

Safety

The teaching and practice of organic chemistry has undergone major changes in the past few years with regards to the safe handling and disposal of chemicals and this is likely to continue. Some chemicals such as benzene, commonly used as a solvent a few years ago, have practically disappeared from the laboratory. The use of other chemicals such as carbon tetrachloride are slowly being phased out. Nevertheless the use of many substances of variable toxicity will continue both in industry and academia and it is the obligation and responsibility of a laboratory course in organic chemistry to instruct the student in the safe use and disposal of these substances.

The following safety rules constitute a beginning in establishing a safe laboratory environment:

a. **Eye protection must be worn at all times the laboratory is in session.** This is a regulation of the State of Missouri. The wearing of approved eye protection can be met by several different types of glasses or goggles. If you normally wear glasses, these may be suitable provided the lenses are made of safety glass. Most plastic lenses meet or exceed the specifications of safety glass and are acceptable. Students wearing plastic lenses should be aware that the lenses can be attacked by some of the solvents used in the laboratory and some loss of the optical properties can occur if the two come in contact. It is also recommended that a pair of inexpensive safety side shields be purchased from the bookstore. These shields attach on the side of your glasses and offer protection against peripheral splashes.

Students that do not normally wear glasses are encouraged to purchase a pair of goggles or non-correcting glasses. Although goggles offer the best eye protection, they also have a tendency to fog up thereby reducing vision. Goggles are not intended to protect the forehead! Be sure to purchase a pair that affords plenty of ventilation.

The wearing of contact lenses in the laboratory is strongly discouraged. Material that comes in contact with the eye as a result of a splash is considerably more difficult to remove if the person is wearing contact lenses. Photo chromic glasses are acceptable but sunglasses are not unless there are extenuating medical circumstances which require such glasses.

Everyone should be aware of the location of the nearest eyewash; getting to an eyewash quickly can help to save your sight.

b. Clothing that is worn offers important protection. In a chemical spill, if the chemical is a liquid, it will be absorbed by the clothing and while the clothing should be removed as quickly as possible, contact with the skin is kept to a minimum. The wearing of old jeans is recommended, but clothing covering as much exposed surface as reasonable should be worn. The wearing of shorts or sandals is discouraged unless covered by an appropriate laboratory coat or apron. No shoes, no shirt, no laboratory.

In addition to dressing properly for the laboratory, be sure to take advantage of the protection that the pair of "disposable" rubber gloves (included in your kit) can provide when you are handling strong acids and bases or other toxic materials. These gloves can be reused indefinitely, provided they are not torn, by simply washing them with soap and water. A small amount of talc or other similar powder will assist inserting your hands in the gloves.

c. No food or beverages are allowed in the laboratory. Be sure to wash your hands when you leave the laboratory, particularly if you are going out for snack. Remember that even after washing your hands with soap and water, some "memory" of the materials you have been working with is retained on your hands.

d. Open flames are not allowed in the laboratory. Fires have been one of the major causes of accidents in the laboratory. For those experiments that require an open flame (the preparation of glass capillaries used in thin layer chromatography), a special hood in the laboratory will be designated for use. Hot plates, electric heating mantles and steam baths will be used as sources of heat instead. While the use of other sources of heat has eliminated the cause of most fires, the risk of fire has not been totally eliminated. Many of the organic solvents in use today are quite volatile, quite flammable and can be ignited given the right conditions. Heating solvents should always be conducted in a well ventilated area such as a hood. You should also be aware of the properties of the common solvents you are using, particularly their flash points. Although not used as a common solvent, carbon disulfide will spontaneously ignite on a steam bath if the vapors are heated above about 80 °C. While the risk of fires has been reduced, significantly, you should be aware of the location of the nearest fire extinguisher. Most laboratories are also equipped with a fire blanket and safety shower. When you are in the laboratory, take a minute to read how to operate the device. This could come in handy later on.

e. If, during the course of a laboratory, you are injured, no matter how minor, you should bring this to the attention of the instructor or teaching assistant. If the injury does require some medical attention, the instructor or teaching assistant will escort you to the Campus Health Center. In case of a serious injury, you will be escorted to the appropriate medical facility. Students should be aware that in the event that either the teaching assistant and/or instructor must leave the laboratory, and the other is unavailable, you will be asked to stop work until they return.

In the case where you spill a chemical on your skin and there is other immediate damage, remove as much of the chemical from your skin by using a towel and then wash very well with soap and water. The laboratory is equipped with a safety shower located by one of the doors. This shower is designed to deliver a large volume of water in a short period of time and should be used in case of a fire or large chemical spill on an individual.

While it would take a long discussion to describe the different types of accidents that can happen in an organic laboratory, it may be useful to describe the most common accident in the laboratory that usually requires some sort of medical attention. The most frequent type of accident is usually associated with inserting or removing a thermometer or glass tubing in or from a rubber stopper. While the need for rubber stoppers and glass tubing has been greatly reduced with the use of ground glass joints and other changes, please heed the following advice if you need to insert or remove a glass rod into a rubber stopper. Always use a lubricant such as stopcock grease to lubricate the shaft. Do not force or apply excess pressure to dislodge or insert a stopper and use a towel as an intermediary between you and the glass. Instead of pushing the glass rod or thermometer in or out, try using a pulling, twisting motion instead. Don't hesitate to ask for assistance. In trying to insert or remove your Teflon thermometer adapter from your thermometer, use the steam in the hood to heat and lubricate. Once heated, the Teflon will expand and slide much easier down the shaft of the thermometer.

f. Chemicals are generally not to be disposed of by flushing down the sink or simply tossing in the trash. While many of the materials you will be working with in this course can be safely disposed of in this way, get into the habit of following the suggested disposal directions and of asking your instructor how to properly dispose of your wastes. Solid wastes will either be collected in an appropriate container or you will be instructed to use the trash containers. Please note that the laboratory is equipped with special waste containers for glass. Liquids are generally segregated into either halogenated or non-halogenated wastes and containers for these materials are kept in a corner in the laboratory. Acetone is usually used to wash and dry glassware in the laboratory. While it is acceptable to flush wash acetone

down the drain, provided plenty of water is used to dilute it and reduce the possibility of fire, collect your wash acetone in a beaker and dispose of it in the container specifically designated for wash acetone.

g. Take only as much of the reagents as you need. In the event you have any excess reagent left over, ask your instructor how to dispose of it properly. Accidental contamination of reagents is not only unfair to your colleagues, it can be down-right dangerous. Potassium permanganate in contact with glycerol and other organics can spontaneously ignite.

h. Ingestion of chemicals can occur in several obvious and some less obvious mechanisms. The tasting of laboratory chemicals, once a common practice, is no longer an acceptable practice. Many organic solvents are quite volatile and a common exposure to these substances is through the lungs. The vapors of some common solvents such as the simple halogenated methanes, can cause liver damage and some are suspected of being carcinogenic. Avoid breathing the vapors of these materials and always work with these materials in a well ventilated area such as a hood. Many organic solvents are also rapidly absorbed through the skin. It is a good idea to use the disposable gloves when handling these materials. Organic ethers pose fire hazards. The vapors of diethyl ether can accumulate in troughs or on the floor and can be ignited by remote sparks or flames. Additionally, the more highly substituted ethers react readily with oxygen to form potentially explosive peroxides. Avoid distilling ethers to dryness.

i. Proper laboratory practices, neatness and organization in the laboratory are considered closely associated with safety. A neat and well organized student is usually less likely to have an accident and more likely to get a better grade. Come to laboratory prepared. Be sure to read the experiment before coming to lab and run through how you will complete the experiment in your mind before you try it with your hands. Look up the properties of the materials you will be working with and be aware of any precautions associated with any of these substances. Ask questions if any part of the experiment is unclear to you.