Department of Chemistry
University of Wisconsin-Madison
Safety Worksheet for Post-Doctoral Researchers

On behalf of the Chemistry Safety Committee, I welcome you to the University of Wisconsin Chemistry department. I hope your research endeavors in our department turn out to be interesting, productive, and SAFE. The safety training for post doctoral researchers includes two requirements. The first requirement is to complete the attached Safety Worksheet. The intent of this worksheet is to provide you with a review of good general safety laboratory practices and an introduction to the Safety Policies and Procedures specific to UW Chemistry research laboratories. To complete the worksheet, refer to the following resources:

1) *UW-Madison Safety-Laboratory Safety Guide*, available online at http://www.ehs.wisc.edu/chem-resources-labsafetyguide.htm You can get a hard copy of this document from the Chair of the Safety Committee.

2) Safety pages on the departmental web site at http://www.chem.wisc.edu/content/safety-information

3) The Chemistry Library Safety page at http://chemistry.library.wisc.edu/resources/#safety The library site contains links to Material Safety Data Sheets (MSDS).

You will also need to locate specific safety items and information within the laboratories that you will be working.

This worksheet is not intended to test your current safety knowledge, but to help you prepare for safe laboratory work in our department. Therefore you are allowed, and encouraged, to consult your supervisor, members of your group, or others in the department for help with the worksheet. Remember that preparation and communication are essential to ensure a safe work environment. Your completed worksheet must be approved by the Chair of the Safety Committee, or another member of the committee, and signed by your research advisor before you commence any laboratory work.

The second requirement is to attend the "Chemical Worker Safety Training" class given by the UW Safety Department. Contact UW Safety at http://www.ehs.wisc.edu/chem-training.htm for information about this class. You will receive a certificate upon completion of the class. Please submit a copy of this certificate to the Chair of the Safety Committee, or another member of the committee.

Recognize that these two requirements make up only the basic safety training required by our department. Depending on your research, you may be required to have additional training in the areas of biological or radiation safety.

Rob McClain mcclain@chem.wisc.edu Safety Committee Chair

1. When you dial 911 from a campus phone, who are you first connected to? What if you are using a cell phone? If your labs are located in the Shain tower, where is the location of the emergency call station nearest to your laboratory?

2. Who do you contact, provide web link or phone number, to arrange for a pick up for your organic solvent waste?

3. On the chemistry department web site, there is an online form for safety incident reporting. Provide an example where an incident report needs to be submitted.

4. Access an MSDS for benzene, and record its flashpoint, UEL, LEL, Autoignition temperature, flammability classification, extinguishing media, its Oral LD50 and its inhalationLC50, and its OSHA PEL and STEL. Use this data to answer the following questions related to the safe handling of benzene.

F.P	UEL	LEL	AI temp	LD50	LC50	PEL	STEL

Flammability classification:

Extinguishing Media:

a) What are the three conditions necessary to support a fire? Which condition is benzene?

b) What is the Safety significance of the flash point of benzene being below room temperature?

c) The oral LD50 is about 13 g/kg for cyclohexane. What does this information tell you about the relative toxicity of cyclohexane and benzene?

d) Which routes of exposure would be of concern to someone who was working with benzene in the laboratory? What Personal Protective Equipment (PPE) would be recommended for working with benzene.

e) A 1L bottle of benzene was left to completely evaporate into a small laboratory that measured 8 ft x 10 ft x 10 ft. Assuming a worst case scenario of no laboratory ventilation and using the ideal gas law, the concentration of the benzene vapor can be calculated. See below(ppm for gases is defined as moles of gas per million moles of air). Here is some useful information: for benzene mw = 78.1 g/mole; density = 0.88 g/mL. 1 ft^3 = 28.3 L, R= 0.0821 Latm/molK.

$$(1000\text{mL})\left(\frac{0.880\text{g}}{1\text{mL}}\right)\left(\frac{1\text{mole}}{78.1\text{g}}\right)=11.3\,\text{mol ben}\quad (800\,\text{ft}^3)\left(\frac{28.3\text{L}}{1\text{ft}^3}\right)=22610\,\text{L}$$

$$\text{n}=\frac{\text{PV}}{\text{RT}}=\frac{1\text{atm}(22610\text{L})}{0.0821\frac{\text{Latm}}{\text{molK}}((298\text{K}))}=924\ \text{mol of air}$$

$$\frac{11.3\text{moles}}{924\text{moles}}\text{x}10^6=12194\,\text{ppm}\qquad \text{or}\quad 01.2\%$$

Would the concentration of benzene vapor be explosive?

Would it be safe to work in this room continuously for an 8 hour work day?

Would it be safe to work in this room for only 15 minutes a day?

Would it be safe to enter this room to turn on the fume hood?

5) Provide one example of each of the following types of chemicals:

a) shock sensitive

b) asphyxiant

c) hepatotoxic

d) carcinogen

e) neurotoxic

f) teratogen

g) pyrophoric

h) water reactive

6) Which government organization mandates that all laboratories need to have a Chemical Hygeine Plan?

7) The University of Wisconsin is considered a large-quantity generator. Why does the UW receive this designation? How does this designation affect the disposal of chemicals in your laboratory?

8) According to NFPA, how many gallons of flammable liquids can be left on the lab bench of a 300 sq.ft. laboratory? Would you leave this much flammable liquid out in your laboratory?

9) Conduct a walktrough of your own laboratory and fill out a Laboratory Safety Survey http://www.ehs.wisc.edu/documents/chem-lsgappendixe.pdf

Attach the completed survey to the end of the worksheet.

a) Does your lab follow the good housekeeping and laboratory hygiene guidelines recommended? Be honest.

b) Locate the safety shower, the eye wash station, the first aid kit, the fire extinguishers, the solvent disposal carboys, the hazardous glass container, other disposal containers, and any spill kits in your laboratory.

c) What are the eye protection and clothing requirements for your laboratory?

d) Flooding due to worn out tubing, inappropriate fittings, or improper clamping in water circulation systems can cause serious floods to your lab and other labs below you. Identify any water circulation systems used in your lab and comment on the integrity of the system.

e) Find and look over your group's chemical hygiene plan. Add your name and signature to the list of personnel. Complete section 5. Record the date after this worksheet has been signed.

10) What precaution must you take when transporting chemicals from one room to another in the chemistry building?

11) Where do you properly store a 14% BF_3 in methanol solution? The solution needs to be stored at 2 - 8^0C and is flammable.

12) Should you wear contact lenses while working in your laboratory?

13) The following chemicals all have possible exposure through the skin. What type of glove would you use when working with each?

a) hexane

b) benzene

c) methylene chloride

14) What are four guidelines to remember for using fume hoods properly?

15) The formation of explosive peroxides was responsible for one of the more serious accidents that occurred in this department.

a) Explain how peroxides are formed in a solvent.

b) Explain how the formation of peroxides can be prevented.

c) Explain how you can test for peroxides in a solvent.

d) Explain how peroxides can be removed from a solvent.

16) Why must you always chain down compressed gas cylinders?

17) The heat of dilution of concentrated sulfuric acid is about 100 kJ/mole. Below is a calculation to determine the amount of heat released, and the temperature change, when a 50/50 mixture of H_2SO_4/H_2O is made by adding 250 mL of 18 M H_2SO_4 to 250 mL of water. The calculation assumes all of this heat goes to heating the solution, and the specific heat of the solution is about the same as water, 4.18 J/^oC-g. Using the densities of the individual materials, the final mass of the solution is estimated to be 710 g. Describe how you would safely make a 50% dilution of 250 mL of 18 M H_2SO_4

$$(0.250\text{L})(18\text{M}) = 4.5 \text{ mole } H_2SO_4$$

$$100\frac{\text{kJ}}{\text{mole}}(4.5\text{mol}) = 450\,\text{kJ of heat}$$

$$C = (710\text{g})\left(4.18\frac{\text{J}}{\text{g}^\circ\text{C}}\right) = 3\frac{\text{kJ}}{^\circ\text{C}} \qquad q = C\Delta T \qquad \Delta T = \frac{q}{C} = \frac{450\text{kJ}}{3\text{kJ}/^\circ\text{C}} = 150^\circ\text{C}$$

18) Find 5 particular hazardous substances that you have either worked with already or expect to work with in the future. State why they are particularly hazardous.

19) The following chemicals need to be stored in your laboratory:

perchloric acid	glacial acetic acid	sodium metal	hexane
benzene	potassium cyanide	sodium azide	sulfuric acid
methanol	potassium permanganate	ammonium chloride	
potassium dichromate			

a) Discuss any incompatibilities hazards associated with these chemicals.

b) How would you organize these chemicals for storage to prevent these incompatibility hazards.

20) What kind of fire extinguisher would you use to extinguish a sodium fire?

21) Describe a situation that you think would be a high hazard emergency.

22) How is a “simple spill” defined ?

23) How do you make a mercury spill powder? What do you with the powder that has been used to clean up a mercury spill?

24) What supplies should be available to a laboratory where there is a potential for solvent spills?

25) The following scenarios are based on actual emergencies that have taken place in the chemistry department. Provide a description of how you would respond to these emergencies if they happened in your laboratory and recommendations for how these accidents could have been prevented.

a) A researcher is condensing an organic solvent in a small glass vessel from a vacuum line with a liquid N_2 cold trap. She removes the sealed vessel from the vacuum line and upon warming, the glass vessel explodes and the flying glass causes severe cuts to her face and arms that result in major bleeding.

b) A researcher is doing a syringe transfer of butylamine. The needle of the syringe came loose and the researcher was sprayed in the face with about 0.5 mL of butylamine.

c) A researcher was using lithium aluminum hydride to reduce a nitroso group of a compound in with ether solvent in a 3-neck flask. Using a syringe, the researcher added water to the reaction vessel to quench the remaining lithium aluminum hydride. After adding the water, the inner pressure blew off the stopper, ejecting some lithium aluminum hydride, which immediately caught fire burning the hands of the researcher.

26) Describe both the primary and secondary exit routes for your laboratory in case of a building evacuation.

27) What is meant by the expression “less is better”?

28) 1,3-dicyclohexylcarbodiimide is sold by Aldrich in 25 g quantity for $26.90 and 100 g quantity for $ 40.20. You are doing an experiment where you need about 20 g of the compound. This is the first time doing this experiment, so you may need to do a second trial. How much of the compound would you purchase? 1,3-dicyclohexylcarbodiimide is highly toxic and corrosive. Disposal is done by incineration.

29) What are three alternatives to chromic acid for cleaning glassware?

30) Describe the appropriate disposal procedure for each of the following items:

a) 500 mL of concentrated sulfuric acid

b) 1 Liter 1000 mg/L lead nitrate solution

c) ethidium bromide stained agarose gel (used for electrophoresis)

d) 200 1 mL centrifuge tubes used for chloroform extraction empty

e) 1 L of used vacuum pump oil

f) 25 g of cobalt(II) nitrate

31) Classify each of the following as a *sharp, hazardous glass, or other glass,* and state how these items are disposed of in the chemistry building.

a) old beaker

b) razor blade

c) used pasteur pipet

d) broken flask

e) used GC syringe

f) plastic pipet tips

g) 0.6 mL centrifuge tubes used with infectious materials

The post-doctoral researcher has successfully completed this Safety Worksheet as part of his or her preparation for research work in the University of Wisconsin-Madison Department of Chemistry laboratories.

Signature of Post-Doctoral Researcher

_____ Date _____

Signature of Safety Committee Member

_____ Date_____

Signature of Faculty Mentor

_____ Date_____