

Appendix I

More Chemistry Laboratory Safety

General Safety Guidelines

Chemistry laboratories have certain inherent dangers that students should know about and appreciate. Many experiments can be hazardous unless the experimenter is aware of the nature of the materials used and is careful in planning and carrying out manipulations with them. To acquaint you with the dangerous situations that might arise and how to prevent them or cope with them if they do arise, you must become conversant with safety in the laboratory before you do any laboratory work. While work involving chemicals can be hazardous, awareness of these hazards and proper planning will make laboratory work quite safe.

The instructors will do all they can to prevent accidents, but they cannot do this without your full cooperation. You are responsible for your safety as well as the safety of your coworkers. For your protection, the following rules will be strictly enforced.

The best precaution against an accident is a well-prepared experiment and a neat, well-organized laboratory bench.

- Plan your experiments carefully in advance. This will not only minimize accidents, but will also make your work proceed more rapidly and smoothly. Be sure you understand the experiment before you start. Seek assistance from the instructor if necessary, but only after you have tried to understand the material on your own.
- All experiments must be authorized by an instructor. We do not wish to discourage unassigned work, but it must first be approved by your instructor, who will discuss both the scientific aspects of your proposal as well as any possible hazards. Any modifications of the experimental details of assigned experiments must also be discussed with your instructor.
- Never work in the laboratory unless an instructor is present. Never leave an experiment unattended while it is in progress.
- Eating, drinking (even water), and smoking are prohibited in the laboratory. These prohibitions are necessary not only to prevent fires but also to avoid ingestion of toxic materials.
- Personal effects that are not needed during the laboratory period should not be brought into the lab.
- In all cases of accident or injury, no matter how slight, call an instructor immediately.

Safety Equipment

While emphasis should be placed on the prevention of accidents, high priority is also placed on correct response in the event of an accident. To these ends, a number of rules pertaining to safety equipment will be strictly enforced. **Safety goggles must be worn at all times in the laboratory**, even if you personally are not doing any work. Many of the injuries that result from flying glass or splashed chemicals originate at a

considerable distance from the victim and could be avoided through the use of safety goggles. Safety goggles must be worn over prescription glasses.

It is advisable to wear protective clothing. Loose or dangling clothing, hair, jewelry, etc. should be restrained. Shoes must be worn at all times in the laboratory for protection from broken glass or spilled chemicals.

Learn the location of the safety showers, eyewashes, fire extinguishers, first-aid kits, respiratory equipment, and emergency exits.

Cleanliness

Keep your bench area neat. A crowded, unorganized bench leads to confusion, whereas experiments performed in a neatly kept area will proceed more rapidly and safely. Your laboratory should be clean when you enter and you must leave it clean when you depart. Occasional spillage is unavoidable and will cause no damage if it is immediately sponged off with water. Many solutions and solids will react with the bench surfaces if allowed to remain on them for any length of time. Any spilled chemical or large quantities of water or other liquids must be cleaned up immediately by the person responsible for the spill, unless the material is toxic, corrosive, or flammable, in which case the instructor should be consulted. Mercury is very toxic, even in small quantities (for example, from broken thermometers). Notify the instructor immediately in the case of a mercury spill.

All excess chemicals should be disposed of appropriately. Before putting anything down the sink check for a waste container. If you are unsure about the safety of the chemical, ask your instructor how to dispose of it.

You should always use clean apparatus for each experiment. If you wash dirty equipment at the end of each laboratory period, it will be easier to clean and will be available when you next need it. Clean glassware by scrubbing with a brush, hot water, and detergent. A final rinsing should be made with a stream of distilled water. Do not dry glassware with compressed air because it is often oily. Before you leave the laboratory, remove all materials from your bench and wash the bench with a damp sponge. Make certain that all gas and water outlets are turned off.

Any special equipment that you obtain for an experiment must be returned at the end of the laboratory period. This includes hardware, glassware, instruments, etc.

Procedures

Balances: Keep balances and surrounding areas clean. **To prevent corrosion, do not place chemicals directly on the balance pans** - place a piece of paper or a small container on the pan first, then weigh your material. Never weigh an object while it is hot because convection currents will lead to unstable readings.

Pipetting: **Never pipet any liquid directly by mouth!** Use a rubber bulb instead. The possibility of getting a toxic chemical into your mouth has greater ramifications than any inconvenience involved with the use of the rubber bulb.

Glass tubing: If a piece of glass tubing or a thermometer is to be inserted into a hole in a rubber stopper, lubricate the glass tubing with a drop of glycerin or water, hold the tubing in your hand close to the hole and keep the entire assembly wrapped in a towel while applying gentle pressure with a twisting motion. Use only tubing that has been fire

polished. Cuts incurred as a result of attempting to insert glass tubing in rubber stoppers are probably the most common significant laboratory injuries.

Heating: When heating a substance in a test tube, use a test tube holder, and be careful not to direct the opening of the tube toward yourself or anyone nearby. A suddenly formed bubble of vapor may eject the contents violently and dangerously. Do not heat small test tubes directly in a flame because the probability of the contents being ejected increases substantially. Use a water bath to heat in these cases. Pyrex glassware is usually safe to heat but never apply the direct heat of a flame to heavy glassware such as volumetric flasks, burettes, graduated cylinders, bottles, and thermometers. These objects break spectacularly when heated too much. Volumetric glassware will be permanently distorted from the calibrated volumes. Avoid heating any object too quickly. Apply the flame intermittently at first.

During any procedure involving the heating of an object, avoid burns by thinking twice before touching anything. Give heated glass adequate time to cool; it looks cool long before it is safe to handle. Use the appropriate type of tongs when moving hot objects. Test tube holders should be used for test tubes only, because they are too weak to carry flasks or other heavier objects.

Chemicals

Your instructor will discuss the toxicity and other dangerous properties of any materials for which special precautions are necessary. Material Safety Data Sheets are available for all chemicals used in the laboratory. All chemicals should, however, be considered potentially toxic, so **never taste a laboratory chemical or solution**. If you are asked to smell a laboratory chemical, gently fan the vapors toward your nose. Nearly all chemicals are poisonous to the human body to some extent.

Any laboratory chemical that comes in contact with the skin should be considered toxic and immediately washed off with soap and copious quantities of water. If the area of contact is large, use the safety shower. If the eyes are splashed with a liquid, immediately flush with the eyewash. Many toxic organic compounds, which are not corrosive, are absorbed through the skin with no immediately visible symptoms. Make a habit of washing your hands before leaving the laboratory and never remove any chemicals from the laboratory. If you receive a chemical burn, wash with water and seek medical treatment. Be prepared to assist other students in the case of an accident.

When diluting concentrated acids, always pour the acid slowly into the water while stirring continuously. Heat is liberated in the dilution process and if water is poured into acid, steam may form with explosive violence, causing splattering of the acid solution.

Never purposely allow fumes or volatile liquids to escape into the open room. **Use a fume hood for all experiments involving poisonous or objectionable gases or vapors**. Inhalation of more than a slight dose of such fumes should be reported and you should get to fresh air immediately. You should also report faintness induced by prolonged exposure to laboratory fumes.

Never use an open flame and flammable liquids at the same time. If you are using a flammable liquid, make certain there are no open flames in the area and preferably carry out your experiment in the hood. Do not heat anything other than water or an aqueous solution directly over an open flame. Consider all other solvents to be at least as flammable as gasoline. Many, such as ether, are more flammable.

Reagents

Read the label carefully before taking anything from a bottle. Use of the wrong material could result in a serious injury. Do not take reagent bottles from the cart to your work area. Instead use test tubes, beakers, or paper to obtain chemicals from the dispensing area. Label your container before dispensing the material. Do not take any more material than is required, because chemicals are expensive. If you take too much, avoid possible contamination by **never returning unused chemicals to the reagent bottles.**

Do not insert your own pipettes, droppers, or spatulas into the reagent bottles. To avoid contamination of materials, pour them from the bottles. When pouring liquids from glass-stoppered reagent bottles, grasp the stopper between two fingers of the hand with which you hold the bottle to pour. To avoid contamination, never place the stopper on the bench. When pouring solid chemicals, rotate the bottle to control the rate of flow from the bottle. Do not tap or pound. If chemicals are spilled on the outside of a bottle while pouring, the bottle must be washed off. If chemicals are spilled on the reagent bench, they must be cleaned up immediately. When you wipe up solid chemicals, be sure to avoid contamination of your skin. Avoid breathing dust from solid chemicals.

Safety Self-Test

1. When must goggles be worn in the lab?
2. Why are eating, drinking, and smoking prohibited in the lab?
3. Where should personal effects be placed in the lab when they are not needed?
4. If you injure yourself, what should you do?
5. Why should loose or dangling hair, clothing, and jewelry be restrained while you are in the lab?
6. Describe the location of the nearest
 - (a) safety shower
 - (b) eyewash fountain
 - (c) fire extinguisher
 - (d) first-aid kit
 - (e) emergency exit
7. If you spill chemicals on the lab bench, what should you do?
8. What should you do if you spill some mercury?
9. Why should you never place chemicals directly on balance pans?
10. Why should you never heat heavy-walled glassware directly with a flame?
11. Why should you never use a test tube holder to carry a flask?
12. How should you smell a chemical?
13. What should your immediate reaction be if chemicals come into contact with your skin?
14. Why should you never taste a chemical or a solution?
15. Why should you never return unused chemicals to the reagent bottles?