

Experiment 1

Lab Safety

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Name:

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Date:

Key Objectives

1. Understand basic rules of laboratory safety.
2. Learn the number 1 rule.
3. Pass safety quiz with 80% or higher

Discussion

Science is about discovery, and one way you will be making discoveries is through science investigations. Some of these investigations make use of equipment and chemicals that must be used safely. Accidents in a chemical laboratory usually result from improper judgment on the part of the victim or one of his or her neighbors. Learn and observe the safety and laboratory rules listed below. The science department continues to do its part in assuring that you will have a safe experience, but you must do your part, too.

Please read the following safety contract, than sign it signifying that you understand it, so that we can be sure that everyone is committed to safe laboratory practice. Every student must also take an exam over these rules and score 80% in order to be allowed in the laboratory.

General Rules

1. Follow all written and verbal instructions carefully. If you do not understand a direction or part of the procedure, **if you don't know ask the teacher** before proceeding.
2. Act appropriately at all times in the laboratory. The same high level of care and attentiveness is required as might be found in a wood working shop or any place where there are potential hazards. The laboratory is not the place for horseplay, jokes, or pranks. In other words, think before acting. Perform procedures with deliberation; do not rush.
3. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
4. **Eating, drinking, and smoking:** Smoke outside. Eating and Drinking are only allowed in the "classroom" side of the room, never in the "lab" side.

If you don't know, ask.
you will be a fool for the
moment, but a wise man
for the rest of your life.
-Seneca the Younger

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5. Be prepared for your investigation
 - (a) Come to class on time and prepared. For reasons of safety, you may not be allowed to attend lab if you are late. This will result in a zero for that lab.
 - (b) Read all procedures carefully **before** coming to class. Make a note of any questions you have and ask them in class before beginning the experiment.
 - (c) Complete any pre-lab assignment before coming to class
6. **Never work alone:** Never work in the laboratory without the instructor present including setting up equipment. Simply wait until instructed to begin.

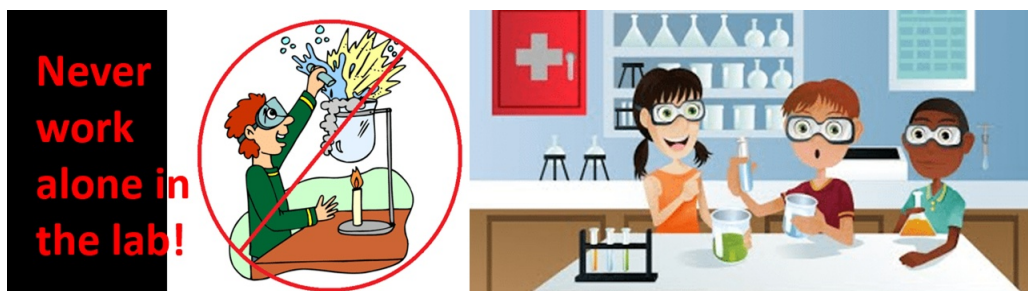


Figure 1.1: Never work alone in lab. Your instructor should **always** be present. credit: <https://inside.ewu.edu/ehs/laboratories-and-shops/laboratory-safety/>

7. Notify the instructor **immediately** of any unsafe conditions you observe.
8. Neighbors: Be aware of your lab neighbors' activities; you may be a victim of their mistakes. If you observe improper techniques or unsafe practices, advise your neighbor and your instructor if necessary.
9. **Perform only authorized experiments:** Unless authorized to do so by the instructor, a student will be subject to immediate and permanent expulsion from the lab if found attempting to conduct unauthorized experiments or attempting variations of the experiment in the lab manual. Set up and use the prescribed equipment as directed in the laboratory instructions or by your instructor.
10. Do not remove any chemicals from the lab: This will result in permanent expulsion from the lab.
11. **Clean and Orderly work-space:** Keep your work-space orderly.
 - (a) Place tall items, such as graduated cylinders, toward the back of the workbench so they will not be overturned by reaching over them.
 - (b) Clean up all chemical spills, scraps of paper, and broken glassware immediately.
 - (c) Keep drawers closed while working and the aisles free of any obstructions, including chairs.
 - (d) Keep the work area clear of everything except for materials, data sheets, and instruction sheets.
 - (e) Never place coats, books, and other belongings on the laboratory bench where they will

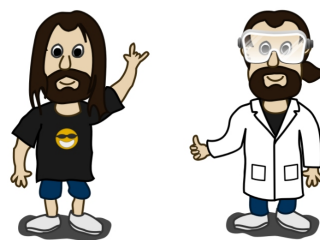
interfere with the experiment and are likely to be damaged.

- (f) Keep aisles clear. Do not crowd around hot plates, balances, or laboratory stations.
- 12. When using chemicals, keep hands away from face, eyes, mouth and body. Avoid rubbing your eyes unless you know your hands are clean. Wash your hands with soap and water after performing all investigations. Clean all work surfaces and equipment at the end of the experiment, and return all equipment to the proper storage area.
- 13. Do not leave an investigation unattended. For example, do not wander from your assigned area to talk with friends if you are in the middle of a procedure.
- 14. Students are not to enter science storage areas except under the direct instruction or supervision of the instructor.
- 15. If you have an allergy or sensitivity to chemicals, please inform your teacher.
- 16. **Before you leave:**
 - (a) Clean your workspace – Return all glassware and equipment, turn off gas and water, wipe off your desktop.
 - (b) Always wash your hands, before leaving the lab since toxic chemicals may be transferred to the mouth at a later time.
 - (c) Notify your instructor.

Clothing

1. **Safety Goggles (REQUIRED):** Because the eyes may be permanently damaged by spilled chemicals and flying broken equipment, be sure to wear Z-87 safety goggles or safety glasses (State law) whenever anyone is working in the lab. Not wearing safety goggles will result in loss 10% on the lab grade for the day. Multiple infractions will result in a cumulative loss.
2. **Suitable clothing (RECOMMENDED):** Wear clothing that will protect you against spilled chemicals or flaming liquids. Hard-soled, close toed, covered footwear and pants/skirts that cover your legs.

Chemistry is cool ...



**and safer
WITH safety glasses**

credit: <https://openclipart.org/detail/251205/chemistry-is-cool-by-b-lachner>

Accidents and Injury

1. Notify your instructor at once in case of **ALL** (no matter how apparently minor) accidents or personal injuries to you or your neighbor. If your instructor is temporarily absent, notify the instructor in the adjoining lab. If you are asked to go to the hospital, you must go. Refusal to do so is

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grounds for being dropped from the course.

2. Chemicals:

(a) Chemical splashes in your eye(s): If you get anything in your eye, use the eye wash immediately, and then report it to your instructor. Use your hands to hold your eye open so that it can be rinsed thoroughly. Rinse for 15 minutes. Note: Eye washing with a contact lens in place will not clear a splashed chemical from the eye. The contact must be removed for effective cleansing. It is advisable for those wearing contacts to switch to glasses for the lab period.

(b) Chemical splashes on the skin, flush with water. Inform the instructor immediately.

(c) Chemical spills on lab benches or floor. Inform the instructor immediately.

3. Report any broken glassware to the instructor.

4. **Fires:** If it is a small, contained fire, such as in a flask or beaker, cover the container with a piece of ceramic, cutting off the supply of oxygen to the fire and thus putting it out. If it is open fire, such as a large chemical spill on a lab bench, the correct extinguisher should be used. Inform your instructor immediately.

5. **Evacuation:** If we are forced to evacuate the building due to fire, chemical spills, or other reason, meet on the step in front of the McLaughlin Building. Do not leave campus, attendance will be taken to be sure that everyone is safe.

6. Be familiar with the location of exits and all safety equipment (Fire extinguisher, fire blanket, eye-wash, medical kits, phones, fire alarms, safety shower).



credit: <https://commons.wikimedia.org/wiki/File:Salle-blanche-rince-oeil-rot.jpg>

Handling Chemicals

1. **All** chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so.

2. **Smelling Chemicals:** When smelling chemical, do not inhale a large amount. Waft a small amount towards you as you move the container slowing towards you.

3. **Tasting Chemicals:** Don't ever taste a chemical or place it in your mouth.

4. **Double check** all labels on chemicals before using them. If you are uncertain a chemical is the one required for the experiment, **ask your instructor**.

5. Never return unused chemicals to their original containers.

- When transferring chemicals from one container to another, hold the containers away from your body.
- Acids require special care. You will be shown the proper way to dilute acids. Dilute concentrated acids and bases by pouring the reagent into water (room temperature or lower) while stirring constantly. Never pour water into concentrated acids; the heat of solution will cause the water to boil and the acid to splatter.
- Never dispense flammable liquids anywhere near an open flame or source of heat.
- Mixing chemicals: Always add a reagent slowly—never "dump" in. Some reactions give off a lot of heat, and unless adding slowly, can become too vigorous and out of control. If you make a mistake and choose the wrong chemical, adding slowly decreases the possibility of causing a serious accident.
- Dispose of all chemical waste properly. Your instructor will tell what materials can be poured down the drain and what materials must be placed in a waste container. In general, solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink.

Chemical Waste Disposal Guideline

Innocuous aqueous waste	Organic Solvent	Red List	Solid Waste
<ul style="list-style-type: none"> Acid (pH<4) Alkali (pH> 10) Harmless soluble inorganic salt Alcohol containing salt Hypochlorite solution Fine (tlc grade) silica and alumina <p style="font-size: small; margin-top: 10px;">These chemicals should be washed down with excess water.</p>	<ul style="list-style-type: none"> Chlorinated Example: DCM, Chloroform, Chlorobenzene etc. Non-Chlorinated Example: THF, ethyl acetate, hexane, toluene, methanol, etc. <div style="text-align: center; margin-top: 10px;">  </div>	<ul style="list-style-type: none"> Compounds with transitional metals Biocides Cyanides Mineral oils and hydrocarbons Poisonous organosilicon compounds Metal phosphides Phosphorus element Fluorides and nitrites. 	<ul style="list-style-type: none"> Lightly contaminated Example: Gloves, empty vials/centrifuge . <p style="margin-top: 10px;">Broken Glassware Broken glassware are usually collected in plastic-lined cardboard boxes for landfilling. Due to contamination, they are usually not suitable for recycling.</p>

Figure 1.2: Dispose of waste in the properly marked containers. If you don't know ASK! credit: https://en.wikipedia.org/wiki/Chemical_waste/media/File:Chemical_Waste_Disposal_Guideline.jpg

Glassware

- General: Always check glassware for cracks or chips before using. If it is cracked or chipped ask your instructor for a new piece.

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2. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
3. When working with glass tubing, follow the specific instructions of your teacher. Puncture wounds by broken glass are some of the most common laboratory injuries.
4. Never use dirty glassware. Improperly cleaned glassware may give incorrect results for chemical tests. Always clean glassware before using it.
5. Do not immerse hot glassware in cold water; it may shatter.

Electrical Equipment

1. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
2. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
3. **Electronic Balances:** Do not spill chemicals (liquid or solids) on the scales.
 - (a) Never pour liquids over the scale. Use a tared beaker and pour the liquid into it while the beaker is on the lab bench.
 - (b) Measure out solids carefully.
 - (c) Clean scales after each use.
4. If you do not understand how to use a piece of equipment, ask the instructor for help.

Heating Substances

1. Be careful around any heating device, but be especially cautious around open flames. Take care that hair, clothing and hands are a safe distance from the flame.
2. Never heat heavy glassware such as graduated cylinders, suction flasks, or reagent bottles since they might shatter. Only heat beakers, Erlenmeyer flasks, test tubes (without corks), and crucibles.

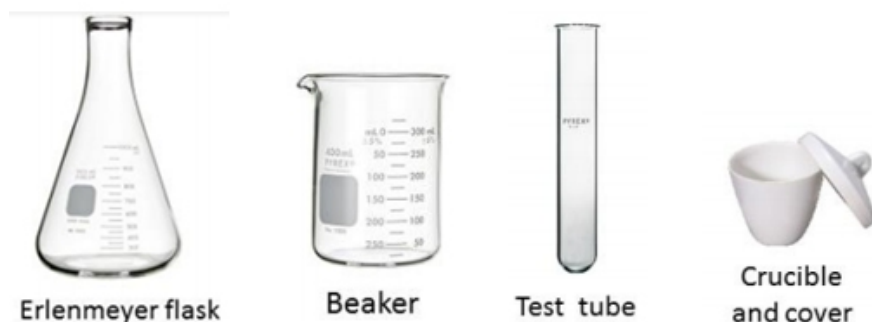
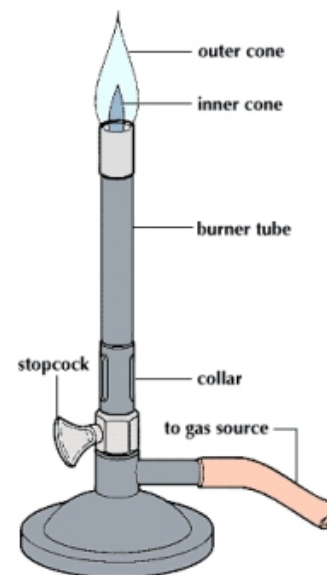


Figure 1.3: Only heat the following objects. credit: author

3. Do not put any substance into a flame unless specifically instructed to do so.
4. Do not reach over any heating device.
5. Do not leave a heating device unattended, and turn off a heating device when not in use. Never point a test tube towards a laboratory neighbor or yourself when heating or carrying out a chemical reaction. (It is like a loaded gun).
6. Heated metals and glass remain very hot for a long time. They should be identified (set on a ceramic pad) as being hot and set aside to cool.
7. Never look into a container that is being heated.
8. Be careful not to place hot equipment on flammable material.
9. Use tongs or heat-protective gloves if necessary.
10. Bunsen Burners:

- (a) The burner should be burning only for the period of time in which it is actually utilized.
- (b) Before lighting your burner carefully position it on the desk away from flammable materials, overhanging reagent shelves, flammable reagents such as acetone, toluene, and alcohol on neighboring desks.
- (c) Be careful not to extend your arm over a burner while reaching for something. Keep long hair tied back so that it cannot fall forward into a flame. Keep beards away from flames.
- (d) Always adjust your Bunsen burner to provide a small blue flame by adjusting the oxygen (by turning the barrel) and the gas (by turning the screw at the base). NEVER adjust the flame at the stop-cock. Be sure to turn off the Bunsen burner at the stop-cock (not at the base).



credit: unknown

Miscellaneous Procedures

1. Boiling Water: Add boiling chips to minimize bumping. Never fill the beaker over 75% full. Do not excessively heat the water. Make sure the container does not boil dry.
2. **Round objects roll.**
3. Detecting Temperature Changes: Carefully hold your hand near the object and feel for heat. If not heat is detected lightly touch the object. If no heat is detected you may hold the object normally.
Hot objects are hot.
4. Fume Hoods. Any experiment involving the use of or production of poisonous or irritating gases

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must be performed in a hood. Be sure the fume hood is turned on and that air is flowing from the room into the fume hood.

5. **Assemble safe apparatus:** Always assemble an apparatus as outlined in your instructions. Obtain instructor approval after apparatus is assembled before using it. Makeshift equipment and poor apparatus assemblies are the first steps to an accident.

Hazardous Materials (Chemical Safety and Waste Disposal)

1. General: Treat all chemicals as Hazardous unless you know for sure it is not.
2. MSDS: Material Safety Data Sheets are available for all chemicals used in lab. You may request to see them at any time (preferably prior to lab, to avoid unnecessary disruptions).
 - (a) PEL/TLV's - Permissible Exposure Limit and Threshold Limit Value
 - (b) Physical and Chemical Properties - BP, MP, VP, Solubility, Evaporation Rate
 - (c) Fire and Explosion Hazards - Flash point, Auto ignition, Flammability limits, recommended extinguishing media
 - (d) Health Hazard Data - LD50, LC50



Figure 1.4: Internationally accepted safety symbols. credit: Globally Harmonized System of Classification and Labeling of Chemicals, United Nations New York and Geneva, 2005

3. Classes of Hazardous Materials: Chemicals are often grouped into different classes of hazards materials. Learn each class.
 - (a) Avoid Contact – general irritant
 - (b) Carcinogen – cause cancer
 - (c) Corrosive – destroy living tissue/equipment
 - (d) Danger Unknown - Unknown
 - (e) Explosive – may explode under some conditions
 - (f) Flammable – vapors are flammable
 - (g) Irritant – may irritate eyes, skin, respiratory tract
 - (h) Lachrymator – as above but more severe

- (i) Mutagen – can cause genetic damage
- (j) Peroxide Former – very explosive
- (k) Poison – serious effects on body, often lethal
- (l) Stench – they smell, open only in hood
- (m) Teratogen – cause defects in fetus and embryo
- (n) Toxic – hazardous to health if exposed

4. Types of Hazards:

- (a) **Acute Poisoning:** Rapid absorption leading to sudden and severe effects. Ex: CO, Cyanide poisoning
- (b) **Chronic Poisoning:** Prolonged or repeated exposure over long times, symptoms may not be immediate. Ex: Pb or Hg poisoning
- (c) **Substances in combination:** Two or more substances that interact leading to a larger effect. Ex: Alcohol + Chlorinated Solvents or Depressants



Skull and Crossbones: Substances, such as poisons and highly concentrated acids, which have an immediate and severe toxic effect (acute toxicity).



Health Hazard: A cancer-causing agent (carcinogen) or substance with respiratory, reproductive or organ toxicity that causes damage over time (a chronic, or long-term, health hazard).

Figure 1.5: Acute and chronic poisoning symbols. credit: author

- 5. Read the label: Read the label carefully, read it twice, before taking anything from a bottle. Many chemicals have similar names and chemical formula's, such as sodium sulfate and sodium sulfite. Using the wrong reagent can spoil an experiment or can cause a serious accident.
- 6. Excess Chemicals: Avoid using excessive amounts of reagent.
 - (a) Never obtain more than called for in the experiment.
 - (b) Do not return any excess chemical to the reagent bottle; share it with another student or dispose of it according the instructions given in the lab.
 - (c) If you are uncertain how to dispose of an excess of a specific chemical, consult your instructor.
- 7. Matches/Burning Splits: Never throw lighted matches or wooden splits into a sink it may ignite a discarded flammable liquid. Wet the match or splint and dispose of in the properly labeled container.
- 8. Waste Chemical: Excess chemicals, or completed experiments should be discarded as instructed

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in the lab manual. This will generally consist of placing the chemicals in the properly labeled container in the hood.

- (a) Sinks and Drains: Never dispose of chemicals down the drain unless explicitly told to do so by the instructor or laboratory instructions.
- (b) Liquids: labeled containers in the hood.
- (c) Solids: labeled container in the hood.
- (d) Paper Towels: Trash can.
- (e) Glass: Tubing waste or broken glass should be placed in the broken glass container.

The most important rule: “IF YOU DON’T KNOW ASK!”



- **Chemical splash goggles** are on her head instead of over her eyes.
- Her **hair** is not tied back.
- An open flame is near a **flammable liquid** (acetone).
- The lab worker has long, loose **sleeves**.

Figure 1.6: Quick safety quiz. For more examples visit the link. credit: <https://www.wisc-online.com/learn/abe-ell/science/sce0919/introduction-to-safety-in-the-chemistry-lab-v>

Your signature on this contract indicates that you have read this Safety Contract and that you subscribe to our efforts to insure the safety of students and staff during science laboratory activities. No student will be permitted to perform laboratory activities unless this contract is signed by both the student and instructor.

STUDENT'S PRINTED NAME

STUDENT'S SIGNATURE

DATE

TEACHER'S SIGNATURE

DATE

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