

SAFETY IN THE LABORATORY

Experience has demonstrated the necessity of maintaining a constant awareness of the hazards of experimental work performed in the study of chemistry. The best way for a student to protect himself and his coworkers is to incorporate safety as an integral part of each task and operation.

You are expected to exercise good judgment and common sense in preventing hazardous situations. To help you plan your work safely, this safety handbook has been compiled. Remember that these safe practices are not hard and fast and that all circumstances are not covered. If under exceptional circumstances good judgment indicates certain of these practices should not be followed, then make certain you are not creating a hazard by selecting a different procedure.

I. LABORATORY SAFETY RULES

1. Eye Protection

All students **must** wear safety goggles or safety glasses while doing work in the chemistry laboratory. If you do not have safety glasses (available in bookstore) do not come to lab. Do not wear contact lens in the lab.

2. Horseplay

Horseplay and practical joking of any kind are strictly forbidden.

3. Working alone

No one is to perform experimental work in a chemical laboratory unless a second person is present or nearby.

4. Work authorization

Unauthorized experiments are forbidden. Extra work or original work is encouraged, but before any experiment is performed in a laboratory, approval must be given by the instructor in charge.

5. Safety precautions

Before performing any experiment, become familiar with any safety hazards (flammability, toxicity, etc.) which may be present and take necessary safety precautions.

6. Reporting accidents and fires

All accidents resulting in injury, property damage, or fire must be reported immediately to an instructor.

7. Eating

Preparation, storage, or consumption of food or drink in work areas is not allowed and should not be practiced because of the danger of contamination with toxic and poisonous substances. Before handling food, students should thoroughly wash their hands.

8. Smoking

Smoking is not permitted in the laboratories or stockrooms. Flammable liquids, vapors, or gases create a definite fire hazard.

9. Working at night

Except for regularly scheduled night classes, all students must obtain the instructor's permission to work in the building after 5:00 p.m.

II. EMERGENCY PROCEDURE

A. In case of accident or illness:

- Render prompt first aid.
- Have someone report to an instructor for help.
- If injury or illness appears to be serious, have someone call an ambulance.
- Report all accidents that cause injury, regardless how minor, immediately to your supervisor.

B. In case of fire:

- If automatic alarm is not sounded, pull the alarm switch located in each hall.
- If fire is small and easily extinguished, use the laboratory extinguisher at once.
- If fire is large and difficult to extinguish, have someone call the fire department at once. Make sure no one is injured and immediately evacuate the area. Proceed with an orderly evacuation of the building
- Immediately report all fires to your instructor.
- Take all fire extinguishers that have been used to the storeroom for replacement. Tag such extinguishers as empty.
- If your clothing should catch fire, try to stay calm, don't run, but quickly get under a shower.

- Call for help.
- If the fire alarm sounds, prepare to shut down your experiment and evacuate the building.

C. First Aid

If any chemical gets into your eyes or mouth, or on your skin, go quickly to the nearest eye wash, sink or shower and wash with as much water as possible. If the eye is involved, hold the eyelids open with your fingers and allow water to run freely over the ball of the eye. It is best to assume that all substances except pure water are harmful when in contact with any part of the body.

In case of a cut, direct pressure on the cut is usually the best way to stop bleeding. All cuts, burns, and other injuries should be reported to the instructor at once.

III. GENERAL LABORATORY PRACTICES

A. Safety check

1. Locate all exits from the laboratory and from the building. Every laboratory has at least two exits.
2. Locate the fire extinguisher.
3. Locate the nearest telephone for use in case of an emergency.
4. Locate the safety showers and eye wash fountains.
5. Locate the power line cut-offs. (multi-breaker boxes).
6. Locate the nearest fire alarm switch.
7. To perform laboratory work safely, it is essential that the worker include in his experimental design provision for power or water failure which could cause an accident situation or an unsafe condition to develop. For example, consider the possibility of the loss of cooling water to a condenser or the loss of power to an expensive instrument. Plan to meet such an eventuality.
8. Operations or experiments are not to be left unattended.
9. Unsafe conditions and practices cause virtually all accidents. A person observing an unsafe act, practice, or situation should call it to the attention of his instructor.

B. Housekeeping (Removal of the Hazard)

The continuous practice of good housekeeping is essential to the prevention of accidents, fires, and injuries. Students re expected to keep their benches neat and orderly; a cluttered laboratory is a dangerous place in which to work.

1. Keeping benches, tables, hoods, floors, and desks clear of all material not being used.
2. Keeping adequate passageway to exits.
3. Cleaning up spills.
4. Removing broken glass.
5. Using proper waste-disposal receptacles.
6. Keeping all chemical containers clean and properly labeled.

NOTE: Eye wash fountains are **not** drinking fountains or sinks for disposal of chemicals or solutions.

C. Handling Chemicals

Chemicals can be dangerous unless properly handled. Before working with any chemical, know its properties. Hazardous chemicals include those which are flammable, toxic, corrosive, and/or reactive. Use of a hood is required in cases where an undesirable gas is produced.

A most important safety practice is to keep all material properly labeled. The label should show the following:

1. Chemical name and structure.
2. Date of purchase, preparation, or transfer to present container.
3. Brief notation of hazard, if any.
4. If a solution, concentration and name of person preparing solution.

Safety Precautions

1. Keep reagent container clean.
2. Use rubber or plastic gloves as necessary.
3. avoid contact of chemicals with skin.

4. Avoid breathing vapors.
5. Avoid contamination by not returning unused portions of reagents to stock bottles.
6. Never taste a chemical.
7. Do not pipette by mouth
8. When preparing solutions add concentrated chemicals (never vice versa).
9. Keep flammable solvents away from heat and flame.
10. Use care in transporting chemicals.
11. Use caution in working with mercury. The equilibrium concentration of the vapor over liquid mercury at room temperature is approximately 20 times the threshold toxic limit.
12. Clean up spills immediately. Use sodium bicarbonate to neutralize acids and dilute acetic acid to neutralize bases.
13. Never look directly into a test tube or beaker, or point a test tube toward anyone, especially when heating.
14. Before using a reagent always read the label twice to be certain you have the correct reagent.

D. Chemical Waste Disposal

1. Water-soluble wastes may be flushed down the drain with large amounts of water.
2. Liquid wastes not miscible with water must not be poured into the sink. Consult your laboratory instructor for directions.
3. Water-insoluble solids should not be poured into the sink.

E. Handling Compressed Gas

Know the cylinder contents and its properties. Transport cylinders carefully, using a wheeled cart for large cylinders. To remove gas through a regulator, make sure all valves are closed, then open slowly all valves, starting with the cylinder valve. Make sure all cylinders are securely attached to a bench or wall.

F. Handling Laboratory Glassware

1. Always carry glass tubing in a vertical position. Protect hands with towel when cutting tubing.
2. Lubricate, using water or glycerine, the surface of glass tubing, and thermometers before inserting into a stopper. Protect your hands with a towel. If it is difficult to remove glass from a stopper, cut off the stopper.
3. Broken or cracked glassware is unsafe and must be disposed.
4. Never heat graduated cylinders, bottles, funnels, or watch glasses over a flame.

G. Fire Prevention

To start a fire, three components are necessary: fuel, oxidizing agent, and source of heat for ignition. Many fires can be prevented by keeping fuel and oxidant away from hot ignition source.

A fire is extinguished by using the same principles followed in trying to avoid it.

1. Reduce air supply by smothering—cover the vessel or apply CO₂.
2. Shut off or reduce fuel supply.
3. Cool the fuel below its ignition temperature.
4. Lower the concentration of the fuel by diluting with an inert material.

Types of Fires:

- Class A: Burning wood, paper, cloth, etc.; extinguish with water, foam, soda-acid, or CO₂.
- Class B: Burning oils, greases, paints, etc.; extinguish with foam, CO₂, or dry chemical.
- Class C: Live electrical equipment; extinguish with CO₂ or dry chemical.
- Class D: Active metals, such as sodium, potassium, magnesium etc.; extinguish by smothering with dry soda ash, or dry chemical extinguisher.

H. Teaching Assistant: Duties and Responsibilities for Safety:

1. Teach and enforce safety as an integral part of the course.
2. See that the students make a careful analysis for safety before starting an experiment.
3. See that safety rules are obeyed. Set a good example yourself.

4. Remain in the laboratory at all times when students are present.