

# SAFETY IN THE LABORATORY

At the first laboratory class you will view a lab safety video, and receive a copy of the latest edition of the *Undergraduate Safety Manual*. Carefully read the manual, then sign and detach the *Laboratory Safety Agreement* form on the last page of the *Manual*. Give that sheet to your laboratory instructor at the beginning of the second laboratory class. That signed record will be filed with the chemistry department as an assurance that you have viewed the safety video, that you have accepted the assignment to read this *Manual* carefully, and that you have accepted the responsibility to abide by the rules set forth in the *Manual*. Refer to the *Manual* when preparing for lab, bring it to each lab for reference, and retain it for use in future laboratories.

The freshman chemistry laboratory experiments are designed to maximize learning with minimal risk. Most chemicals used could be encountered in everyday life. Examples are hydrochloric acid and ammonium hydroxide in cleaning products, sodium hypochlorite in bleach, or sulfur dioxide in the air on a smoggy day. As long as normal precautions are taken, chemicals such as these pose little if any risk to a healthy person. However some medical conditions can make a person especially susceptible to even common irritants. Precautions should be taken regarding some chemicals if a preexisting condition is present.

If you have or suspect you may have any of the following conditions, please speak to either your lab instructor or to a representative of the Chemistry Department Safety Committee before attending your next lab class.

1. Pregnancy
2. Chronic breathing problems. This could be caused by asthma, emphysema or many other conditions.
3. Immune suppression. This could be caused by drugs following an organ transplant, AIDS or many other illnesses.
4. Chronic Anemia.
5. Treatment with the prescription drug Acutane.
6. Any other drugs which you may have questions about.

Please feel free to discuss with us any concerns about your health as it relates to the lab, or matters of laboratory safety and procedure.

*The Department of Chemistry Safety Committee  
Manhattan College – College of Mount Saint Vincent*

# CONDENSED LABORATORY SAFETY RULES

*Chemical laboratories are potentially dangerous, but it is possible to work in complete safety if the following common-sense rules are obeyed.*

1. Come to lab prepared. Read the directions for the experiment *before* coming to lab and outline the directions in your notebook. Take special note of any comments related to laboratory safety.
2. *Always* wear safety goggles in the laboratory. If you need vision correction, wear eyeglasses instead of contact lenses underneath your goggles.
3. Wear clothing which protects you from chemical spills and splashes: shorts, skirts, sandals, and open toe shoes may not be worn in the lab. Avoid loose or bulky clothing. Tie back long hair. Remove rings, watches, and other jewelry from your hands and arms before working. It is good practice to wear a lab apron or lab coat.
4. Know the locations of the exits, fire extinguishers, eyewash fountains, safety showers, fire blankets, and other safety equipment.
5. Never fool around in the lab.
6. Follow the directions in this lab manual. Do not modify those procedures, or try other experiments, without obtaining the permission of your teacher.
7. Be neat. Don't put your books or clothing on the lab benches. Clean up chemical spills, broken glass, and floods as soon as they occur.
8. Be aware of what is happening around you. Be prepared to help if another person has an accident. Do not tolerate unsafe laboratory practices by others.
9. All chemicals should be handled as if they are hazardous. Never taste or smell a chemical in the laboratory, or let it come in contact with your skin. Never heat a chemical in the laboratory unless you are directed to do so. Be familiar with the properties and hazards of any chemical before you use it. Dispose of all chemicals according to your teacher's instructions.
10. Never light a match, Bunsen burner, or other flame until you are sure that there are no flammable substances nearby. Smoking is not permitted in the laboratory.
11. If you splash chemicals into your eyes, immediately wash them using the eye wash fountains. If you spill chemicals on yourself immediately wash it off using large amounts of cold water.
- 12. All accidents, however minor, must be reported immediately.**

# **UNDERGRADUATE SAFETY MANUAL**

## *Manhattan College – College of Mount Saint Vincent*

### **I. PERSONAL HABITS**

#### **A. Goggles**

1. Safety goggles must be worn to protect the eyes whenever laboratory activities are in progress. These must be purchased at the Stockroom during the first laboratory period.
2. The type of protection should be appropriate to the hazards involved. With particularly hazardous operations or substances, face masks, gloves, shields or other additional protection may be necessary.
3. Contact lenses should never be worn even with goggles over them. Irritating or corrosive substances cannot be washed away from the eyes when contact lenses are in place; foreign solutions are not only drawn under the lenses but also may be more damaging when hidden from the normal protective mechanisms of the eye. Those who normally use contact lenses should obtain prescription glasses for use in the laboratory. Prescription glasses must be covered by safety goggles.

#### **B. Attire**

1. Loose or fluffy clothing is more likely to catch fire or to become entangled in mechanical devices; it should not be worn in the laboratory.
2. Clothing is good protection against chemical damage to the skin. Shorts and bare midriffs are prohibited; bare feet and open-toed sandals are not permitted. A laboratory coat or laboratory apron is the preferable outer costume for laboratory work.
3. Long loose hair is a fire hazard; it should be tied back.
4. Don't wear jewelry to the laboratory; it may be damaged by fumes or spills. Chemicals can also get trapped between the jewelry and skin and cause severe irritation.

#### **C. Hygiene**

1. Most laboratory chemicals are toxic! Wash your hands after you handle chemicals; always wash your hands when you leave the laboratory. Never use fingers as stoppers.
2. Odors and fumes are part of everyone's image of chemistry; in fact, they are a hazard to your health. Always dispense compounds with strong odors or strongly fuming materials in the hood. Make sure hood has a draft toward the interior.
3. Know the characteristics of the substances you are using; never inhale odors at short range.
4. Smoking in the laboratory is never permitted.

5. Never taste chemicals, or wet labels, with your tongue.

#### D. Behavior

1. All students are expected to demonstrate mature judgment and good common sense in their work and conduct while in the laboratory.
2. Always work at your own desk. Socializing, practical joking, working under the influence of drugs or alcohol, or any other form of conduct deemed unsafe by the instructor is intolerable and is grounds for *immediate dismissal*.
3. Because of the risk of accidental contamination, food and drink should not be stored or consumed in the laboratory.
4. Keep noise to a minimum. Noise breeds confusion and may make it difficult for you and others to hear important instructions. A slightly lowered voice is appropriate when communication is necessary.
5. The student should be familiar with the work he/she is about to perform. This means that reading of all assigned material should be completed *before* the laboratory period.

#### E. Neatness

1. Hooks have been provided for outer clothing; don't place it on work surfaces.
2. Keep only necessary items at your desk and work area. Books and papers may be damaged through accidental spillage or fire.
3. Neatness is a sign of good technique. Clean your glassware after use; organize storage to minimize breakage and to improve accessibility.
4. You are responsible for cleaning up your working space before you leave the laboratory.
5. Label all containers legibly as to contents, date, your name, and any unusual hazards. Protect labels with transparent tape if they are not for short-term use.
6. Take special care to avoid dropping ice or oil on the floor; clean up any spills at once. Consult your instructor for advice on how to clean up and dispose of spilled chemicals.

## II. ADMISSION TO AND SUPERVISION OF LABORATORIES

- A. No student is permitted access to any non-public area of the Department unless he/she has specific business in that area.
- B. Visitors may not be in a laboratory area without the permission of the faculty member in charge. Visitors must comply with appropriate personal protection requirements, including wearing safety goggles.
- C. Pets are never permitted in laboratory areas.
- D. No student may work in any laboratory outside of the assigned hours of the course unless given permission by a faculty member to do so.

E. The level of supervision necessary is based on knowledge of the student's level of skill. The duty to recognize that he/she does not know what he/she is doing rests on the student, and he/she must seek further instruction and guidance if this is the case. Deliberate neglect of this duty will not be accepted as an excuse for the damage of sensitive and valuable instruments or the injury or inconvenience of others.

F. Students may pursue only experiments assigned for their course unless the instructor is informed and has given his/her consent.

G. No materials may be removed from laboratory areas for any reason without the instructor's knowledge and consent.

### **III. EMERGENCY PROCEDURES**

A. If you cannot help in an emergency, get out of the way of people who can. Remember that an injured person may be too excited to act rationally. Firm action on your part may avoid serious consequence.

B. ***Fires are the chief hazard in a chemistry laboratory.*** If you see a fire, tell your instructor and get out of the way. Warn others in your vicinity. Do not attempt to extinguish a fire unless an instructor is not nearby or unless someone is in immediate danger of serious injury.

You should be familiar with the location of all fire extinguishers in the laboratory and the types of fire for which each is appropriate. Do not use water or a Class 'A' extinguisher on chemical fires: use a Class 'B' extinguisher. Class 'D' extinguishers are used for sodium fires, and Class 'C' extinguishes for electrical fires.

#### ***WHEN THE FIRE GONG SOUNDS –***

- 1. Turn off all burners, steam, electrical equipment, etc.**
- 2. Exit in a quick, orderly manner via the nearest stairway.**
- 3. Never use an elevator during a fire emergency.**

C. Clothing fires are especially serious because a few seconds may mean the difference between minor and fatal injury. If your clothing catches fire grab the nearest fire blanket and wrap yourself in it. If a fire blanket is not available, roll on the floor to extinguish the flames. If you see a person with clothing afire, rush a fire blanket to him/her and wrap the person in it. If a fire blanket is not nearby, roll the person on the floor to extinguish the flames. Never use a carbon dioxide extinguisher on a person because the intense cold may cause burns as severe as thermal burns.

D. The eyewash fountains are for use when material gets in the eyes. Know where the nearest one is. Bend over the fountain *with your eyes open* and press the paddle at the side to turn on the water. If you observe that an injured person is having difficulty finding the fountain, guide the person there, hold his/her head in position and press the paddle. Tell the person to open their eyes as the water flows. Prompt flushing with copious amounts of water is preferable to any chemical treatment.

E. If chemicals are spilled over a small area of the body immediately flush with cold water and then wash with soap. If chemicals are spilled over a large area of the body, get under the shower and pull the chain. Make sure that large amounts of

water flush the affected areas. It may be necessary to remove clothing (particularly shoes) which covers the affected area.

F. The severity of an injury may be difficult to determine initially; therefore, *all* injuries, fires and explosions must be reported to the instructor at once. Students with injuries needing more than a Band Aid are required to go to the College health service. Delayed, often allergic, reactions may result from contact with chemicals. If a delayed action is noted (for example, the next day) report immediately for medical attention and explain carefully what chemicals were involved.

#### **IV. LABORATORY CHEMICALS AND APPARATUS**

Common chemicals and apparatus must be treated with caution; you must be familiar with them. There is no substitute for knowledge; consult your instructor if you are in doubt.

##### **A. Chemicals**

1. To determine the odor of a chemical, waft the vapors toward you by a wave of your hand from the open container. Do not smell the bottle directly.
2. To determine the appearance of a chemical, make your observation through the side of the container if possible. If you must look through the open mouth of the vessel, do so with great caution.
3. Do not add any solid to a heated liquid near its boiling point, since this may cause it to boil violently. Liquids should be added to hot liquids slowly and carefully.
4. Sulfuric and nitric acids are perhaps the most frequently encountered dangerous chemicals. They must be carefully used for they are corrosive. Heat may be created at a dangerous rate when these are diluted with water. Always add acid to the water slowly with stirring. Nitric acid is also a strong oxidizing agent and may cause organic matter to ignite or explode on contact. A common cause of explosion is the addition of nitric acid, used as a cleaning agent, to a vessel containing organic material or residual rinse of solvents such as alcohol or acetone.
5. Oxidizing agents supply oxygen to support combustion of burnable material in contact with them. The *per-*, *-ic*, and *-ate* salts, particularly of the heavy metals, are capable of supplying oxygen at explosive rates when heated with organic or other combustible matter. Be careful about heating mixtures of such salts or their acids. Do not let them contact your flesh or clothing. Spills should be cleaned up promptly. Any compound with *per*, *nitrate*, or *nitrite* in its name should be assumed to be a strong oxidizing agent (examples: perchloric acid, hydrogen peroxide, sodium nitrate).
6. Sodium and potassium metals often ignite in air and ignite and explode if contacted with water. Obtain correct handling directions from your instructor.
7. Chlorine, bromine, iodine, and solutions of these elements are intensely irritating to the eyes, skin and respiratory system. Any work with these substances must be done in the hood. Chlorine and bromine are to be used only after taking special precautions.

8. All compounds labeled *stench*, and other malodorous chemicals, such as organic compounds of sulfur and low molecular weight organic acids, must be used in the hood.

9. Compounds with *cyanide*, *cyano-*, or *nitrile* in their names are usually toxic. They should be kept away from acid and handled in a hood.

10. Many compounds of heavy metals such as antimony, arsenic, barium, bismuth, lead and mercury are toxic. Dispense these with particular care.

11. Clean up waste and spilled chemicals promptly. Consult the instructor for the proper method to follow with your materials.

12. Never use any substance from an unlabeled or dubiously labeled container. Carefully read the label before removing any reagent from its container. Take only the needed amount of a chemical, and do not return material to a reagent bottle.

13. Two of the most common solvents are among the most flammable laboratory chemicals: acetone and ethyl ether ('ether'). These substances have high vapor pressures at room temperature and may be ignited by a flame quite distant from the solvent container. Flames and other sources of ignition must be strictly excluded from work areas where these or other flammable substances are used.

14. Sodium hydroxide is found in the laboratory in the form of pellets or 50 per cent solution. Both forms are extremely hazardous to human tissue. In addition, potassium hydroxide and sodium hydroxide will destroy the stone work benches if left in contact with them. Clean up all spillage of these solids or their solutions at once.

15. Liquid mercury and its vapor are toxic.

## B. General Handling

1. Many chemicals are either too valuable or too toxic to be disposed of in the sink. Waste jars or special containers for these will be supplied. Don't pour chemicals into the sink unless you are sure that this is the proper method for their disposition.

2. When disposing of chemicals in the sink or when cleaning up, use water generously. A running faucet near where you work is good for you and your sink.

3. Do not store chemicals in the ice machine. If you must place chemicals in a refrigerator, be sure that they are in tightly sealed containers. Flammable materials can be stored only in special *explosion-proof* refrigerators.

## C. Apparatus

1. Do not use mouth-suction to fill pipettes. Use a rubber bulb or tube. Never use your mouth to start a siphon.

2. When gases from cylinders are to be used, make certain the cylinder is firmly secured to a sturdy support. Be careful with the cylinder and its regulatory apparatus: never bump or strike them. If they are opened too rapidly or damaged mechanically, explosion may occur.

3. Pressure or vacuum should be applied slowly to an apparatus. This is especially important with mercury manometers, because sudden pressure changes may cause a mercury surge which can smash the apparatus. Hold stopcocks with both hands and turn very slowly. Report all mercury spills to the instructor immediately.
4. Provide a vent if chemicals are to be treated in an apparatus. When you heat apparatus containing a volatile liquid, *be sure that the apparatus is not a closed system.*
5. Dry ice or cryogenic fluids such as liquid nitrogen should not be used until you have received proper training from the instructor. Never allow these materials to contact the skin. Do not put anything in a cryogenic fluid without consultation with the instructor.
6. Beware of electrical shock. Several common laboratory devices operate at high voltage/current. Never attempt to repair a piece of equipment; instead notify the instructor of any malfunction.
7. Beware of pumps and other apparatus with moving belts, pulleys or shafts. Loose clothing is a special hazard around such equipment.
8. Make sure that all apparatus is securely supported so that it cannot fall over.
9. Hot liquid baths are occasionally used for heating laboratory vessels. These baths must be supported properly to avoid spills.
10. Steam baths may inflict painful burns; exercise caution when using them or a steam distillation apparatus.
11. A proper safety vacuum trap should be used to protect all vacuum lines or vacuum pumps from contamination or damage.

#### D. Glass

1. Although glass is the most common cause of cuts, there is no substitute for this material in most laboratory applications. It is fragile and should be handled carefully.
2. Protect your hands with a towel or gloves when breaking or cutting tubing.
3. Joining of glass and rubber apparatus requires lubrication with glycerin or water. Grasp the glass near the end to be inserted and use back-and-forth twisting motion to join it to rubber. Protect your hands with towels or sturdy gloves.
4. Glass stoppers, ground glass joints, desiccator lids and stopcocks may freeze into place if improperly lubricated or if contacted with alkaline solutions. In such an event, ask the instructor for assistance.
5. Handle desiccators with care. To open, slide the top sideways. Never lift the top straight up because the bottom part may drop; or, if the bottom is held, it may recoil and break against the desk top. Make sure the ground glass surfaces of the desiccator body and lid are properly lubricated and kept free of grit and old lubricant.

Vacuum desiccators require extreme care. Always consult an instructor before using them. They should always be protected by a metal guard, and not be moved

when evacuated. They must never be opened until their internal pressure has been equilibrated with the atmosphere.

6. Never use cracked, chipped, or broken glassware. Be particularly alert for the small star-shaped cracks which form when glass strikes stone or metal; these cracks will burst when the glass is heated or evacuated.

7. Clean up broken glass promptly, using a brush and dustpan. Place all broken glass in the container provided for it.

8. Report any damaged or malfunctioning apparatus to an instructor, whether or not you are responsible for the problem, so that it can be repaired for the next user.

9. Thermometers are fragile and present two hazards when broken: mercury vapor and broken glass. When assembling glassware, the last step should be installation of the thermometer.