa.gov/enviro/html/emci/chemref/index.html
Agency for Toxic Substances and Disease Registry at http://www.atsdr.cdc.gov/cgi-bin/search
CDC/NIOSH - health hazard evaluations at http://www.cdc.gov/niosh/homepage.html
with the especially useful pocket guide page at http://www.cdc.gov/niosh/npg/pgdstart.html
National Toxicology Program http://ntp-server.niehs.nih.gov/Main_Pages/Chem-HS.html

Physical data

ChemFinder: Physical data, and many links to other sites with information on the compound. Highly recommended at http://chemfinder.cambridgesoft.com/
NIST Site: physical data and spectral data at http://webbook.nist.gov/chemistry/
ACS: - Chemcyclopedia, mostly for finding a manufacturer of a compound (Knowledge of the manufacturer can assist you in finding more information on a compound.) at http://www.chemcyclopedia.ims.ca/

General Guide for Handling Chemicals in the Laboratory

Knowing what the hazards are is one thing, and knowing how to handle chemicals with these hazards is another. The goal of the following sections is to teach you how to handle chemicals with the most common hazards you will encounter. The chemicals most frequently used in the Cerritos College organic chemistry laboratories are provided as examples for each type of hazard.

Chemical Bottle Labels

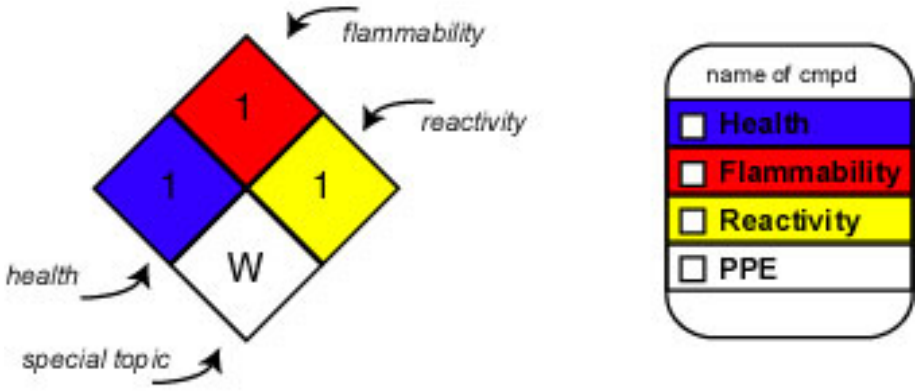
The two major systems of chemical hazard labeling are NFPA (National Fire Protection Agency) and HMIG (Hazardous Material Information Guide). Each uses the same color and number codes, but each lays the label out in a different manner:
The University of Oregon has a very good web site explaining these two systems summarized below:

NFPA system **http://chemlabs.uoregon.edu/Safety/NFPA.html**
The hazard identification signal is a color-coded array of four numbers or letters arranged in a diamond shape. An example is shown below. You will see hazard diamonds like this on trucks, storage tanks, bottles of chemicals, and in various other places around campus and around town. The blue, red, and yellow fields (health, flammability, and reactivity) all use a numbering scale ranging from 0 to 4. A value of zero means that the material poses essentially no hazard; a rating of four indicates extreme danger. The fourth value (associated with white) tends to be more variable, both in meaning and in what letters or numbers are written there.

HMIG system http://chemlabs.uoregon.edu/Safety/HMIG.html

Although the details of how numbers are assigned may vary somewhat between systems, this is essentially the same. The fourth, white bar is marked "protective equipment" in the HMIG system, and "personal protection" in the HMIS system.

NFPA **HMIG**



1. (RED) Flammable Chemicals (examples: diethyl ether, acetone, hexanes, ethanol, methanol)
The method for proper handling of these flammable chemicals depends on their flammability rating, as given by a number “0” through “4” in the red area of a NFPA/HMIG label. The NFPA/HMIG rating for diethyl ether is "4" while acetone, methanol, ethanol, and hexanes are "3". Ether is extremely flammable and any spark or simply heat can ignite it. The other four solvents listed here will readily burn, but they are not as likely to spontaneously combust. (Ether is also quite volatile, and its vapors can travel quickly away from the immediate work area. This fact increases its flammability danger.)

Never use ether in a lab that has an open flame anywhere in the room. Be careful not to spill any flammable solvent (especially ether) on a heating mantle or hot plate. Keep them away from electrical outlets. Do not use an open flame in a lab where anyone is using flammable solvents. It is your responsibility to ask others if they are using flammable solvents.

In case of fire:

If your clothing catches fire, immediately drop to the floor and roll to smother the flames and call for help.

If a compound or solvent catches on fire, *if you can*, quickly cover the flames with a piece of glassware.

Do not put water on an organic chemical fire because it may spread the fire.

If the fire is large, do not take chances; evacuate the lab and the building immediately and tell your instructor what happened.

If no one in authority is available, pull the fire alarm in the hallway.

If no one in authority is available, call 911 from a safety phone (Red phone in the hall).

If the fire alarm sounds, turn off gas and heating mantles, and exit the building immediately.

2. (White) Volatile Chemicals (examples: hexanes, acetone, methylene chloride, diethyl ether)
Diethyl ether and methylene chloride are the most volatile of the chemicals that you will use in the organic chemistry teaching labs. If they are accidentally inhaled, they can cause irritation of the respiratory tract, intoxication, drowsiness, nausea, or even depression of the central nervous system.

Raising the hood sash decreases the ventilation efficiency of the hood, Therefore, leave the sash down whenever possible. Work in the hood when you are handling volatile chemicals. If you need to carry volatile chemicals in the lab, carry them in a covered container.
Do not bring volatile chemicals to your instructor in an open container.

If you inhale vapors:

Leave the area immediately - at least into the hallway. Tell your instructor, or have a labmate tell the instructor. Then step outside into the fresh air, and if necessary, obtain first aid or get medical attention.

3. (Blue) Contact Health Hazards of Solvents and Organic Chemicals (examples: methanol, ethanol, hexanes, acetone, methylene chloride, diethyl ether)
The health hazard of a chemical is designated by a number 4-0 in the blue area of a NFPA/HMIG label. None of the chemicals you will use has a "4" rating; most are 1 or 2. If you had a one-time overexposure to the above chemicals, you might suffer a minor or a serious injury. If you protect yourself properly by wearing gloves, lab coat, goggles, and closed-toed shoes, and if you are careful not to spill chemicals, you are not likely to come into contact with these chemicals.
Clean up a chemical spills promptly. If you see a chemical spill do not leave it there, whether you have spilled it or someone else. This could cause serious harm to another student. Please be especially aware of chemical spills near the balances. Often in the Lab Manual, you will be directed to clamp reaction flasks and vacuum flasks. The reason for this is two-fold: so that you do not lose your product and so that you do not spill chemicals.

If you spill a chemical on yourself:

Immediately rinse the affected area with lots of water. Use soap if you wish, but never try to "treat" the spill with another solvent or chemical unless directed to do so by your instructor. If the affected area remains more than slightly red after the rinsing period, seek medical attention.

4. (Blue) Hazards of Corrosives (examples: hydrochloric acid, sulfuric acid, phosphoric acid, nitric acid, sodium hydroxide)
Strong acids and bases are used frequently in the organic chemistry teaching labs. At full strength, they have a health rating of "3", meaning that short exposure could cause serious injury. (As they are diluted, the health rating drops, about one number in rating for each 1:10 dilution.) If spilled on your skin, they cause a chemical burn. They are very harmful to your eyes. If you breath in a big whiff of vapors, you will burn your nasal and respiratory passages.
Handle corrosives with great care so as not to spill them or inhale their vapors. Always wear goggles, gloves, protective clothing, and shoes. The heavier style of (Playtex) gloves are recommended for use when handling strong corrosives.

If you spill a corrosive on yourself:

Immediately rinse the affected area with lots of water. Use soap if you wish, but never try to "treat" the spill with another solvent or chemical unless directed to do so by your instructor. If the affected area remains more than slightly red after the rinsing period, seek medical help.

Glassware Safety

Use common sense when handling glassware. Keep glassware away from the edge of the benchtop. Always clamp your reaction flask and the suction flask securely to a ring stand to prevent them from falling over. Check each piece of glassware for hairline or star cracks before using it. When doing a distillation, clamp each piece of glassware securely. If you do break a piece of glassware, do not leave it in the sink or on the benchtop because someone may be cut inadvertently. Wearing thick gloves, use the brush and dustpan from the stockroom to sweep up the broken glass. Place the broken glassware in one of the "Broken Clean Glassware" containers located in the labs.
If your reaction requires the use of a heating mantle or steam bath, glassware or the clamps used to hold glassware can become hot enough to burn you. The number and severity of cuts can be reduced by wearing gloves, especially while washing glassware. Protect your feet by wearing closed-toed shoes, not only to protect your feet from dropped glassware, but to protect them from broken pieces of glass which may be on the floor from a previous lab section. Always wear your goggles to protect your eyes from flying broken glassware.

If you cut or burn yourself:

If you cut yourself, wash the wound immediately with large amounts of cool water. If it is your neighbor who has been hurt, be prepared to help them if they are unable to help themselves. Apply direct pressure to stop the bleeding as necessary. If the bleeding is profuse, elevate the affected limb. Watch for evidence of shock.

Waste Chemical Handling

There are two major focuses for chemical waste in organic chemistry lab, these are:
1. Proper storage and handling of hazardous waste.
2. Reduction of the volume hazardous waste produced.

1. Where to put the hazardous chemical waste you produce in lab.

Since you are the one producing the chemical waste, it is up to you to dispose of the waste properly. We have made this as easy as possible for you, by predetermining compatibilities and contents of all the waste solutions you are likely to produce. All you have to do is:

Follow Directions!

All hazardous chemical wastes are collected in the organic hood of the lab room.

Waste rules:

Always put the waste in the waste receptacle as directed in the procedure section of each experiment in the Lab Manual.

Do not put acetone into the waste jars; but into the one gallon glass bottle labeled "used acetone".

When using acetone or water to rinse chemicals from glassware, use as little as possible (these rinses are placed in the hazardous waste container).

Pay attention to all special waste containers.

Do not place filter or weigh papers in the waste jars, they must be placed in the filter paper tray.

If you have chemical waste that is not specified in the manual, ask your instructor what you should do.

It only takes a one student to put waste in the wrong container and the labels are incorrect. Then, the waste is handled improperly.

Common waste receptacles include:

Nonhalogented Organic Waste - the 1 gallon red plastic container for solvents and liquid mixtures that **have no halogens** (F, Cl, Br and I) present.

Halogenated Organic Waste –Small brown container with the green twist off lid for solvents and liquid mixtures that **have halogens** (F, Cl, Br and I) present.

Solid Chemicals Jar - a small jar in the organic hood for the collection of excess solid starting materials and solid products (after they have been graded).

Used Acetone - a one gallon brown-glass bottle in the organic hood. Used for rinse acetone from cleaning glassware. This container is different from the new technical grade acetone, for cleaning. Be sure to read carefully.

Clean Solids Tray - a small tray in the organic hood for the collection of filter paper and solids used in columns, TLC's and drying. It is used to allow the solvent to evaporate and then the solid is placed in the trash. These should be uncontaminated solids. They can be put in the regular trash as soon as any solvent has evaporated from them. Do not place product in this receptacle, since it is emptied into the regular trash.

Broken Glassware Tall green and white boxes at the end of each lab bench. Only for clean broken glassware. Please do not put paper towels in these containers. NEVER put your hand into the broken glass container for any reason!

Trash bins – The small round containers at each end of the lab bench are for non-chemical trash. Please be careful not to put any broken glass in these containers- as it may cut our janitors. You may place dry filter paper, drying agents, column and TLC materials.

2. Reduction of the amounts of hazardous waste produced

The following rules will help you to limit contaminations of ground water and reduce hazardous waste.

Pasteur pipets: These are intended to be disposable and are quite inexpensive. You can easily rinse a Pasteur pipet and use it in a future experiment. Please reuse the pipets as much as possible.

Aqueous acids and bases: When neutralizing a solution with an acid or a base, students usually take more than they need to their workspace. This is okay, but if you do not use all the solution, offer it to your labmates. The solution can then be reused or neutralized and placed down the drain.

Acetone: Acetone is a great solvent for cleaning organic chemistry glassware, and it is inexpensive. However, please use as little as possible, because it is expensive to process as hazardous waste. Currently, it makes up about 40% of the waste reported in organic chemistry. Please use it sparingly.

Water: Water rinses of glassware are also a problem. *Do not put any chemicals down the drain.* If you pour a large quantity of water used to rinse glassware into a waste container, that clean water immediately becomes "hazardous waste" and must be treated as such. Use as little water as absolutely necessary to rinse residual chemicals into the waste containers, then rinse the flask in your sink.