

# Laboratory Safety Rules and Regulations

## SAFETY RULES

### A: Eye Protection

The Occupational Safety and Health Administration (OSHA) regulations (29CFR1910.133) require that all persons in a chemical laboratory must wear suitable eye-protection at all times while in the laboratory. These eye-protective devices shall be provided free of charge to the student.

During the first laboratory period you will be issued one pair of chemical splash goggles. These must be returned in good condition upon completing or dropping the course. These devices must be worn at all times in the laboratory. Anyone with a severe eye condition that requires other protection may wear individual eye protection that has been certified in writing by an optician (or equivalent) to meet all pertinent OSHA regulations.

Contact lenses are never recommended and by themselves do not constitute appropriate eye protection. Students that choose to wear contact lenses will be asked to sign a waiver form releasing NCSU from liability in the event of damages as a result of wearing contact lenses in the laboratory.

### B: Clothing and Personal Items

Proper shoes that cover your feet without gaps such as open toes must be worn during the lab period. Sandals, thongs, crocs and similar footwear are never permitted in the lab.

Students are urged to dress with potential lab hazards in mind. It is never a good idea to wear expensive clothing in the lab due to the chances of spills. Clothing should be worn that protects as much of the body as possible.

<b>Shorts (regardless of length), short skirts, sleeveless shirts, tank tops, and halter tops are not considered safe attire and are not permitted.</b>
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Clothing may have to be removed immediately if ignited or grossly contaminated with chemicals during an experiment.

Laboratory aprons or lab coats may be worn to provide extra protection from accidents and spills. Lab coats and aprons may be purchased at the NCSU Bookstore. Loose fitting clothes, easily combustible clothes, and long, unrestrained hair are all fire and accident hazards, and are not appropriate in the laboratory.

### C: Handling Chemicals

- 1 Treat all chemicals in the lab as toxic substances. Keep them off your skin and clothes.
- 2 Due to danger of chemicals entering the mouth or lungs: smoking, vaping, drinking and eating are forbidden in the laboratory.

- 3 Many chemicals are thought to pose special risks to unborn children, especially during the first few months of pregnancy. To minimize this risk, consult the Laboratory Director for alternatives to lab, if you are pregnant.
- 4 Do not taste anything in the laboratory. This applies to food as well as to chemicals.
- 5 Do not place your mouth on any chemical equipment.
- 6 Keep your hands and face clean. Flush any spill on your body with cold water for at least 15 minutes. Wash your hands with soap and warm water *before* leaving the laboratory.
- 7 Avoid inhalation of fumes of any kind. To test an odor, fill your lungs with air and cautiously sniff the vapors as you waft (fan) them from the source.

**Never** inhale fumes directly from a chemical substance. All odorous and/or fuming chemicals must be kept in the dispensing hood. Any reaction that emits a fume must be carefully set-up to trap the fumes, or to direct them into the bench-top hoods.

- 8 Never leave excess or spilled chemicals on equipment (in particular, the handling surface of glassware); wipe clean with a damp towel immediately and dry immediately with another towel.
- 9 Avoid violent splattering by always pouring concentrated solutions (e.g., acids) slowly INTO water or less concentrated solutions while stirring. Never the reverse.
- 10 Do not point the mouth of a reaction vessel containing chemicals toward yourself or toward anyone else.
- 11 Never leave any reaction unattended.
- 12 Most organic substances are flammable. Sparks, flames or other ignition sources should be kept out of the laboratory. Heat organics in a sand or water bath, or use an aluminum heating block.

**CAUTION:** Chemicals spilled on hot plates can result in fire.

- 13 For additional information on the properties of laboratory chemicals, consult the Safety Data Sheet (SDS) file, the Aldrich catalog or the Laboratory Safety Plan (Chemical Hygiene Plan), all of which are available during laboratory hours in the Stockroom.

## EMERGENCY PROCEDURES

*Immediately alert your instructor to ANY accident or fire.*

### A: Fire

In the event that your hair or clothing catches fire—**STOP - DROP - ROLL** to smother the fire. Help to smother any fire on a peer. Designate someone to pull the fire alarm and call 911.

If a fire begins and is confined in an open container such as a beaker, it can usually be extinguished simply by covering the top of the beaker to remove the source of oxygen. Be careful to

avoid spreading a confined fire by blasting it with a fire extinguisher. It is usually best to have the TA operate a fire extinguisher if one is needed at all. Much damage can be done by the improper use of a fire extinguisher.

## **B: Evacuation**

Whenever a Fire Alarm sounds, turn off water and electrical devices at your lab station, collect your purse and/or calculator and exit the building by the *stairwell* closest to your lab.

<b>CAUTION: AVOID PANIC. DO NOT RUN.</b>
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Avoid inhaling smoke from a chemical fire. Assemble in front of the FOX building. Your teaching assistant will check the student roster to be sure everyone is safe. Do not leave the area until your TA has checked your name on the roster. Return to the building **ONLY** after a security officer gives clearance.

## **C: Injury**

Be familiar with the location and operation of the eye wash fountains and safety showers. Any chemical splash into the eye should be flushed for a full 15 minutes using the nearest eye wash. First aid supplies are available in the Stockroom. Slight wounds or burns may be treated there. *Report all burns, cuts, or other injuries to your instructor.*

# **HOUSEKEEPING**

## **A. General**

- 1 Stay in your assigned section during the laboratory period. Do not sit in the aisles or on the benches.
- 2 Do not perform any lab work until you have been briefed.
- 3 All unauthorized experiments are expressly forbidden.
- 4 Do not enter instructor stations or the Stockroom unless asked to do so by the staff.
- 5 Do not move or try to repair instruments. Report malfunctioning equipment to your instructor at once.
- 6 Clearly label your safety glasses or goggles with your name.

## **B. Laboratory Work Area**

In the laboratory each student has the use of and the responsibility for drawers containing itemized equipment. The student may share the use of a bench top and a sink. These latter areas consist of a center shelf, gas outlets, a fume exhaust hood, water taps (undistilled water), and a computer.

### **1. Drawer and Bench Top**

Maintain general order and cleanliness in all parts of these areas. This is essential. *Your observation of these rules will be evaluated in lab grading.* Clean up any spills IMMEDIATELY. Equipment must be kept clean, intact, and in the amounts indicated on the equipment sheet.

*Keep your bench top uncluttered.* Coats, book bags, umbrellas, etc. should be kept only in designated areas, not at your lab bench.

Nothing should be present except authorized equipment and chemicals, and writing materials. Keep materials not in use well away from the work area and the edge of the bench. Objects that may roll (e.g., a thermometer) should be carefully placed in a drawer and not allowed to remain on the bench top.

## **2. Sinks, Gas Outlets, Hoods**

Each sink has a tap for undistilled hot and cold water plus a tap providing a connection for suction tubing attached to an aspirator trap. A small exhaust hood is located over each sink. Do not attempt to adjust it. Place any sample emitting vapors directly under the hood to get optimum vapor trapping.

- a Do not put trash in the sink.
- b Discard glass only in containers marked "BROKEN GLASS".
- c Do not leave rubber tubing attached to taps after experimental work is completed for the period.
- d A detergent soap bottle should be located behind the water taps.
- e Never hold glassware under the faucet nozzle while turning the tap ON or OFF. Water pressure may splatter chemicals or force the vessel from your grasp.
- f Always check gas valves *upon entering* the lab and before *leaving*.

## **C. Instrument room**

The instrument room is a community area. Items located in the instrument room area include: Balances, DigiMelts, weighing paper, and electronic equipment.

## 1. General

- a Instrument room housekeeping is as important as at individual bench top areas. Your work will be observed and evaluated at both locations. Leaving spilled chemicals on container surfaces or on the floor creates a hazard to all that work in the area after you.

*CLEAN UP ALL SPILLS*

- b Remember that traffic is often congested in this area; safe movements, orderliness, and cleanliness are critically important.

## 2. Reagent Use

*NEVER remove any chemical from the laboratory.*

- a Do not alter the laboratory set-up. Ask your instructor if you think something is missing or out of place.
- b Know the name of, *and hazards presented by*, any chemical involved in an experiment *BEFORE* you use it.  
Consult the Safety Data Sheet (SDS).
- c Know the amount of reagent you wish to obtain before you go to the hood. Avoid taking amounts greater than called for by your manual and/or instructor.
- d Please be careful to *avoid contaminating reagents* for others and for your later use.
- e To obtain a bulk (i.e., more than a few mL) liquid reagent, pour the reagent into a beaker from the bulk container. NEVER pour a bulk liquid directly from the bottle into a graduated cylinder.
- f Remove solids by using a clean spatula or spoon to obtain the desired amount of material from the reagent bottle onto weighing paper.
- g NEVER return excess reagents to the containers. Check the needs of others before discarding excesses in the proper waste container.
- h Hold stoppers and droppers while using a container. Do not put stoppers on bench or plastic surfaces.
- i Replace stoppers, lids, and droppers immediately after use to prevent contamination of reagents.
- j Do not use reagent containers without labels or with improper labels. Report these situations to your instructor.
- k Always check sides of reagent containers for drips *before* and *after* use. Remove excess chemicals with a damp towel and then wipe dry.

### 3. Reagent Disposal

- a *NEVER* discard chemicals in sinks, or trash receptacles.
- b Place all *organic wastes* or other hazardous wastes in the properly designated containers in the Main Hood.
- c DO NOT MIX WASTES. Be sure to keep chlorinated and non-chlorinated liquid waste separate.

### 4. Equipment handling

- a When glass is broken, contact your instructor immediately. He/she will determine if a repair is possible. Receptacles under sinks are for paper and miscellaneous trash items. *Glass should only be discarded in containers marked "BROKEN GLASS"*.
- b To minimize wear on the Lab Jack, never open or close it all the way.
- c Before elevating or lowering the Lab Jack, be sure the hot plate electrical cord is in a safe position. Do not catch the electrical cord in the Jack mechanism.
- d At the end of every experiment, unplug hot plates and turn both dials to the OFF position.

### 5. Analytical Balances

- a **Instructions for use of these items are available in lab and must be followed carefully.**
- b NEVER allow chemicals to contact a balance pan. Always use weighing papers on the balance pan when another container is not used for weighing solids.
- c Be particularly careful when weighing liquids on balances.
- d All spills must be immediately and thoroughly cleaned.
- e Do not attempt adjustments not specifically described in the posted instructions. Report any irregularities to your instructor at once.
- f Use the same balance throughout any experiment to minimize weighing errors due to small variations in balances.

## HAZARDS AND FIRES

The Organic Chemistry Laboratory is a “**High Hazard**” area.

However, with proper attention to details and by following the “*Safety Tips*” given in lecture, lab briefings, and with most of the experiments in this book, this experience can be a totally safe and interesting one.

We have made a concerted effort to eliminate the use of unusually toxic compounds. However, we will use a few compounds that are known to be, or which are suspected to be, quite toxic. This is inevitable if we are to give you a realistic experience with a wide variety of compounds. We will provide a special warning in these instances, and your TA will provide ideas on how to minimize the risk of handling them.

You will notice that you are **never** asked to touch, taste, or inhale **any** compound in **any** experiment. We will also attempt to use the smallest quantities possible, and to keep these well contained. Please cooperate by following directions closely, taking only what you need from the supply containers, and by carefully disposing of waste according to directions from your instructor.

Safety Data Sheets (“**SDS**”) for most compounds used in this course are available through the NCSU EHS database, Sigma Aldrich database, and/or on the Internet. Each sheet describes the physical and chemical properties, as well as the hazards, of a particular chemical. Be sure you know how to locate the SDS file.

If you have any safety-related questions, be sure to ask your instructor for the answers. *The time to inquire is NOW, before an emergency develops.*

### Useful Internet Sites for Safety, SDS, as well as other aspects of Organic Chemistry:

<https://jr.chemwatch.net/chemwatch.web/home><sup>1</sup>

<https://www.sigmaaldrich.com/US/en/search><sup>2</sup>

## Fires in the Laboratory

One of the most feared accidents in any lab is a fire. However, fires are quite rare, and **not** a cause for undue concern. We have done everything possible to minimize the chances for a fire by drastically reducing quantities of flammable materials and eliminating most potential sources of ignition (sparks and flames). For your information the following material is provided, just in case a fire does happen to break out.

While any fire is serious, it is important to react in a manner that is appropriate for the scale of the fire. Remember that your safety is of primary importance. Never attempt to fight a fire if you fear that you will be unable to escape the laboratory. Your teaching assistant is trained to use the fire extinguishers. Rely on your TA for guidance. Take very good notes when your TA briefs you on laboratory safety.

### A. Requirements for a Fire

All fires require three items:

- FUEL**,
- OXYGEN**, and
- ENERGY**, (a source of ignition)

Without all three of these, there can be no fire. Likewise, if a fire has started, removing the fuel or the oxygen will extinguish the fire.

<sup>1</sup><https://jr.chemwatch.net/chemwatch.web/home>

<sup>2</sup><https://www.sigmaaldrich.com/US/en/search>

## B. Classes of Fires

- **Class A** – *Ordinary Combustibles* such as wood, cloth, paper, rubber, plastics and similar materials that burn easily
- **Class B** – *Flammable Liquids* such as most of the solvents used in this lab, gasoline, oil based paints, lacquer and flammable gases
- **Class C** – *Electrical Equipment* such as computers, instruments, motors, fuse boxes, and other energized electrical equipment
- **Class D** – *Combustible Metals* and metal dusts such as sodium, lithium, potassium, magnesium, titanium, and zirconium

Each class of fire requires a special type of extinguisher. For example, water may serve well for Class A, but it is not very effective for Class B, and it is definitely not acceptable for Class C or Class D. In these latter cases, water would cause much greater problems than the fire itself.

## C. Fire Extinguishers

For a *small* fire, a portable fire extinguisher is a very valuable piece of equipment. However, there are several things that must be clearly understood *before* you even consider using one.

There are several types of extinguishers for different types of fires. *You may cause an even greater problem by using the wrong type of extinguisher.*

<b>CAUTION:</b> Check the label on the extinguisher before using it.
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Many extinguishers are designed for several classes of fires. A common multi-purpose extinguisher may be effective for Class A, B and C fires. Check the label. It is uncommon to find an extinguisher that is also approved for Class D fires. If this class of fire is possible in your area, for example if you are working with or storing considerable amounts of sodium metal or of magnesium powder or turnings, insist that a Class D extinguisher be available.

The extinguisher is usually mounted out in the hallway. This is to insure that you are at an escape route *before* you consider fighting the fire. Also, keep the Exit to your back as you fight the fire. In case the fire appears to get out of control, leave at once. Close the door behind you to help contain the fire, and notify your TA or the Stockroom personnel.

## D. Fighting the Fire

**Fight a fire ONLY if ALL of the following are TRUE**

- Everyone has left, or is leaving the lab.
- Public Safety has been called (911).
- The fire is very small *and confined*. (If the fire is in a beaker or a wastebasket, try to smother it by covering the container. Often, this works quite well and does not require the use of a Fire Extinguisher.)



- You have a way out and you can fight the fire with your back to the Exit.
- The extinguisher is rated for the class of fire you are fighting.
- You can stay close to the floor to avoid breathing too much of the smoke.
- You have had training and you feel confident in the use of the extinguisher, or no other escape alternative is available to you.

### When you're ready to use the extinguisher —

What do you do? The key word to operating a fire extinguisher is **PASS**. This acronym is a good way to remember exactly what to do.

**PULL** the pin. Point the nozzle away from you and release the locking mechanism.

**AIM** low. Hold the extinguisher upright. Aim at the base of the flame. You should be 6–10 feet away. If you're too close, you'll hit the fire with enough force to scatter it. If you're too far away, you may not reach the fire with enough extinguishing material.

**SQUEEZE** the trigger. Be prepared. The extinguishing agent may come out with considerable force and noise. Most portable extinguishers will last for only 15 to 30 seconds. That's the actual "fighting time" you have. You can prolong the effective fighting time if you use short bursts. If aimed well, they can be very effective.

**SWEEP** side-to-side. Drive the fire back. As you extinguish the fire closest to you, move forward, but continue the sweeping motion.

Once the fire is out, you should have your TA and the lab supervisor check on the area. They will assume the responsibility of following up the incident with the appropriate authorities—if necessary. This will include making certain that all persons are out of the area, ensuring that another fire extinguisher is nearby in the event of a recurrence of the fire, and contacting the appropriate fire safety personnel on campus to replenish the spent extinguisher.

Remember you will probably NOT need to use a fire extinguisher at all in your chemistry laboratory.

***Abandon the Fight if ANY of the following are TRUE***

- The fire has started to spread.
- Your escape route may be blocked.
- You have any trouble operating the extinguisher.

As you leave the lab, *close the door* to prevent spread of the fire and **call 911** to be sure help is on the way. Then leave the building and wait in the designated area (in front of the FOX building) for help to arrive. (Remember that everyone must be accounted for at the meeting place BEFORE leaving that area. Anyone not found at the meeting area will be presumed trapped inside and someone will attempt a rescue).