

SAFETY AND LABORATORY RULES

Department of Bioorganic Chemistry,

Uppsala University

Explanatory comments may be found below under [Standard Operating Procedures](#)

1. APPROVED [SAFETY GOGGLES](#) MUST BE WORN AT ALL TIMES.
2. NO [FOOD, DRINKS](#) OR SMOKING ARE ALLOWED.
3. [SHOES](#) MUST BE WORN. No bare feet or thong sandals are allowed.
4. No LAB-WORK IS PERMITTED WHEN YOU ARE ALONE IN THE LAB, specially with any solvents or chemicals. For any other work, kindly talk to Jyoti.
5. [NO OPEN FLAMES](#) ARE ALLOWED except as directed by the instructor.
6. Inform yourself about THE [LOCATION](#) OF [FIRE](#) EXTINGUISHERS, SAFETY EQUIPMENT, emergency showers and eye-wash, and the emergency telephone numbers AND THE NEAREST EXIT.
7. NO UNAUTHORIZED EXPERIMENTS MAY BE PERFORMED.
8. DO NOT USE BROKEN OR CRACKED [GLASSWARE](#). Check glassware before using it.
9. NEVER TASTE OR SMELL [CHEMICALS](#). Consult Chemical-safety handbook before using any unknown chemical (which is to be used for the first time).
10. AVOID [CONTACT](#) OF CHEMICALS WITH SKIN. The use of rubber gloves is recommended. Have Lab-coates ON you all the time
11. DISPOSE OF CHEMICAL [WASTE](#) AS DIRECTED BY Chemical-safety handbook or INSTRUCTOR.
12. [CLEAN](#) YOUR WORK AREA AND PUT AWAY ALL [EQUIPMENT](#) AND GLASSWARE BEFORE LEAVING. Make sure equipment is put away in the correct locker - your personal locker or the common locker.
13. PUT PAPER TRASH AND [BROKEN GLASS](#) IN TRASH CONTAINERS.
14. KEEP [INSTRUMENT ROOM](#) CLEAN AND FREE OF PAPER.

STANDARD OPERATING PROCEDURES

IN THE ORGANIC CHEMISTRY LABORATORY.

1. Attitudes and Preparation

- a. Come to laboratory periods on time (preferably before 09.30 hours) and mentally prepared by studying the experiment and planning your activities. This will help us to interact with each other.
- b. Be prepared physically; for example, don't try to do lab work on an empty stomach, or without sleep or when you have alcohol in your bloodstream.
- c. Write everything you do and see in your notebook so that you can trace your actions and make corrections if necessary.
- d. Wear sensible clothing, including shoes that are comfortable and permit rapid movement in case of emergency, and hair or hat that does not obstruct your view or dangle into the experiment.

- e. If you wear contact lenses, try to avoid wearing them in the lab. If you must wear contact lenses, your goggles must seal particularly well to your face.
 - f. If you injure yourself, even slightly, report it to the safety-officer and/or your instructor, and seek first aid. If you experience eye irritation, flush your eyes at the nearest emergency eyewash station for 15 minutes (remove contacts) and seek medical attention immediately.
 - g. If you have any existing physical conditions that might affect your performance, your health, or other peoples' health in the lab, please inform your instructor. This information will be kept confidential; examples might include pregnancy, medications, allergies, epilepsy, AIDS. Special arrangements may be possible.
-

2. Your Working Environment

- a. GOGGLES meeting ANSI standard Z87.1-1979 for chemical splash protection are **required** at all times in labs or instrument rooms, i.e. all parts of the lab, even when you are not handling chemicals. The goggles will protect your eyes from most splashes and impacts. The goggles do **not** meet the standard if the air baffles are removed. Some people have trouble with their goggles fogging up. The best solution is to take a short break outside the lab to clean them.
 - b. Rubber gloves are strongly recommended to protect you from absorption of chemicals through the skin. We also recommend a lab coat to protect your clothes and skin from your and your neighbor's spills.
 - c. Keeping your bench space tidy will minimize breakage and spills of your valuable products.
 - d. You are expected to clean up your own mess in community areas such as the IR room.
 - e. Keep your glassware and other equipment cleaned up as you work. Having clean, dry glassware available at all times will save you much time in the long run.
 - f. Be careful not to contaminate reagents with your spatulas or droppers. If you take too much of a reagent, give it to a needy neighbor - do not return it to the bottle.
 - g. Do not wander off with the only bottle of a reagent that everyone needs; keep it in its assigned location.
 - h. Be sure the aisles are passable.
-

3. Glassware

- a. The most common laboratory injury is a cut occurring upon breakage of glass or porcelain. Most cuts can be prevented by careful work which prevents breakage.
- b. The safe procedure for inserting a glass tube or thermometer into a stopper with a hole is as follows:
 - i. Be sure the tip of the tube is fire-polished.
 - ii. Lubricate the glass with glycerol or water.
 - iii. Be sure the hole in the stopper is large enough.
 - iv. Grasp the glass about 1" (no farther) from the end and push and twist to insert it into the stopper.
 - v. Be sure that the hand holding the stopper is not in line with the entering glass.
 - vi. As the glass begins to slide into the rubber, move the hand holding the glass back a little, always keeping it no more than 1" from the rubber.

- vii. Most accidents occur because the glass snaps above the stopper from a force sideways (torque). Keeping your hand close to the stopper will help prevent your exerting a force sideways on the glass.
 - viii. The above considerations apply also to *attaching rubber hoses to condensers*. The condenser should be in your hand (not clamped to an apparatus) and gripped close to the lubricated connector being inserted into the hose.
 - c. Never use a thermometer as a stirrer! Always support a thermometer in a beaker or flask with a clamp. If a mercury thermometer breaks, immediately contact the laboratory instructor and restrict access to the area of contamination until cleanup can be arranged.
 - d. Round-bottomed flasks will not stand upright by themselves and if rested on the counter will roll. They must be supported on a cork ring, in (not **on**) a beaker, or in a clamp.
 - e. When glassware is assembled, care should be taken to use the minimum number of clamps needed for support, making sure:
 - i. The clamp is attached to a vertical support bar.
 - ii. No torque is applied by the clamp.
 - iii. Top-heavy apparatus is prevented from rotating and tipping.
 - iv. Hanging pieces are clamped - grease will not hold them against the force of gravity!
 - f. Do not use a glass stopper to seal a hot container or you may never get it out again. Cork is recommended for organic solvents since rubber dissolves in organic solvents and **vice-versa**.
 - g. Graduated cylinders are metastable and tip easily with the touch of a sleeve.
 - h. Report breakage of glassware to your instructor for disposal instructions.
 - i. Think before cleaning equipment - it makes little sense to scrub a graduated cylinder that contained ether or a water-insoluble material with soap and water.
-

4. Safety Equipment

Your safety officer will show you where it is; remind yourself from time to time during the semester.

- a. Fire Extinguishers for smothering fires. Department's policy regarding response to fires restricts the use of fire extinguishers to persons who are properly trained. Small fires may be extinguished by covering with a book or larger container.
 - b. Fire Blanket for smothering fires.
 - c. Safety Shower for rinsing chemicals off the body.
 - d. Eye Wash Fountain for rinsing chemicals from the eyes.
 - e. First Aid Kit - Note: even minor injuries must be reported to your instructor.
 - f. At least two exits.
 - g. Dustpan and broom for removing broken glass.
-

5. Toxic Hazards

- a. The materials used in the organic lab are the safest we can find consistent with your need to develop skills in working with hazardous materials in your career in science.

- b. Since you are wearing eye protection, the opportunity for liquids or solids to enter the eye is small. Chemicals in the eye should be immediately flushed with copious amounts of water using the eyewash fountain.
 - c. To prevent inhalation of organic and inorganic vapors, do your experiments in the fume hood or under the minihoods on the bench.
 - d. If you need to determine the odor of any material, waft it gently toward your nose with your hand - don't stick your nose in the container and inhale.
 - e. Organic compounds can be absorbed through the skin, so be careful about spilling things. Wear rubber gloves to prevent contact with your skin, but treat the gloves as if they were bare skin, keeping them scrupulously clean. You might set aside a pen for laboratory work to minimize the possibility of contamination from your gloves via your pen to your hands and face. Obviously, chewing a pen or pencil that has been used in the lab would be unwise.
 - f. Organic vapors also can be absorbed into food or tobacco which you may ingest later. Moreover, any drinks brought into the lab could have things spilled into them. No food or drinks in the laboratory, not even stuffed in your backpack. If you do not have a locker to keep food in, please remove the food, drink and cigarettes to the hallway, or ask your instructor for a safe place to keep it. Smoking is not allowed in State buildings, as the nicotine and other contents of the smoke are well-known health hazards (look up the LD₅₀ of nicotine if you are skeptical).
 - g. If you spill a liquid on the bench, immediately soak it up with paper towels and, if it is volatile, transfer the towels to the hood. Inform your instructor as to the nature of the spill in case further action is warranted.
 - h. If concentrated acid is spilled, add sodium carbonate or bicarbonate, solution or solid. If concentrated base is spilled, add dilute and/or weak acid (e.g. acetic). Indicator solution or paper will be available in the lab. If your skin (or clothing) comes in contact with the spill, immediately flush the skin or clothing with water for 15 minutes.
 - i. Should you spill bromine solution anywhere, treat the spill immediately with sodium thiosulfate solution.
 - j. Bottles of the reagents mentioned in g) and h) are available on the small counter above your bench.
-

6. Heat Hazards

- a. Most organic compounds are flammable and may catch fire even in the absence of flame at high temperatures.
- b. Flames are rarely allowed in the organic laboratory. If flames are permitted by your instructor, plan your experiments so that you **never leave your flame unattended**.
- c. If you light a flame, you are responsible for the consequences, so check with your instructor for a safe location.
- d. If you use a bunsen burner, be sure to tie back your hair and be careful that hair or clothing are kept clear of the flame.
- e. If there is a flame in the neighborhood, do not pour flammables; organic vapors are usually denser than air and will flow along the bench without alerting you by their odors.
- f. Make sure you know the location of the nearest fire extinguisher and the nearest exit.
- g. Reactions that are exothermic or are being heated must be monitored; do not leave them without having someone watch.

- h. Never, never, **never** heat a closed system! Pressure will build up and cause the glass to fail, sending projectiles of glass in all directions. Do not depend on small leaks - a substantial air exit must be provided.
-

7. If There is a Fire

- a. In the lab where you are working.
 - i. Shout "fire" to alert your neighbors and instructor if you discover it.
 - ii. A small fire in a test tube or other container can usually be extinguished by covering the container with a watch glass or book. If the fire cannot be extinguished by one extinguisher or by sand or water, you will be instructed to evacuate, following the procedure in b).
 - iii. One terrible possibility is that someone's clothing is set on fire. If the person runs, the flame will be increased by increasing the supply of oxygen. It must be smothered. Wrap the person in a lab coat, fire blanket, or whatever is handy to exclude oxygen.
 - b. Elsewhere in the building (fire alarm sounds):
 - i. Extinguish any flames and turn off electrical equipment.
 - ii. Close any open windows and internal doors near you.
 - iii. **Walk** quickly through the nearest exit to the hallway and leave the building by the nearest stairwell.
 - iv. The last person leaving the room, usually your instructor, will close the hall door.
-

8. Laboratory Electrical Equipment

- a. During the semester you will use a variety of instruments to analyze your samples. As with all electrical equipment, a certain amount of care is needed to prevent fire, shock and damage to the equipment. Be careful not to bring water, especially on your hands, into contact with connected electrical equipment.
 - b. The hot plates you are provided are powerful and seldom need to be set higher than 3.
 - c. Much of the heating in organic chemistry is done with electrical heating mantles; these must be plugged into a variable transformer, **not** directly into the outlet or they will overheat and may cause a fire.
 - d. Never transfer anything into a flask that is sitting in a heating mantle; use a cork ring, beaker or clamp to hold the flask during transfers. Organics spilled in a mantle will catch on fire when the electricity is connected, acids or bases will corrode the wires, and water will cause a short circuit.
 - e. Never pour into a container on an electronic balance - they often have the wiring and knife edge under the pan are thus easily damaged.
 - f. Turn off electrical equipment immediately after you have finished unless your instructor has stated otherwise (e.g. the gas chromatographs must be left on for an hour to stabilize).
 - g. Report frayed cords, or non-functional equipment to your instructor. Do **not** put it back in the cupboard or you will be stuck with it again next time.
 - h. No samples are allowed on top of any instruments.
-

9. Pressure Hazards

- a. **Never** heat a closed system.
 - b. When using a separatory funnel, vent frequently and remove the stopper immediately upon setting it upright for separation.
 - c. Compressed gas cylinders must be strapped to the bench above their center of gravity when the protective caps are off. Pressure regulators are generally **not** interchangeable between gases for safety reasons. Gas cylinders should be free of regulators and protected by their cap before moving.
-

10. Waste Disposal

- a. In order to minimize damage to the environment, and in compliance with State and Federal law, chemical wastes must be separated into categories and carefully labelled as to their contents. Please read and follow the labels on the waste bottles to ensure that your chemical wastes are treated safely and appropriately. You will find containers for:
 - i. General Organic Waste (flammable)
 - ii. Halogenated Hydrocarbons (non-flammable)
 - iii. Chromic Acid Solutions (these have been phased out)
 - iv. Lead
 - v. Silver
 - vi. Other Heavy Metals
 - vii. Waste from specific experiments in some cases.
 - viii. Acids
 - ix. Bases
 - x. In some experiments, acids and bases will be neutralized to a pH of 6 - 10 (State law) as part of the experiment and flushed down the drain with lots of water. Your instructor will give you instructions in particular cases. Indicator solution or paper will be available in the lab.
 - xi. Broken thermometers create the special problem of spilled mercury (a toxic heavy metal). Report such accidents immediately to your instructor; usually any mercury which cannot be collected is reacted with sulfur or absorbed with a special kit before disposal as heavy metal waste.
 - xii. Broken glass or porcelain is swept up into a dust pan and disposed of in a special container for broken glass. Please don't use your fingers.