

Topic 1: Safety in the Organic Chemistry Laboratory

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Recommended Resources

- Video ~ Lab Techniques & Safety: Crash Course Chemistry #21
<http://www.youtube.com/watch?v=VRWRmIEHr3A>

Safety Guidelines

The organic chemistry laboratory has the potential to be very dangerous. This is why it is extremely important that you follow all safety guidelines when you are in the laboratory. As an ethical chemistry laboratory student you must make sure that you understand and follow all safety precautions. *Ignoring safety precautions may result in a serious injury to yourself or another student.* Any student working in an unsafe manner is a danger to other students and will be asked to leave the laboratory. Always adhere to the following safety guidelines:

1. **Wear eye protection.** Chemicals can cause serious damage to your eyes, including blindness. To prevent chemicals and other hazardous substances from coming in contact with your eyes, safety glasses or goggles must be worn at all times you or someone else is working in the laboratory. (If you must adjust or clean your eye protection, step outside of the laboratory to do so.) Goggles offer the best protection and are particularly recommended to guard against splashes and explosions.
2. **Dress appropriately for lab.** The less skin that is exposed, the better! Sandals are not allowed in the laboratory because they expose your toes to chemical spills and broken glassware. Shoes must be close-toed and offer the best protection when they are made from a non-porous material. Long-sleeved shirts/blouses and long pants are recommended. If you choose to wear a shirt that exposes your midriff, you must wear a lab coat. Lab coats are also recommended to protect clothing you value. Avoid loose-fitting clothing and accessories (e.g., scarves, ties, long necklaces, etc.) because they may cause spills or come in contact with hazardous chemicals. Hair that is longer than shoulder length must be tied back.
3. **Wear appropriate gloves.** Gloves are required at all times when you are handling chemicals and items that have been exposed to chemicals. Keep in mind that different gloves protect against different types of chemicals. However, once you have gloves on, this does not mean that you are free to touch everything! For example, you do not want to rub your eye with a gloved hand once you have handled chemicals. A good rule of thumb is to not touch anything with your gloves that you do not want chemicals on. Obtain a new pair of gloves if they develop a rip or tear.
4. **Keep the lab clean and neat.** Avoid cluttering the lab bench or hood. Clutter can lead to spills, so return items promptly to their proper locations. Do not place personal items, such as bags

and backpacks, on the floor as they may cause others to trip. Promptly notify the laboratory instructor of any spills and clean them up as instructed. Spills must be cleaned up as soon as possible to prevent others from exposure to the spilled chemical. Inform the laboratory instructor of any conditions that seem unsafe.

5. **Perform only authorized experiments.** Unauthorized experimentation may expose you and your lab mates to unforeseen hazards.
6. **Do not work alone.** Always have someone present in the laboratory that knows what to do in the event of an emergency.
7. **Treat all laboratory reagents as if they are hazardous.** Often, not all hazards are known about a chemical you may be working with, so always use maximum precautions. If you spill a chemical on your skin, immediately rinse it with water, and then notify your laboratory instructor. Always wash your hands thoroughly with soap or detergent before leaving the laboratory, even if you wear gloves. Appropriate labels on the reagent bottles will often indicate special hazards.
8. **Store and dispose of laboratory reagents as directed.** Pay careful attention to the lab manual and to your instructor on how to store and dispose of reagents. For example, some reagents are extremely flammable and must be stored in a flammable cabinet when not in use. Other reagents must be kept away from chemicals that they are incompatible with. Many reagents cannot be disposed of down the drain as they may be toxic to the environment. If you are instructed to use a waste container for disposal of a reagent, insure the waste container is closed after you are finished to prevent exposure to noxious fumes. Promptly notify the laboratory instructor of any spills and clean them up as instructed. Spills must be cleaned up as soon as possible to prevent others from being exposed to the spilled chemical.
9. **Know how to transport chemicals safely.** If you must transport a chemical outside of the laboratory, the chemical must be in a closed container (i.e., no open beakers). Additionally, large bottles and particularly hazardous chemicals must be transported in a safety carrier.
10. **Do not bring food, drinks, or cosmetics into the laboratory.** Eating, drinking, or applying cosmetics in the laboratory can introduce toxic or corrosive chemicals into your system. You particularly want to avoid any contamination to your mouth or eyes.
11. **Immediately report all incidents to the laboratory instructor.** An incident is any injury or situation that might result in an injury. The laboratory instructor will best know how to handle the situation and may also use the information you provide to help other students avoid a similar difficulty.
12. **Know the location and use of all safety equipment.** All laboratories will have an eyewash station, safety shower, fume hood, a fire extinguisher, and a carrier for the safe transport of chemicals. Also know the location of the nearest emergency alarm.
13. **Be familiar with the experiment before beginning the lab.** Pay particular attention to cautions given in the procedure and by the laboratory instructor. Learn about hazards associated with the chemicals you will be using by looking up and reading their Material Safety Data Sheet (MSDS). Additionally, be aware of precautions to be taken with any special equipment you may be using.

14. **Work in the laboratory as if someone else is going to have an accident.** Just because you are following all of the safety precautions doesn't mean that your neighbor is!
15. **Read labels carefully.** Only use the correct chemicals in the proper concentrations. The wrong chemical or concentration could result in a violent reaction.
16. **Ask "dumb" questions.** If you are not sure about how to properly perform a procedure or handle a chemical, ask your instructor. Regardless of whatever preconceived notions you may have, asking questions does not make you look stupid, especially when safety is a concern!
17. **Don't rush.** If you are anxious to leave lab early or working hurriedly to catch up, you may neglect important safety precautions. Always make safety a priority.
18. **Label vials and flasks.** If you do not label a vial and then forget what it contains, you will not know how to properly handle and dispose of its contents.
19. **Inform your instructor of any special medical conditions.** If you have a medical condition that might be affected by laboratory work (e.g., allergies) or that might affect safe performance of laboratory work (e.g., seizure disorders), inform your instructor immediately. Additionally, students who are pregnant or breastfeeding must contact the instructor prior to the initiation of laboratory work. Chemicals used in the laboratory may be particularly harmful to developing fetuses and young infants.
20. **Know what to do in the event of an emergency.** Prompt response to an incident can make the difference between a minor event and permanent injury. You should be familiar with actions to take in the event of an incident, as well as the location of the Student Health Center. In the event of an emergency, you can reach CSUB University Police from your cell phone by dialing (661) 654-2111 or from a campus phone by dialing 911 or extension 2111.

Issues Specific to Particular Experiments

Depending on the specific experiment that you will be performing, you may need to take additional safety precautions. The following are common experiment-specific issues that you may need to be aware of:

1. **Never pipet by mouth.** Many organic chemicals are toxic or corrosive.
2. **Carefully inspect glassware for damage.** Broken glassware may cause cuts, and chipped or cracked glassware may break and spill its contents unexpectedly.
3. **Use caution when heating reactions.** Avoid open flames whenever possible. Use a stir bar or fresh boiling chip to avoid bumping (the sudden eruptive release of vapor). Bumping can cause hot liquid to spray out of its flask. A closed system should not be heated because the resulting increase in pressure may cause an explosion that propels reagents or pieces of glass. Always insure that an opening is present when heating a reaction. Do not heat any distillation pot to dryness because overheating could cause the remaining residue to detonate.
4. **Vent separatory funnels into a fume hood or snorkel.** Venting can cause the release of harmful vapors. Never point the end of the separatory funnel at someone's face!
5. **Handle hot objects with caution.** Hot glass, metal, or sand is often indistinguishable from cool glass, metal, or sand. Cautiously touch objects that have been heated before handling them.

Place a note near any hot objects remaining at the end of your laboratory period so that students in the subsequent section will be aware of the danger.

6. **Use a fume hood or snorkel when working with harmful vapors.** A fume hood or snorkel must also be used any time you heating a flammable organic substance (unless you are only working with a very small quantity). When using a fume hood, place items as far towards the back of the hood as possible, and keep your head outside the hood. Ensure that airflow through the hood is adequate, and the hood is completely closed when no one is working in it.
7. **Do not directly sniff the contents of a container.** If you must examine the odor of a reagent, gently waft vapors from the container toward your nose.
8. **Do not use open flames in the presence of flammable materials.** Organic solvents such as acetone, diethyl ether, and petroleum ether are not only extremely flammable but also produce flammable vapors. Use a flameless heat source whenever possible.
9. **Wear appropriate gloves.** Gloves are recommended at all times when you are handling chemicals and items that have been exposed to chemicals. Keep in mind that different gloves protect against different types of chemicals. For example, latex surgical gloves are not appropriate because they do not protect against many organic reagents.
10. **Prepare acid solutions carefully.** Dilute acids should be prepared by slowly adding the concentrated acid to a larger volume of water. The water dissipates the evolved heat and prevents localized boiling that may cause the contents of the flask to spray.
11. **Do not force a thermometer or glass tubing into a stopper.** If the thermometer or glass tubing does not easily slide into the stopper, use grease or glycerol as a lubricant.

Responding to Incidents in the Organic Chemistry Laboratory

In addition to following all of the above safety precautions, you must be familiar with how to handle an incident in the laboratory and be willing to provide assistance to others in emergencies. If you are the first to notice an incident or hazard in the laboratory, you should immediately alert your laboratory instructor and others that may be in harm's way. An incident that seems minor may be much more serious than you think, and your instructor is the best person to evaluate the situation.

The following are incidents that you may encounter in the organic chemistry laboratory:

1. **Broken glass and other sharp objects.** Properly dispose of broken glass. Use a hand brush and dust pan to collect the pieces, and do not attempt use your hands, even if you are wearing gloves. Dispose of broken glass in specially designated glass waste containers and not in the garbage can. Small, sharp objects such as syringe needles and capillary tubes should also be placed in specially designated receptacles.
2. **Spilled mercury.** Inhalation of mercury vapors can be extremely hazardous. If a mercury thermometer or manometer is broken, step back from the work area. Immediately notify your laboratory instructor and anyone working in the vicinity. Your instructor will use special techniques to collect the spilled mercury.
3. **Cuts.** For minor cuts, wash the affected area using soap then inform your laboratory instructor. If the injury does not stop bleeding on its own, apply gentle pressure with a clean paper towel.

or bandage. Go to the Student Health Center if you suspect a cut may be deep, the wound continues to bleed, or it is possible that chemicals have gotten into the wound. When you return to work, be particularly diligent about wearing gloves to prevent laboratory reagents from getting into the wound.

4. **Burns.** Hold the burned area under cool running water for 10 to 15 minutes or until the pain subsides, then inform your laboratory instructor. Use a sink or safety shower depending on the size of the burn.
5. **Chemical spills.** In the event of a reagent spill, immediately notify the laboratory instructor and anybody working in the vicinity. The appropriate steps to be taken will vary, depending on the amount and identity of the reagent. If the spilled chemical is flammable, remove all ignition sources, heat sources, and equipment that could produce a spark. If a spill creates a large amount of fumes, your instructor will direct you in the proper procedure to evacuate the laboratory.
6. **Chemical spills on a person.** Deal promptly with reagent spills because many organic chemicals are fat-soluble and can be absorbed through your skin. Remove any affected clothing (if necessary, down to your underwear) and then wash the area with running water for 10 to 15 minutes. Use a sink or safety shower depending on the size of the spill. Wash with soap or detergent to completely remove the reagent. If the spill occurred on your face, leave your goggles on to decrease the likelihood of getting chemicals in your eyes.
7. **Chemicals in the eyes.** A person who has gotten reagents into their eyes will require assistance. If this happens to you, ask a lab mate to assist you to the eyewash fountain and operate the water flow while you hold open your eyelids. If you are wearing contact lenses, remove them under the flow of water. Ensure that the flow of water gets to the entire eye surface for no less than 15 minutes. Be sure to inform your laboratory instructor, and follow up with an examination by a health care professional.
8. **Fires.** Many solvents and chemicals used in the organic chemistry laboratory are highly flammable, and a fire may occur in the laboratory. If a fire does occur, step back from the fire and then immediately notify the laboratory instructor and anybody working in the vicinity. Move flammable materials away, and turn the equipment off or remove it from the vicinity of the fire. Close any gas lines that may be open in the room. If possible, contain small fires by placing a watch glass or beaker over the fire to smother it. Some small fires, such as alcohol fires, may be allowed to burn out. If a fire spreads to a larger area of the bench, the laboratory instructor or other authorized persons will direct you to evacuate the laboratory and the building.
9. **Fire on a person.** Proper response to a fire can make the difference between loss of clothing or, in extreme cases, loss of life. If your hair or clothing catches on fire, walk (don't run) to the nearest safety shower or stop, drop, and roll (stop where you are, drop to the floor, and roll to smother the flames). When the flames are extinguished, remove any smoldering fabric and hold burned areas under cool running water for 10 to 15 minutes or until the pain subsides. Use a sink or safety shower depending on the size of the burn. If your neighbor catches on fire, assist them to the safety shower or help beat out the flames using a laboratory coat or fire blanket.
10. **Inhalation.** Avoid inhaling unsafe levels of irritating or toxic vapors by following the directions for using laboratory reagents and by using the reagents in a fume hood or with a snorkel. If at

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any time in the laboratory you feel dizzy, light-headed, faint, or develop a headache, step outside of the laboratory for fresh air and immediately notify your instructor.

11. **Ingestion.** If you accidentally swallow a reagent, an ambulance and poison control (1-800-222-1222) should be called immediately. While waiting for assistance, rinse your mouth several times with cool water, and drink one to two cups of water or milk.

Emergency Numbers

The following phone numbers can be used in the event of an emergency on campus. It is recommended that you program these numbers into your cell phone for easy reference:

	From a Campus Phone	From your Cell Phone
Ambulance	911 or extension 2111	1-661-654-2111
Fire - Rescue	911 or extension 2111	1-661-654-2111
Student Health Center	extension 2394	1-661-654-2394
Police	911 or extension 2111	1-661-654-2111
Poison Control	9-1-800-222-1222	1-800-222-1222

References & Additional Resources

1. Hill, R. H.; Finster, D. C. *Laboratory Safety for Chemistry Students*; John Wiley & Sons, Inc., Hoboken, NJ, 2010.
2. Lehman, J. W. *The Student's Lab Companion: Laboratory Techniques for Organic Chemistry*, 2nd ed.; Prentice Hall: Upper Saddle River, NJ, 2008; pp 10-26.