

SAFETY IN THE ACADEMIC LABORATORY

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David A. Katz

Chemist, Educator, Science Communicator, and Consultant.

**5003 Canby Dr., Wilmington, DE 19808 Email:
dakatz45@msn.com**

Laboratory safety is an important part of the chemistry course.

In the laboratory, you are working with chemicals in their pure form, not diluted as they may be in household products.

Therefore, you should be familiar with safety procedures for working with chemicals and should know what to do in the case of an accident or emergency.



When you enter the laboratory,

place all:

books

pocketbooks

book bags

coats, hats, etc...

in appropriate locations (lockers, bins, etc...).

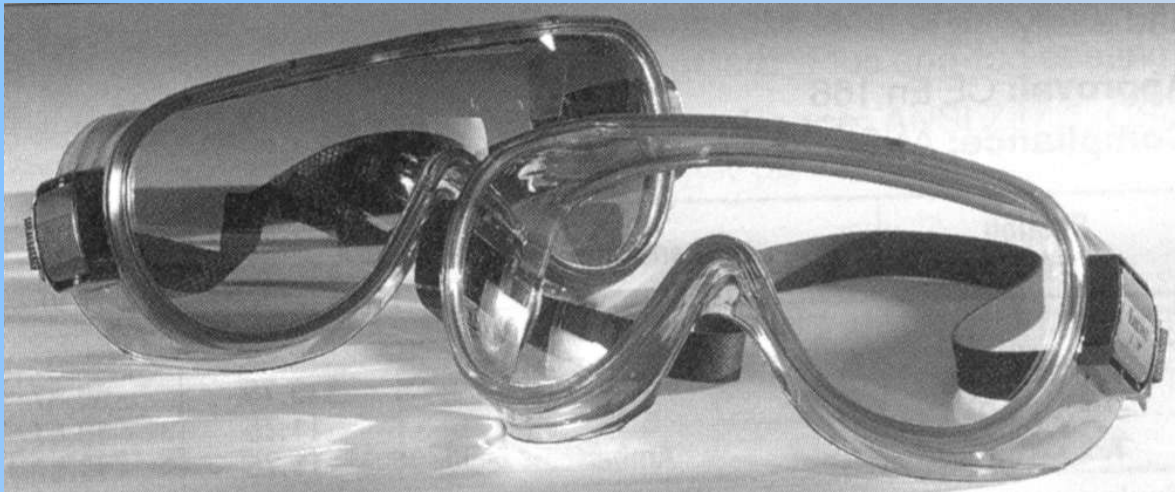
Avoid putting these items on the floor where you may trip over them.

Only essential materials such as your laboratory manual and a laboratory notebook should be on the bench top at your work area.

EYE PROTECTION

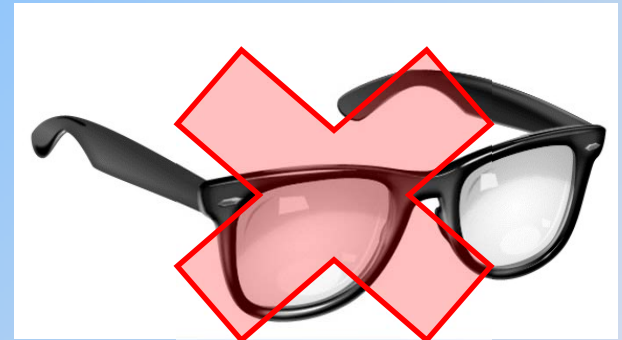
Goggles or safety glasses must be worn at all times in the laboratory to decrease the likelihood of eye injury.

As long as chemicals are being used in the laboratory, goggles are required even if you are just visiting the laboratory or doing calculations.



Eyeglasses/Safety glasses

Normal eyeglasses do not provide protection from splashes coming from the sides, nor are they considered shatterproof by industrial standards.



Safety glasses with side shields may be shatterproof, but **do not provide protection from splashes.**



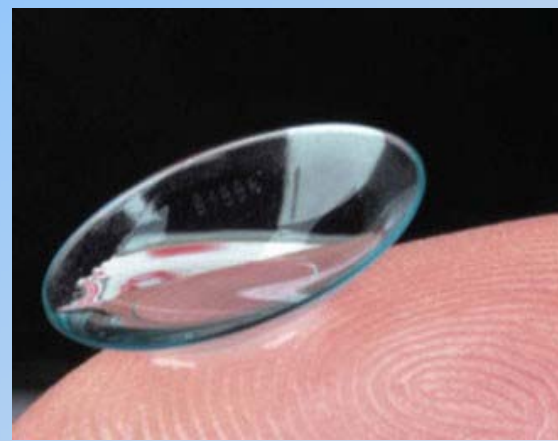
Contact lenses

Contact lenses can be worn in the laboratory provided the **individual wears the proper safety splash goggles** required for laboratory activities.

Contact lenses **do not provide any additional protection to the eyes**, nor, is there any documentation to prove that contact lenses result in any increased problem of injury due to laboratory vapors over that of an unprotected eye.

In the event of any chemical splash into the eyes of an individual wearing contact lenses, the contact lens must be removed to effectively rinse the chemical from the eyes.

Please inform your laboratory instructor if you will be wearing contact lenses in the laboratory.



To properly adjust safety goggles:

- Loosen the elastic band so the goggle is loose against the face.
- Then slowly tighten the elastic band so that the goggle is snug against the face, but not tight.
- Tight goggles will not be comfortable to wear and may result in headaches.



Clean the goggle lens to prevent eyestrain and blurred vision.

Cleaning solution and soft, non abrasive tissues should be available in the laboratory.



If possible, purchase fog-free goggles.

To prevent fogging, add a drop of baby shampoo to the inside of the lens and polish with a lint-free cloth or tissue. (Commercial anti-fog solutions are available.)

If something gets in your eye(s)

go to the
nearest

EYEWASH



Note the location of the eyewash
in the laboratory

To use the eyewash, hold the eyelids open and continue to flush with WATER for up to 15 minutes (or until stinging stops).

Obtain qualified medical assistance immediately to inspect the eyes for any chemical residue or damage.



For normal laboratory operations, **never use another chemical to rinse or attempt to neutralize a substance in the eye**, this may result in further damage.

Qualified medical personnel should inspect the eye for any chemical residue or damage



Eyewash bottles, or similar type containers are recommended only as a temporary measure.

They do not supply a sufficient quantity of water to effectively wash the eye.

Also, the water in such devices may not have been changed at weekly intervals and may contain mold or bacteria.



In case of an accident or injury in
the laboratory

Inform others near you and call your
laboratory instructor.

Your instructor should be trained to assist
with emergency first aid until qualified
medical assistance arrives.

Note the location of the nearest telephone, and also, if it is a direct line to the campus police or other emergency service.

Write down the telephone number of Campus Police or emergency service in your laboratory notebook or add it to your cell phone directory.



For normal laboratory operations **never treat a chemical injury with another chemical** in an attempt to neutralize the corrosive or caustic effect of the substance.

Neutralization reactions produce heat and can cause additional injury.

Wash the affected area with copious amounts of room temperature water for up to fifteen minutes, never rub the affected area, and get immediate qualified medical assistance.

CHEMICAL SPILLS

Clean up all spills immediately, no matter how small.

Liquid on a bench top can be mistaken for water.



A wet ring around the base of a bottle of a chemical indicates a spill.

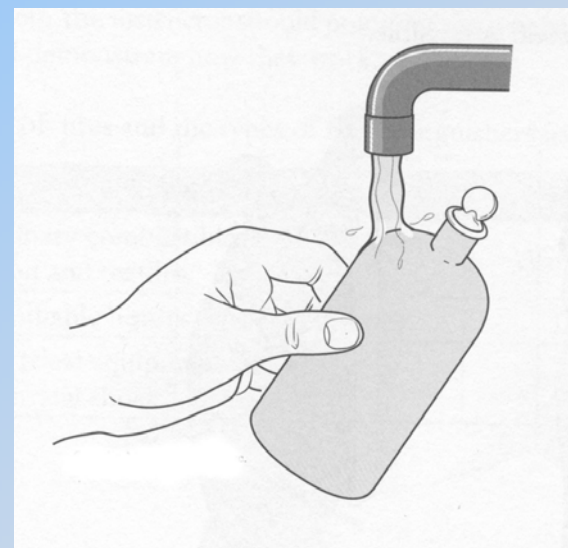
This may be the result of liquid dripping down the side of the bottle.



Wash any chemical from your hands immediately.

The bottle should be sealed and the body of the bottle rinsed with water.

Do not let the running water come in contact with the bottle top or cap.



If you have any doubts about rinsing a bottle, as illustrated, ask your instructor for assistance.

In the event that there is a large chemical spill, move away from the area quickly.

If large quantities of irritating or potentially toxic vapors are generated, evacuate the room.



Assess the spill and take appropriate action to contain it or clean it up.

A spill can be contained and soaked up using spill control pillows, but this may not result in neutralization of the chemical.

A mixture of sand and soda ash can be applied to acid or alkali spills.

If uncertain how to respond, contain the spill, evacuate the area, and seek qualified help or look up information in reference safety books available in the laboratory preparation area.



If chemical is splashed on the skin and clothing, the splashed surface must be drenched with large quantities of water from a **SAFETY SHOWER**.

All contaminated clothing must be removed as drenching will only dilute the chemical absorbed by clothing, not wash it away.

Washing should continue for up to fifteen minutes or until no chemical remains in contact with the skin.

Qualified medical assistance should be obtained immediately to assess any possible injury.



FIRES



In the event of a fire:

- Evacuate the area
- Close all doors
- Call for help
- Sound local alarms.



If clothing catches fire, the safety shower may be effective in drenching the flames.

Also recommended is a **FIRE BLANKET**.

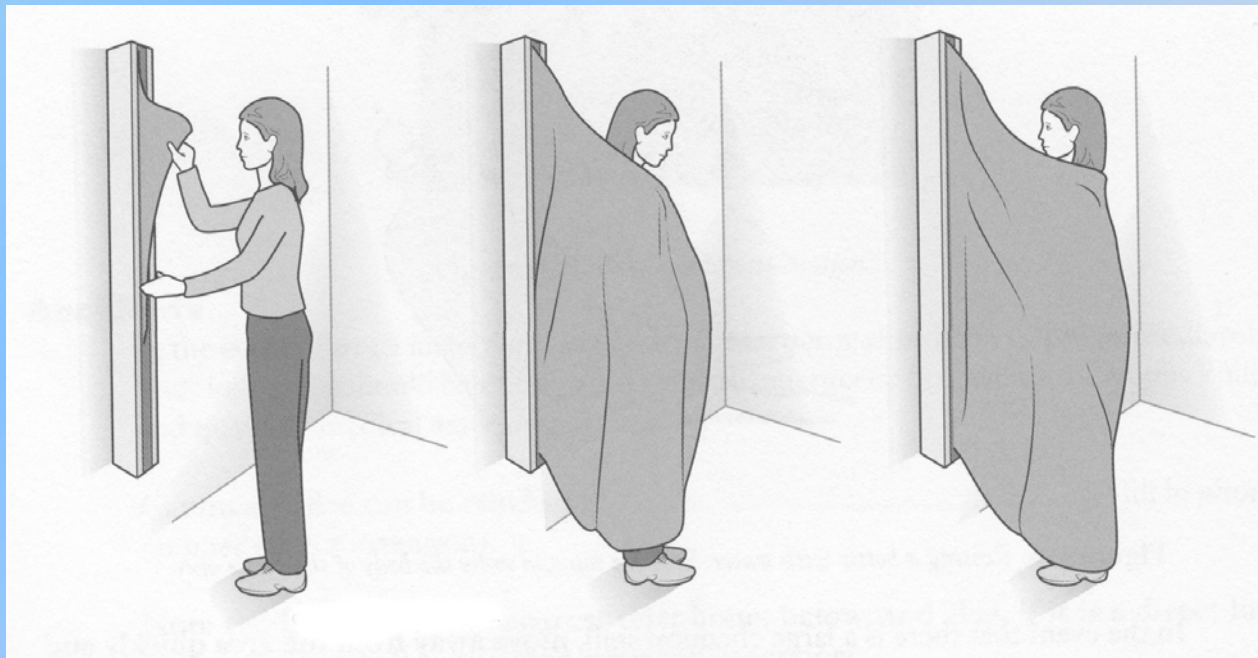
Note the location of the fire blanket in the laboratory.



The individual should be wrapped in the fire blanket and rolled on the floor.

If the person remains standing, a chimney effect may occur permitting the fire to continue to smolder.

Remove all burned clothing as soon as possible.



A **small contained fire** in a test tube or a beaker can easily be put out by covering it with a watch glass or beaker to smother the flames. Do not use papers or towels as they may catch fire.



A fire blanket can also be used to smother a small fire

To extinguish an **open fire** in the laboratory, use a **FIRE EXTINGUISHER**

The different classes of fires and the types of fire extinguishers used for each are:



Class of Fire	Type of Fire	Extinguisher
A	Ordinary combustibles such as paper, wood and textiles	Water, dry chemical
B	Flammable liquids, oils, and grease	Dry chemical
C	Electrical equipment and danger of electrical shock	Dry chemical

Note the types and locations of the fire extinguishers in the laboratory

FIRES

If you attempt to extinguish a fire **keep your back to an exit from the laboratory.**

Do not allow yourself to become trapped or cornered in the lab.



To use a fire extinguisher:

2 Aim the nozzle at the base of the flames, and discharge the extinguisher



1 Remove the metal or plastic pin in the trigger handle. (The pin prevents accidental discharge.)

3 Squeeze the handle

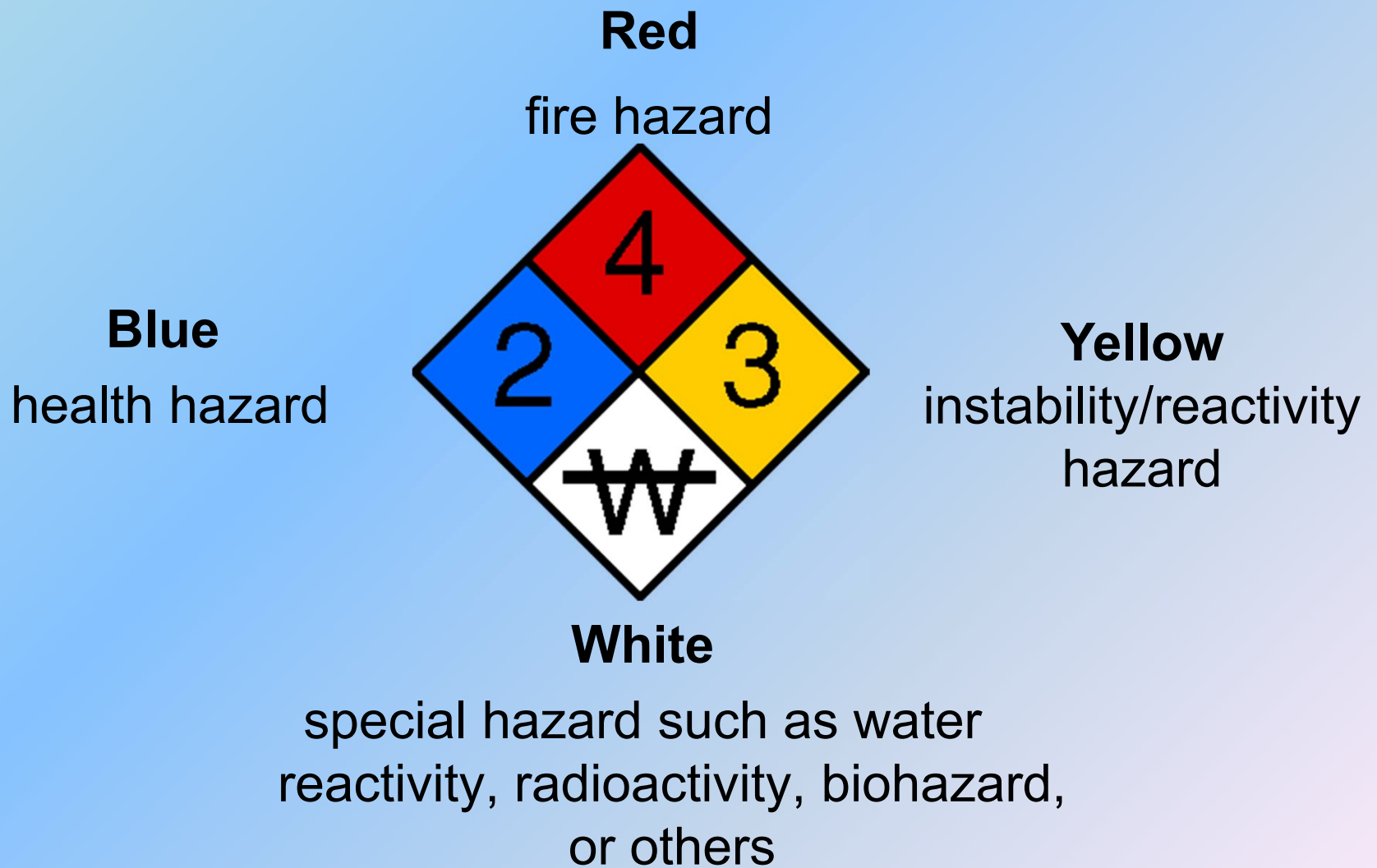
4 Move it slowly and systematically from side to side in a sweeping type motion.

To operate an extinguisher:

Pull
Aim
Squeeze
Sweep



The NFPA hazard signal system



The NFPA hazard signal system

- 4 = extreme hazard
- 3 = severe hazard
- 2 = moderate hazard
- 1 = minor hazard
- 0 = no unusual hazard



The NFPA hazard signal system

No.	Emergency Health Hazard (BLUE)	Fire Hazard (RED)	Instability/Reactivity (YELLOW)
4	Extremely hazardous	Flammable gas or liquid that vaporizes at ambient temperatures and burn readily	Extremely shock sensitive and capable of detonation
3	Toxic or corrosive	Flammable liquid, can be ignited at ambient temperature conditions	Shock-sensitive materials which may detonate under some conditions
2	Moderately toxic	Combustible liquid, must be moderately heated before ignition can occur	Unstable and water reactive materials
1	Irritating	Combustible, must be heated before ignition can occur	Materials that may become unstable under heat or pressure
0	No unusual hazard	Noncombustible	Not reactive

Examples of Hazard Signals for Common Laboratory Reagents

	Emergency Hazard Signal			
Chemical	Health (blue)	Fire (red)	Instability (yellow)	Special Hazards
Acetic acid	2	2	1	
Acetone	1	3	0	
Ethanol (ethyl alcohol)	0	3	0	
Diethyl ether	1	4	1	
Hydrochloric acid	3	0	0	
Hydrogen cyanide	4	4	2	
Picric acid	1	4	4	
Sodium hydroxide	3	0	0	
Sulfuric acid	3	0	2	water reactivity
Toluene	2	3	0	

The GHS (Globally Harmonized System) Hazard Classification



The GHS Pictograms



CORROSION

- Skin Corrosion/Burns
- Eye Damage
- Corrosive to Metals



EXCLAMATION MARK

- Irritant (skin and eye)
- Skin Sensitizer
- Acute Toxicity
- Narcotic Effects
- Respiratory Tract Irritant
- Hazardous to Ozone Layer (Non-Mandatory)



EXPLODING BOMB

- Explosives
- Self-Reactives
- Organic Peroxides



SKULLS & CROSSBONES

- Acute Toxicity (fatal or toxic)



FLAME

- Flammables
- Pyrophorics
- Self-Heating
- Emits Flammable Gas
- Self-Reactives
- Organic Peroxides



GAS CYLINDER

- Gases Under Pressure



ENVIRONMENT

- Aquatic Toxicity



HEALTH HAZARDS

- Carcinogen
- Mutagenicity
- Reproductive Toxicity
- Respiratory Sensitizer
- Target Organ Toxicity
- Aspiration Toxicity



FLAME OVER CIRCLE

- Oxidizers

The GHS (Globally Harmonized System) Hazard Classification

In the GHS, there are:

- 17 physical hazard classes

- 10 health hazard classes

- 2 environmental hazards classes

Within each class, the hazard is placed into a category based on various criteria specific to that classification.








Each category is assigned a number or a letter, for example 1 to 5 or A to E.

In the GHS, *the lower the category value is within each classification for a chemical, the more severe the hazard* .

Physical Hazard: Explosives

Hazard Category	Signal Word	Hazard Statement	Hazard Symbol	Transport Symbol
Unstable Explosive	Danger	Unstable Explosive		
Division 1.1	Danger	Explosion; Mass explosion hazard		
Division 1.2		Explosion; Severe Projection Hazard		
Division 1.3	Danger	Explosion; fire, blast or projection hazard		
Division 1.4		Fire or Projection Hazard		
Division 1.5		May explode in fire		
Division 1.6				

Physical Hazard: Flammable Liquids

Hazard Category	Signal Word	Hazard Statement	Definition	Hazard Symbol	Transport Symbol
Category 1	Danger	Extremely flammable liquid and vapor	Extremely flammable liquid and vapor – Flashpoint < 23C and initial boiling point = 35C.		
Category 2	Danger	Highly flammable liquid and vapor	Highly flammable liquid and vapor – Flashpoint <23C and initial boiling point >35C.		
Category 3	Warning	Flammable liquid and vapor	Flammable liquid and vapor – Flashpoint >/= 23C and = 60C.		
Category 4	Warning	Combustible liquid.	Combustible liquid – Flashpoint > 60C and = 93C		

Physical Hazard: Gases Under Pressure

Hazard Category	Signal Word	Hazard Statement	Definition	Hazard Symbol	Transport Symbol
Compressed Gas	Danger	Contains gas under pressure; may explode if heated.	Extremely flammable aerosols. NOTE: If a product is NOT tested, classify it in Category 1.		
Liquefied Gas	Warning	Contains gas under pressure; may explode if heated.	Partially liquid at temperatures > -50C. *high pressure liquefied gas: critical temperature between -50C and 65C; *low pressure liquefied gas: a gas with a critical temperature >65C.		
Dissolved Gas	Warning	Contains gas under pressure; may explode if heated.	Dissolved in a liquid phase solvent.		
Refrigerated Liquefied Gas	Warning	Contains refrigerated gas; may cause cryogenic burns or injury.	Partially liquid because of its low temperature.		

Physical Hazard: Oxidizing Liquids

Hazard Category	Signal Word	Hazard Statement	Definition	Hazard Symbol	Transport Symbol
Category 1	Danger	May cause fire or explosion; strong oxidizer.	In the mixture, by mass, of substance (or mixture) and cellulose tested, exhibit a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 50% perchloric acid and cellulose.		
Category 2	Danger	May intensify fire; oxidizer	In the mixture, by mass, of substance (or mixture) and cellulose tested, exhibit a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 40% aqueous sodium chlorate and cellulose.		
Category 3	Warning	May intensify fire; oxidizer	In the mixture, by mass, of substance (or mixture) and cellulose tested, exhibit a mean pressure rise time less than or equal to the mean pressure rise time of a 1:1 mixture, by mass, of 65% aqueous nitric acid and cellulose.		

Physical Hazard: Flammable Solids

Hazard Category	Signal Word	Hazard Statement	Hazard Symbol	Transport Symbol
Category 1	Danger	Flammable solid.		
Category 2	Warning	Flammable solid.		

Laboratory attire

When working in the laboratory, wear clothing that covers as much of your skin as possible.

Do not wear clothing that is frilly or flared or has loose flowing sleeves.

Remove bulky sweaters, especially those with a brushed finish.

Generally, clothing which is not torn or raveled, composed of non-synthetic material is best. Synthetics tend to burn and melt, sticking to your skin.

Laboratory aprons and lab coats are recommended.

Note: To launder lab coats, wash with detergent only. Do not use any fabric softener as it increases the flammability of the lab coat material.



Long hair or beards must be confined

Hair burns, especially if covered with hair spray.

Keep long hair tied back so it cannot fall near a burner flame, hot plate, or a mechanical device.

If you are wearing a scarf or necktie, remove it or confine it in such a way as to prevent it from extending into your laboratory work area where it could catch fire, get into chemicals, or get caught in apparatus.



Gloves

Gloves may be required for working with specific chemicals.

There are different types of gloves for different chemicals and operations.

Generally, disposable nitrile gloves are adequate for normal laboratory operations in a general chemistry class.

The gloves should have a good fit to provide dexterity for handling all materials.

Remove your gloves before handling such things as cell phones, calculators, laptops, writing instruments, laboratory notebooks, and textbooks.

Gloves should be removed and disposed of when they are contaminated by laboratory chemicals.

You should wash your hands when leaving the laboratory, even if you have worn gloves.



Footware

Recommended footwear should have a **low heel** and be **composed of leather** or equivalent material.

Shoes should have **no open spaces** to prevent spills from getting on your feet.

Canvas shoes tend to absorb liquids.

Sandals and flip-flops offer no foot protection and are not permitted in the laboratory.



Working with burners and flames

It is dangerous to leave a lit Bunsen burner unattended

The blue flame of a properly adjusted burner is not visible and can result in a burn if you reach over it on the lab bench.

Never reach across a lab bench, either near or over a lighted burner, for any materials you may need for the experiment.



Incorrect flame adjustment



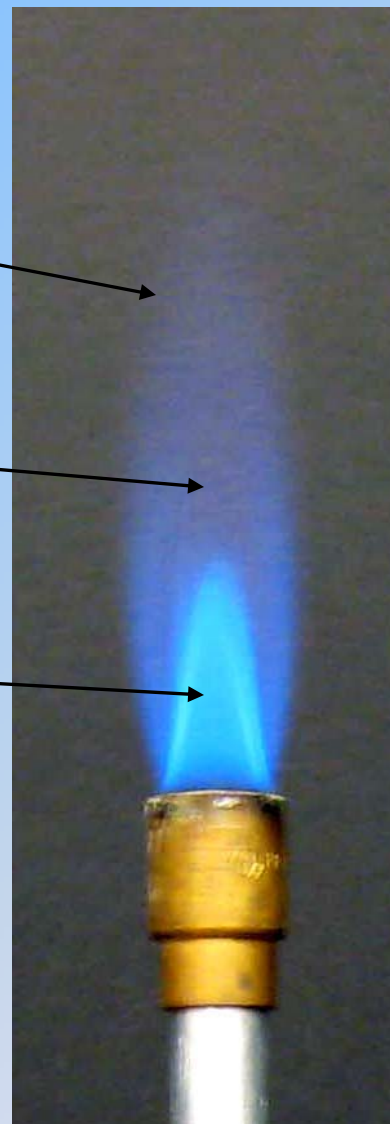
Properly adjusted flame

The Bunsen burner flame

Pale blue-violet outer flame
(oxidizing flame, temperature about 1550°C)

Hottest part of flame
(temperature about 1560°C)

Bright blue inner cone
(reducing flame ranging from about 300°C near bottom to 500°C near top of cone)



Working with hotplates

Hotplates should be positioned away from any flammable materials, such as alcohol, acetone, and toluene, and bottles of reagents.

Hotplates can spark, unseen by your eyes, and ignite flammable liquids or vapors.

Hotplates retain heat for a while after they have been used and turned off. Once they have been used, hotplates are to be treated as if they are hot, even after you have disconnected them from the power supply.

Give a hot plate sufficient time to cool before moving it and putting it away. If you need to leave the laboratory, please inform your coworkers and your instructor that the hotplate, left on the lab bench, is still warm.



Food and drinks

Smoking, chewing, eating and drinking are not permitted in the laboratory due to the possible ingestion of chemicals.



Working with chemicals

Assume that all chemicals used in the laboratory are harmful.

Although the substances you encounter in the laboratory have different degrees of safe exposure, you should not treat anything as safe unless you know for certain that it is.

Every substance in the laboratory must be treated with respect to insure that all exposure is kept at a safe level.

Look up information and hazards about each chemical on the SDS, available in the laboratory.

Working with chemicals

Pregnant women and women planning to become pregnant should be aware that some chemicals may be **teratogens**, that is, they may cause genetic malformations in a developing embryo or fetus.

Known teratogens are not used in laboratory experiments

Your instructor should be aware of pregnancy so that he/she may advise you of any laboratory chemicals or specific experiments to avoid.



Read each label on reagent bottles carefully to note the names of the chemical, its formula, and its concentration.


It is a good idea to **read the label twice** to make sure you have the correct material at the correct concentration.

Many chemicals have similar names such as sodium sulfate and sodium sulfite.

If you are not sure as to the identity of a substance, ask your instructor.



A Sample Chemical Label



CAS 68-12-2; C₃H₇NO; FW 73.1; Fp 58 °C (138.4 °F); bp 153 - 155 °C; mp -61 °C; d 0.948;
US Toxic. EU Toxic.
 May cause harm to the unborn child. Harmful by inhalation and in contact with skin. Irritating to eyes. Restricted to professional users. Attention - Avoid exposure - obtain special instructions before use. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Teratogen. Combustible liquid. Readily absorbed through skin. Target organ(s): Liver. Kidneys.

Store at XX °C.

Product of USA. MSDS available. SLC3424. For R&D use only. Not for drug, household or other uses.

D158550-250ML Batch # : 010K0895

N,N-Dimethylformamide, minimum 99%


Molecular Biology Tested

SIGMA-ALDRICH.COM
 SIGMA-ALDRICH, INC., P.O. Box 14508, St. Louis, MO 63178 USA, 314-771-5700
 SIGMA-ALDRICH CHEMIE GmbH, P.O. 1120, 69082 Steinheim, Germany 49-7141-970

EC 200-879-6 EC Label W08 1: D1438 2

Gifig. Kann das Kind im Mutterleib schädigen. Gesundheitsschädlich beim Einatmen und bei Berührung mit der Haut. Reizt die Augen. (Nur für den beruflichen Verwendung. Achtung - Exposition vermeiden - Vor Gebrauch besondere Anweisungen einholen. Bei Unfall oder Unwohlsein sofort Arzt anrufen (wenn möglich, dieses Etikett vorzeigen).
Toxique. Peut pendant la grossesse d'effets néfastes pour l'enfant. Nocif par inhalation et par contact avec la peau. Irritant pour les yeux. Réservé aux utilisateurs professionnels. Attention - Éviter l'exposition - Se procurer des instructions spéciales avant utilisation. En cas d'accident ou de malaise, consulter immédiatement un médecin (si possible lui montrer l'étiquette).
Toksico. Posso durante el embarazo de efectos adversos para el feto. Nocivo por inhalación y en contacto con la piel. Irrita los ojos. El uso está restringido a profesionales. Atención - Evitar la exposición - Recórrase las instrucciones especiales antes del uso. En caso de accidente o malestar, consultar inmediatamente al médico (si es posible muéstrale la etiqueta).
Tossico. Può danneggiare i bambini non ancora nati. Nocivo per inalazione e contatto con la pelle. Irritante per gli occhi. Utilizzare solo con istruzioni professionali. Attenzione - Evitare l'esposizione - Procurarsi speciali istruzioni prima dell'uso. In caso di incidente o di malessere, consultare immediatamente il medico (se possibile, mostrargli l'etichetta).
Gifig. Kan de onopzettene schaden. Schadelijk bij inademing en bij aanraking met de huid. Irriterend voor de ogen. Uitsluitend bestemd voor gebruik door professionele gebruikers. Opgelet - Blootstelling vermijden - Voor gebruik speciale aanwijzingen raadplegen. In geval van een ongeval of indien men zich onwel voelt, raadpleeg een arts (indien mogelijk, neem dit etiket mee).

Toxic



SIGMA-ALDRICH®

A Product Name and Description

B Product Number

C Further Descriptive Information

D Recommendations on Handling and Storage

E Hazard Statement

F Lot Analysis: Data on activity, purity, degree of hydration, etc., for this lot.

G Package Size

H Lot Number

I Hazard Pictogram

J Further Hazard Information: Description of actual hazards, handling precautions, and emergency management procedures.

ALDRICH Chemistry

CAS 68-12-2; C₃H₇NO; FW 73.1; Fp 58 °C (136.4 °F); bp 153 - 155 °C; mp -61 °C; d 0.948; **US Toxic. EU Toxic.** May cause harm to the unborn child. Harmful by inhalation and in contact with skin. Irritating to eyes. Restricted to professional users. Attention - Avoid exposure - obtain special instructions before use. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Teratogen. Combustible liquid. Readily absorbed through skin. Target organ(s): Liver. Kidneys.

D158550-250ML Batch #: 010K0895

N,N-Dimethylformamide, minimum 99%

Molecular Biology Tested

Toxic

Store at XX °C.

Product of USA. MSDS available. SLO3424. For R&D use only. Not for drug, household or other uses.

SIGMA-ALDRICH



 E Explosive	 O Oxidizing	 F F+ Highly Flammable or Extremely Flammable	 T T+ Toxic or Very Toxic	 Xn Xi Harmful or Irritant
 C Corrosive	 B Biohazard	 N Dangerous for the Environment	 R Radioactive	

K CAS Number
L Chemical Formula and Formula Weight
M Risk and Safety Statements: Provided in multiple languages.
N Material Safety Data Sheet Available
O EC Number: EC Number (EINECS or ELINCS), products without an EINECS number will carry the warning statement, "Caution: Substance Not Yet Fully Tested."

The image shows a Sigma-Aldrich label for N,N-Dimethylformamide (DMF). The label is white with black and red text. At the top, the Aldrich Chemistry logo is visible. The product name "N,N-Dimethylformamide, minimum 99%" is prominently displayed. Below the name, it says "Molecular Biology Tested". The label includes various hazard symbols and codes: a skull and crossbones (Toxic) with code I, and a flame (Flammable) with code F. The label also contains safety information in multiple languages, including English, French, and German. The CAS number 68-12-2 and chemical formula C₃H₇NO are listed. The label is marked with letters K through M, corresponding to the information provided in the legend on the left.

K CAS Number: 68-12-2; C₃H₇NO; FW 73.1; Fp 58 °C (136.4 °F); bp 153 - 155 °C; mp -61 °C; d 0.948;
L Chemical Formula and Formula Weight: N,N-Dimethylformamide, minimum 99%
M Risk and Safety Statements: Provided in multiple languages.
N Material Safety Data Sheet Available
O EC Number: EC Number (EINECS or ELINCS), products without an EINECS number will carry the warning statement, "Caution: Substance Not Yet Fully Tested."

The image shows a legend for hazard symbols and codes. It consists of two rows of symbols, each with a corresponding code and description. The symbols are orange squares with black icons. The codes are in red. The descriptions are in black.

	E		O		F F+		T T+		Xn Xi
Explosive		Oxidizing		Highly Flammable or Extremely Flammable		Toxic or Very Toxic		Harmful or Irritant	
	C		B		N		R		
Corrosive		Biohazard		Dangerous for the Environment		Radioactive			

The SDS

A Material Safety Data Sheet, or SDS, is a federally required hazard communication to employees or users of a hazardous chemical that must be placed in a location where users can have access to the information.

SDS sheets for all chemicals used in the department of chemistry are on file in the laboratory preparation area and in the STEM Division office.

The SDS (continued)

The information that must be contained on an SDS is:

1. The **identification** of the product including the chemical and common names, and product codes of all the ingredients that contribute to any health hazards.
The name, address, and phone number of the manufacturer, importer, or other responsible party, and an emergency phone number.
2. **Hazard(s) Identification** The physical hazards of the hazardous chemical including the potential for fire, explosion, and reactivity.
Pictograms
Precautionary statements

The SDS (continued)

3. **Composition/information on ingredients** including chemical names and synonyms, Chemical Abstracts Service number and other unique identifiers.
4. **First-Aid measures** including necessary instructions by relative routes of exposure (inhalation, skin and eye contact, and ingestion).
Most important symptoms – acute or delayed (chronic)
Recommendations for immediate medical care and treatment.
5. **Fire-fighting measures** including suitable extinguishing equipment, special hazards arising from the chemical, recommendations on special protective equipment.

The SDS (continued)

6. **Accidental Release Measures** which are recommendations on the appropriate response to spills, leaks, containment, and cleanup practices to prevent or minimize exposure to people, properties, or the environment.
7. Any generally applicable **precautions for safe handling and storage** of the chemical including appropriate hygienic practices, protective measures, and specific conditions for safe storage and ventilation.
8. **Exposure Controls/Personal Protection.** OSHA Permissible Exposure Limits (PELs), exposure controls, and personal protective equipment.

The SDS (continued)

9. The **physical and chemical properties** of the hazardous chemical such appearance (physical state, color, etc.) flammability or explosive limits, odor, vapor pressure, pH, relative density, melting point/freezing point, solubility, evaporation rate, flammability, autoignition temperature, decomposition temperature and viscosity.
10. **Stability and Reactivity** lists the chemical stability and possibility of hazardous reactions.

The SDS (continued)

- 11. Toxicological information** on the routes of exposure, the immediate and delayed effects of short- and long-term exposure, measure of toxicity, description of symptoms, and whether --the chemical has been found to be a potential carcinogen (a substance that is know to cause cancer in humans or laboratory animals), mutagen (cause genetic changes) and/or teratogen (can induce a genetic malformation in a developing embryo or fetus).

- 12. Ecological Information** if the chemical were released to the environment such as toxicity to aquatic and/or terrestrial organism, persistence and degradability, bioaccumulation potential, and potential to move from soil to groundwater.

The SDS (continued)

- 13. Disposal Considerations** providing guidance on proper disposal practices, recycling or reclamation of the chemical or its container.
- 14. Transport Information** for shipping by road, air, rail, or sea.
- 15. Regulatory Information** identifying safety, health, and environmental regulations that is not included elsewhere on the SDS.
- 16. Other Information** including when the SDS was prepared or when the last known revision was made.

Liquids should be dispensed from a small reagent bottle

If it is necessary to obtain a small amount of liquid from a large reagent bottle, pour the approximate amount called for into a smaller container such as a beaker. The liquid can then be easily poured into a measuring device such as a graduated cylinder.

If the bottle has a glass or plastic stopper, hold it between your fingers, as shown.

Do not lay the top on the lab bench as it may pick up contamination



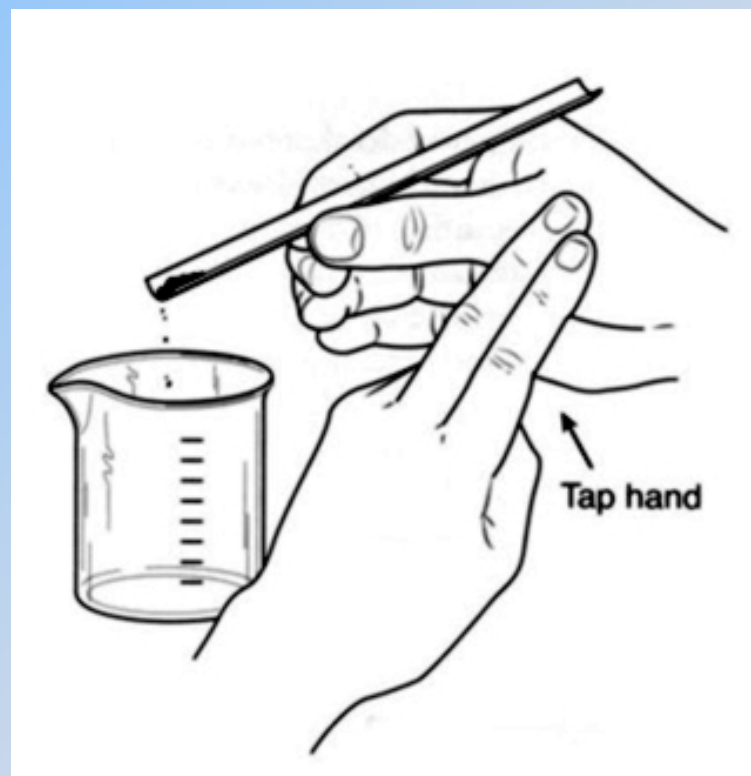
Solid chemicals are best dispensed from a small reagent bottle.

Solid chemicals can be poured from a small bottle directly into a weighing boat or weighing paper on a balance.

Never place chemicals directly on the balance pan.

If necessary, a clean spatula can be used to withdraw small amounts of chemical from a container.

To dispense a small amount of solid from a spatula, tap your hand gently as shown



Chemicals should never be returned to their containers

Once removed from a container, a chemical is considered to be contaminated.

If you have taken too much material, ask a coworker in the laboratory if they can use it. If no one needs the excess, dispose of it in the proper waste container.

Disposal

Procedures for the disposal of chemical wastes vary from locality to locality. What may be acceptable in a large city may not be acceptable in a small town or rural area. Your instructor will advise you on the procedures for each experiment.

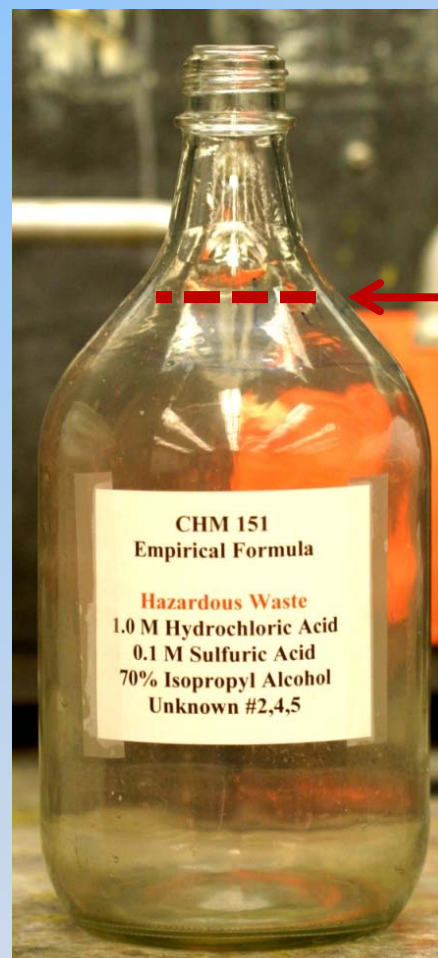
Appropriate waste containers for solids and for liquids should be available in the laboratory.



Disposal of liquid chemicals and solutions

There should be separate, labeled containers for flammable liquids, corrosive materials, oxidizers, heavy metals, and other materials that you are likely to use in an experiment.

Do not overfill a waste container

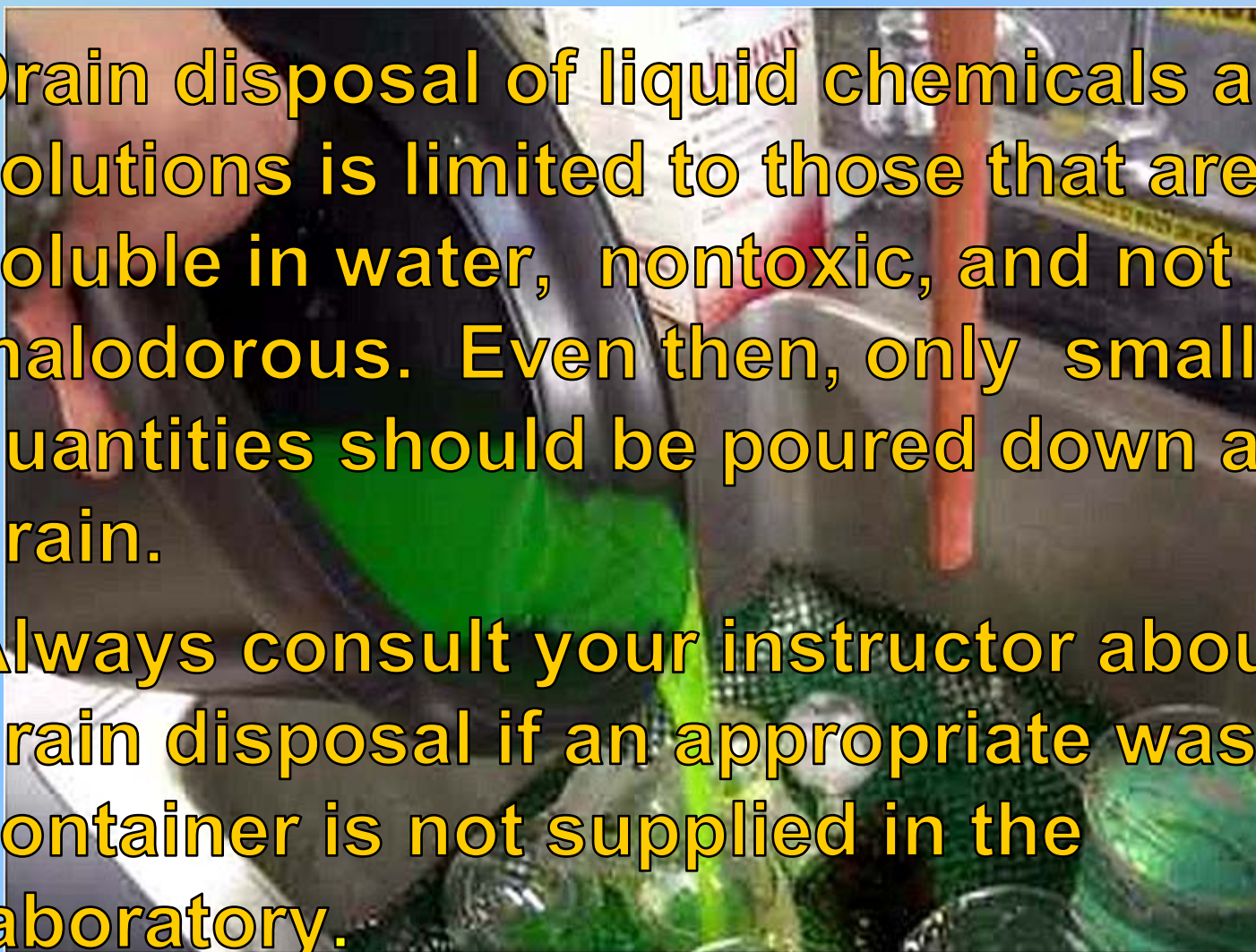


Fill to about here

Drain Disposal

Drain disposal of liquid chemicals and solutions is limited to those that are soluble in water, nontoxic, and not malodorous. Even then, only small quantities should be poured down a drain.

Always consult your instructor about drain disposal if an appropriate waste container is not supplied in the laboratory.

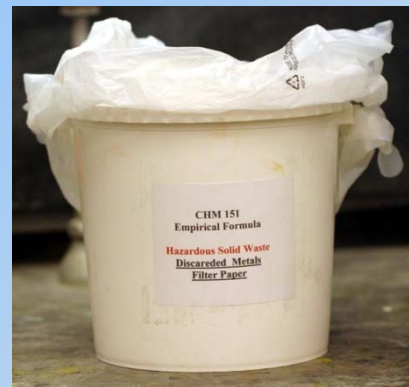


Disposal of solid chemicals

Solid chemical wastes should be placed in the appropriate containers in the laboratory.

Familiarize yourself with the types and location of waste containers.

Do not throw solids into the trash cans unless specifically directed to do so.



DISPOSAL OF GLASS

Broken glass should be disposed of in containers marked for glass only.

When filled, glass disposal containers are sealed and disposed of along with their contents. This will prevent injury to persons handling this type of waste.



Storing chemicals between experiments

Chemicals should never be stored in a desk drawer or locker. There is always the possibility of fumes given off or spilling of the material. This could result in another individual becoming contaminated with an unidentified chemical.

Your instructor will direct you on storing any chemicals between experiments.

Do not remove any chemicals from the laboratory environment. Even if properly labeled, outside of the laboratory an individual unfamiliar with the chemical may mishandle or misuse it and become injured.

Removal of chemicals from the laboratory is prohibited and will result in appropriate actions against the individual.

When working at the balance, clean up spilled materials from the balance and surrounding work area immediately.

This not only protects the balance, but it protects the next person from becoming contaminated with an unidentified chemical.



Fume Hoods

If a chemical or a reaction generates any irritating or potentially toxic gases or vapors, it should be used in a **FUME HOOD**.

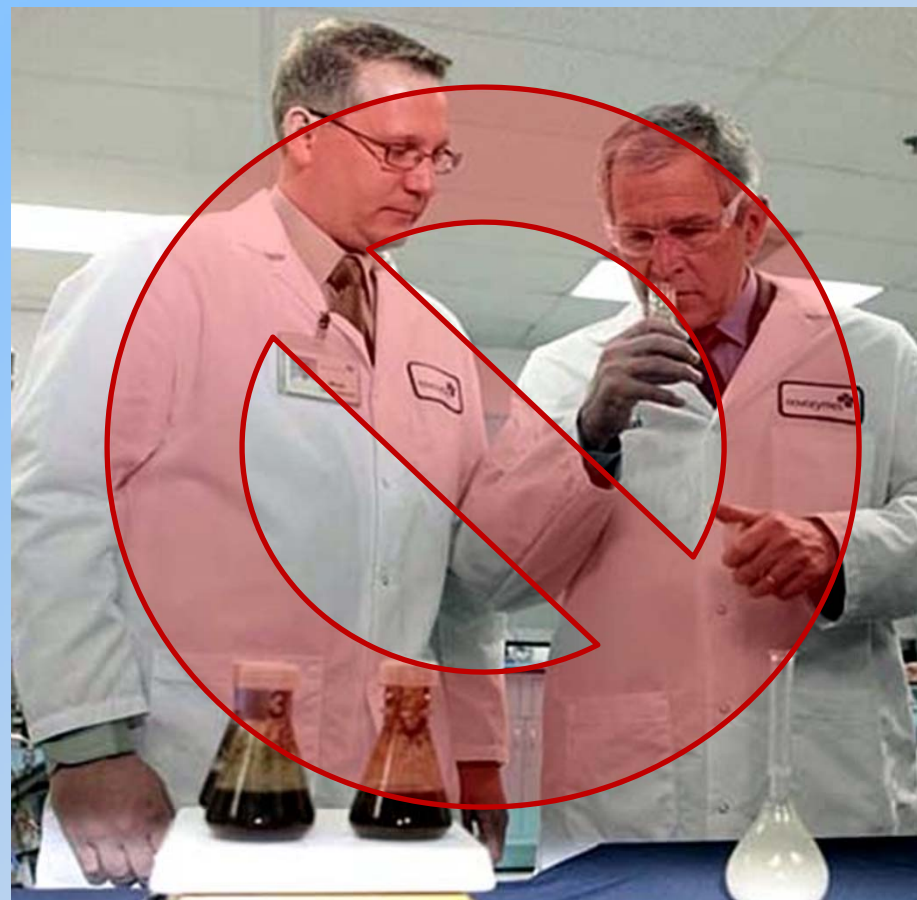
If fumes are generated unexpectedly, turn off any heating device and move the apparatus under the hood as quickly as possible.

If exposed to the vapors, get fresh air immediately.



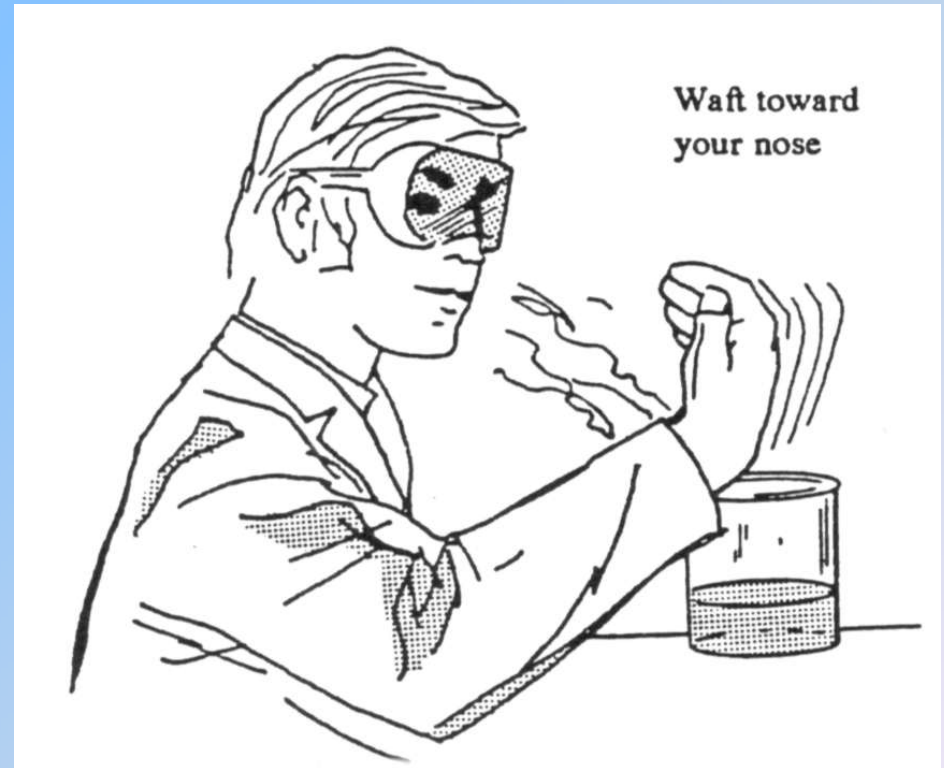
Noting odors of substances

Do not sniff the material at the mouth of the container as the odor may be too strong and may overcome you.



Noting odors of substances

When noting the odor of a substance, **cup your hand and waft vapors toward your nose.**



Chemical reactions

When adding chemical reagents to a reaction, always add the material slowly with stirring. This will help to keep the reaction under control and minimize or prevent splattering or foaming.



Chemical reactions

It is dangerous to leave a reaction unattended while heating it.

An untended reaction is a potential bomb. Material can splatter from the container at any time.

If a reaction is heated to near dryness, it can splatter from its container.

Also, a flask, beaker, or evaporating dish heated to dryness can shatter.



Chemical reactions

Never heat a closed system.

Any flask, beaker, reflux set-up, distillation, or other system must be open to the atmosphere so excess pressure does not build up inside the system. Heat will cause the gases and liquids inside the system to expand until the container breaks, or at the worst, explodes.

Diluting concentrated solutions

When diluting acids, or any concentrated solution, with water, **always pour the acid, or concentrated solution, into water.**

Dilution is often accompanied by heat and splattering may occur if liquids are mixed in the wrong order.

Never mix a concentrated acid with a base. The neutralization reaction produces heat in addition to the heat of dilution and splattering will occur.

Heating liquids

Boiling chips or stones should always be added to liquids to promote smooth boiling and prevent bumping and splattering.

Add boiling stones when the liquid is cold or only slightly warm. If a boiling stone is added to a hot liquid, it may boil over the sides of the container.



Heating a test tube

Use a water bath.

For direct heating:

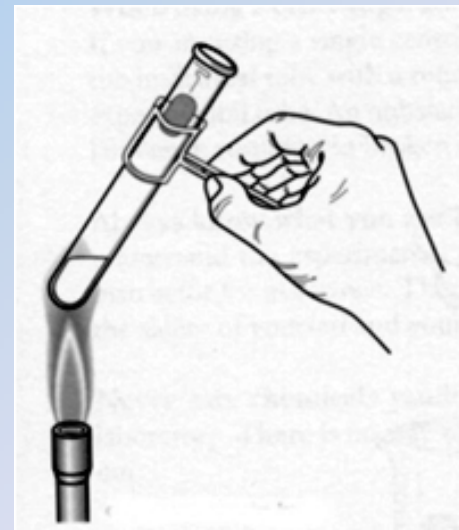
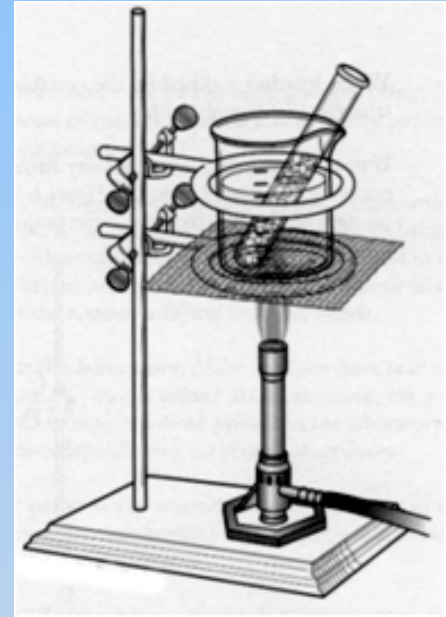
Use a test tube clamp or holder.

Hold the test tube at an angle of about 45 degrees.

Do not point the open end of the test tube toward anyone.

Heat it from top to bottom moving the test tube in and out of the flame.

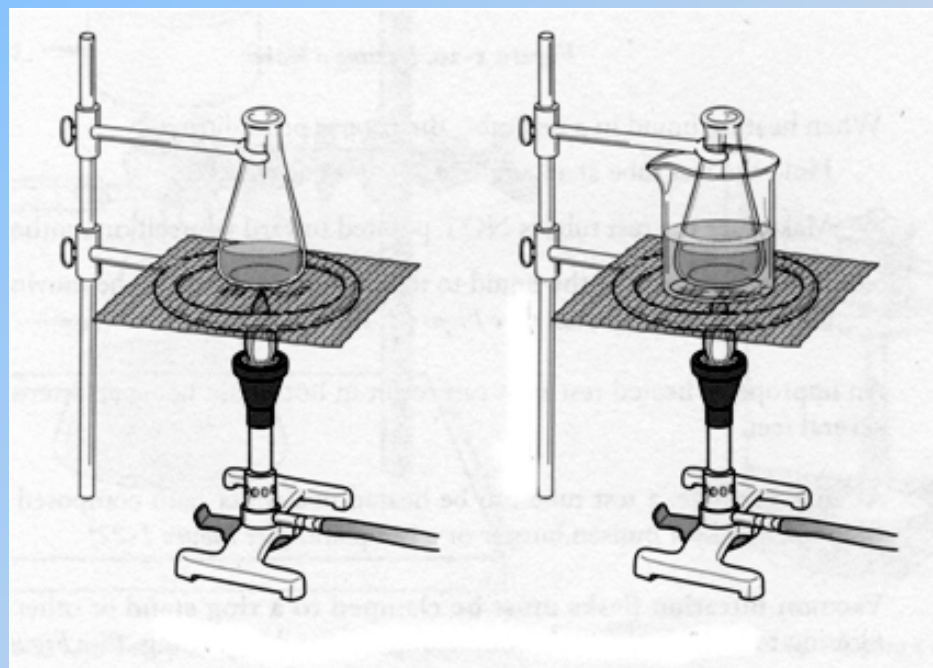
An improperly heated test tube can result in hot liquid being splattered a distance of several feet.



Heating a flask

When heating a flask on a ring support, **always clamp the flask to the ring stand** to prevent the flask from falling off the ring support.

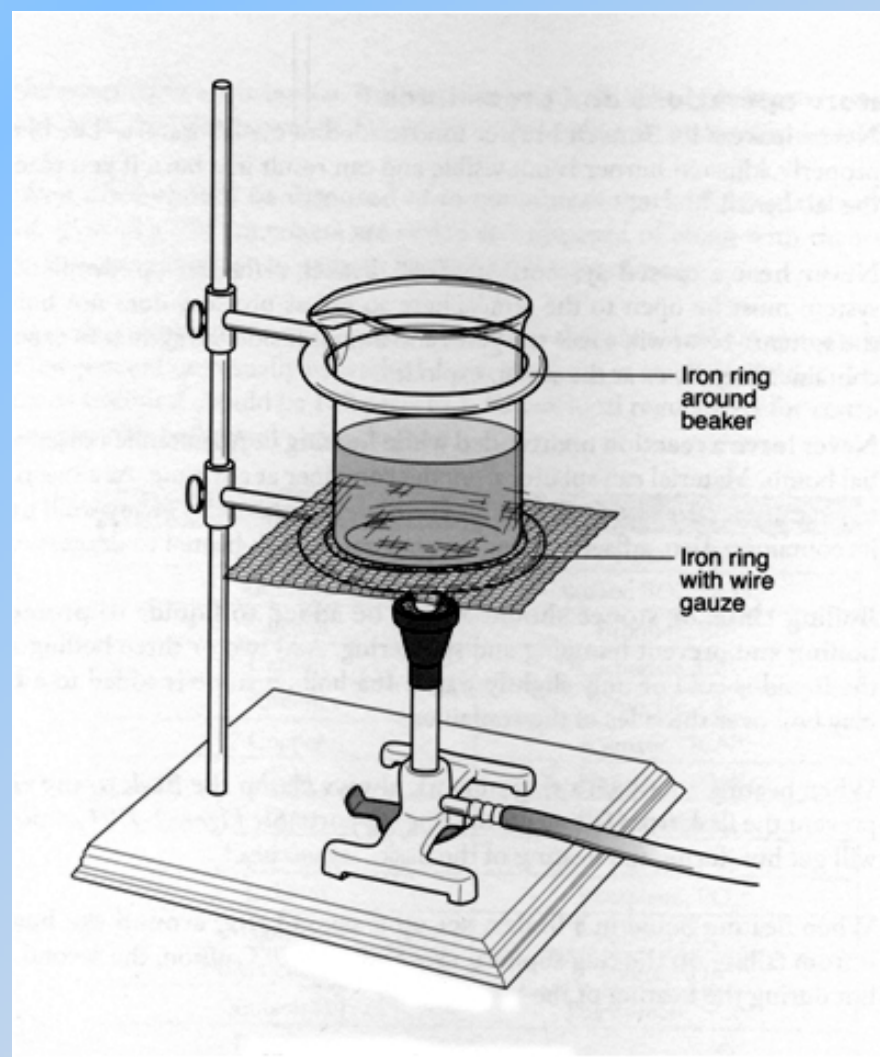
Caution, the clamp will get hot during the heating of the flask.



Heating a beaker

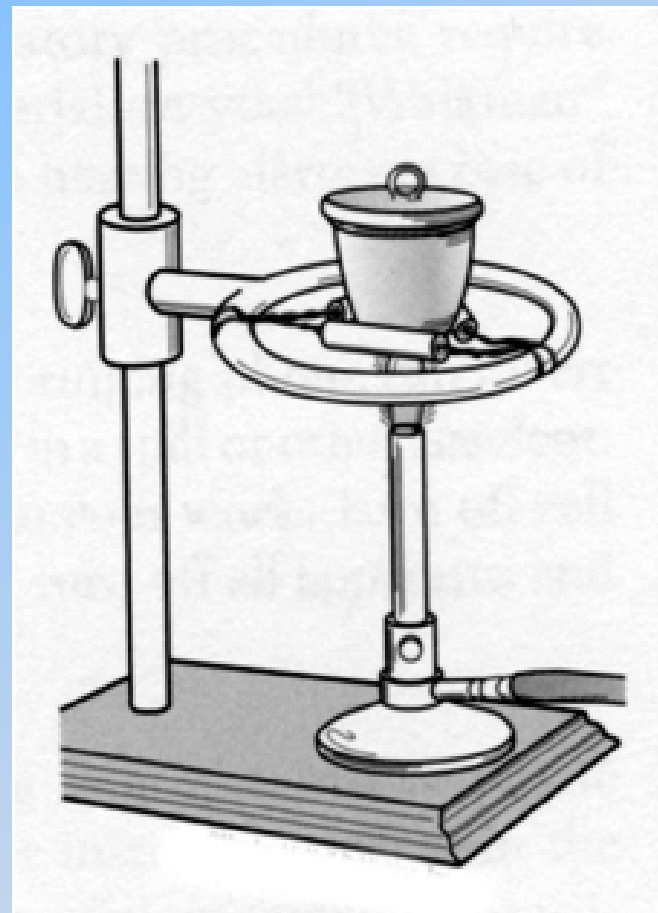
When heating liquid in a beaker, **set up a second ring around the beaker** to keep it from falling off the ring support.

Caution, the second ring will get hot during the heating of the beaker.



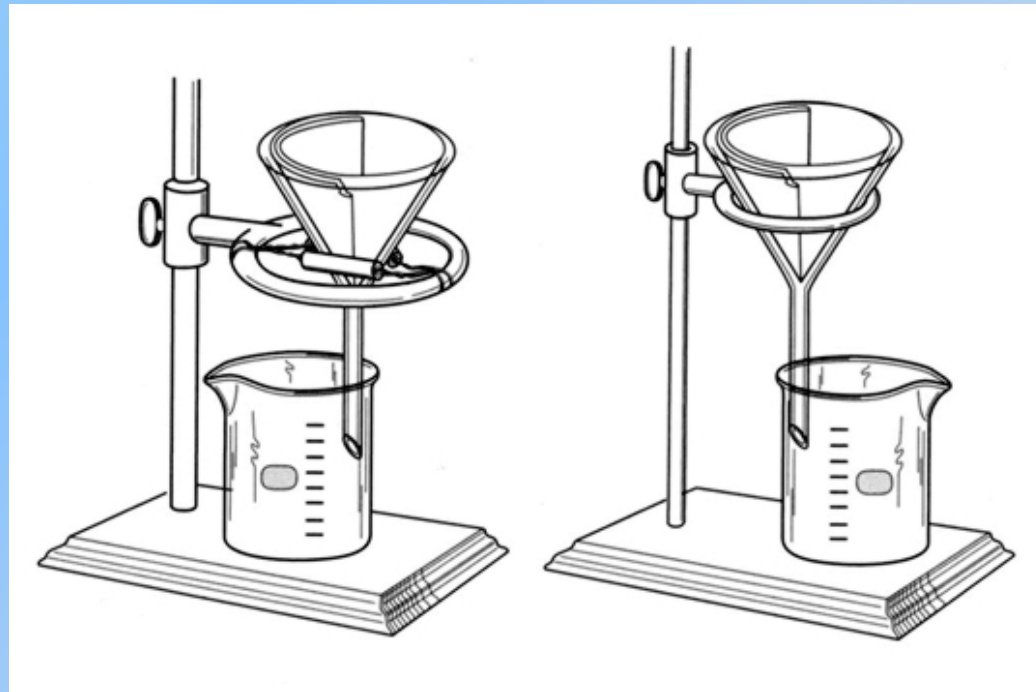
Heating a crucible

When heating a crucible,
the crucible is supported
on a support ring using a
clay triangle



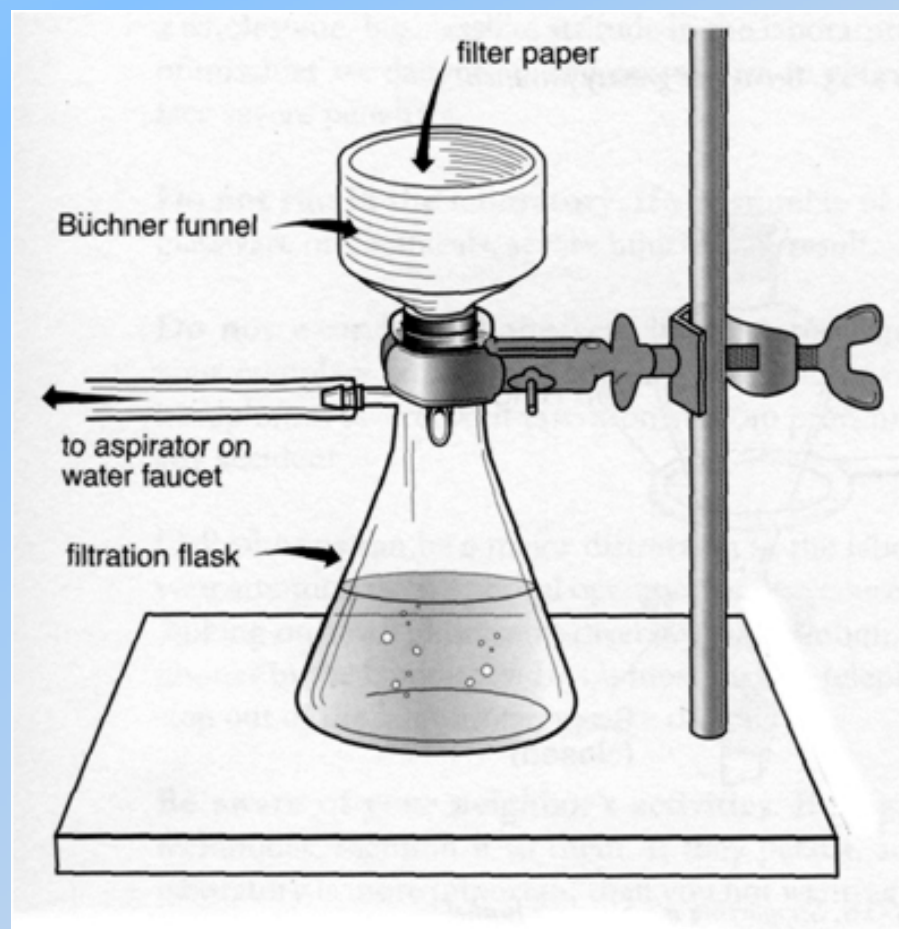
Gravity filtration

If you are filtering using gravity filtration, always support the funnel using a support ring or a funnel rack. If the support ring is too large, place a clay triangle on the ring to support the funnel.



Vacuum filtration

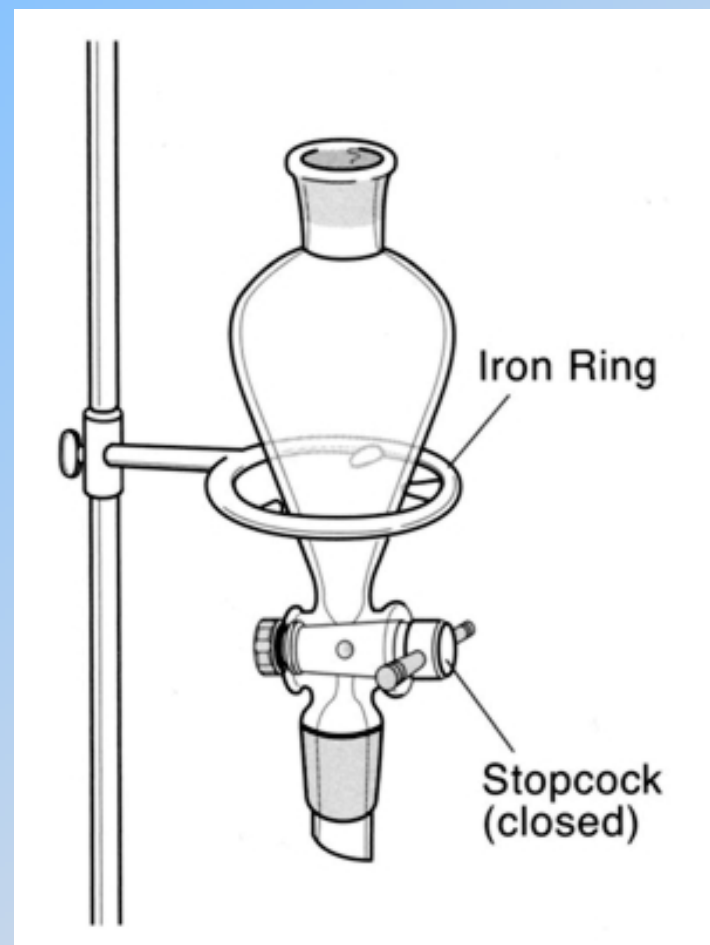
Vacuum filtration flasks must be clamped to a ring stand when filtering to prevent the flask from falling over and imploding.



Separatory funnels

When using a separatory funnel, always support the funnel using a support ring.

This will allow easy removal of the funnel when it is necessary to shake the contents as part of the separation procedure.



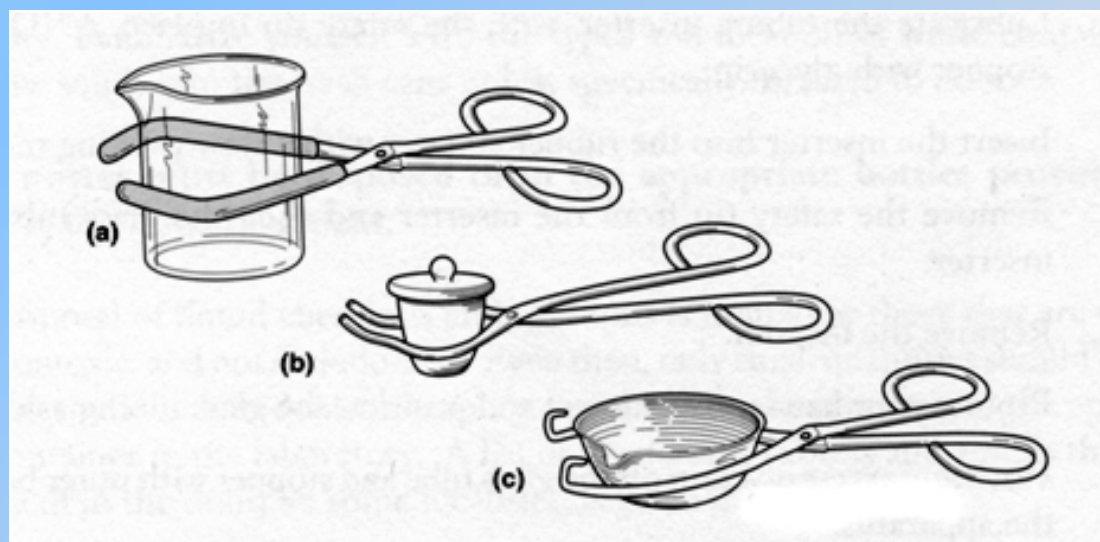
Use the appropriate apparatus to handle lab ware.

Beaker tongs, not crucible tongs, should be used to hold beakers.

Flask tongs are designed for holding flasks.

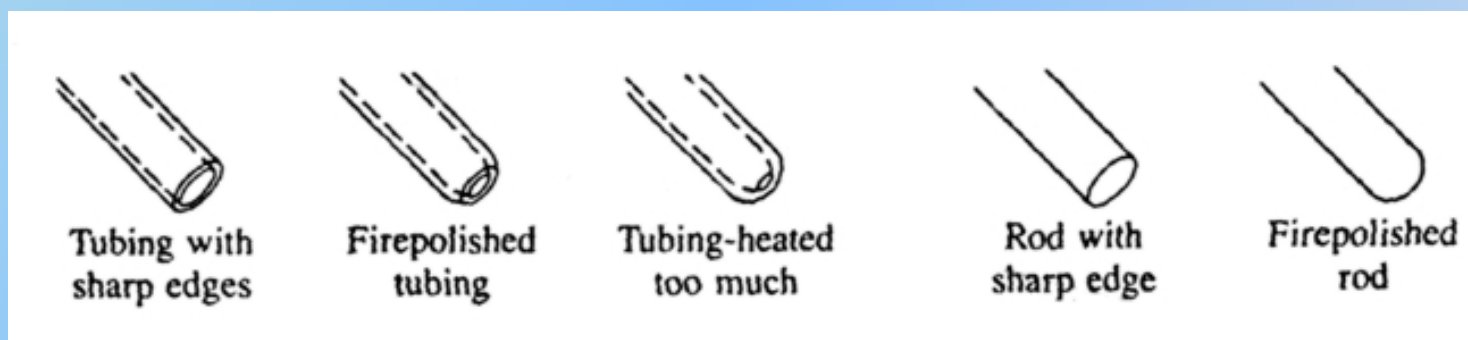
Crucible tongs are designed to hold crucibles.

Dish tongs are used to hold evaporating dishes.



To insert glass tubing into a cork or rubber stopper

Make sure that the ends of the glass tube are firepolished.



Lubricate the glass tubing and the hole in the stopper with glycerin.

Hold the tube with a towel and insert it into the stopper with a slow twisting motion - NEVER PUSH HARD.

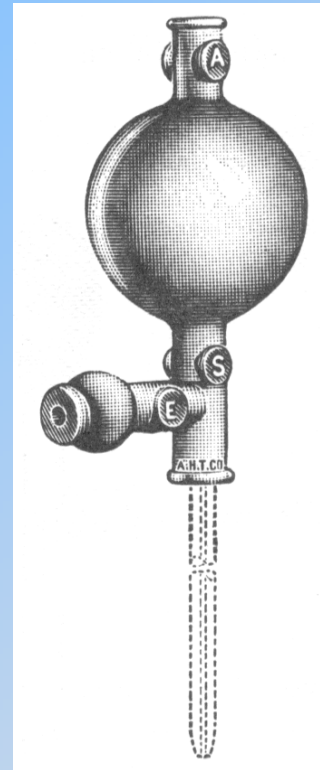
Use extra glycerin if needed.

Wash the glycerin off the glass tube and stopper with water before assembling the apparatus.

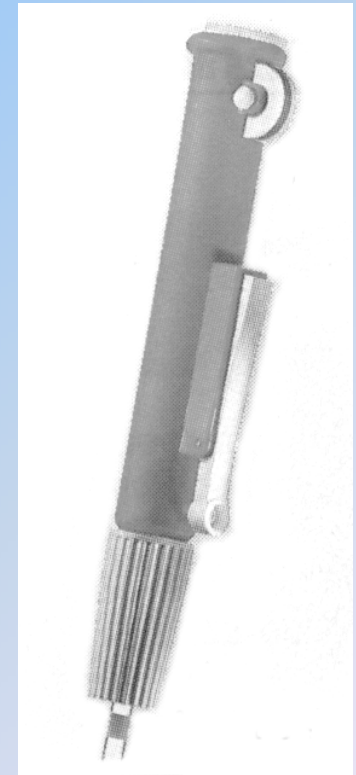
PIPETTING LIQUIDS

When pipetting liquids or solutions, use a pipet safety bulb or a pipet pump to draw the liquid into the pipet.

Never pipet by mouth.

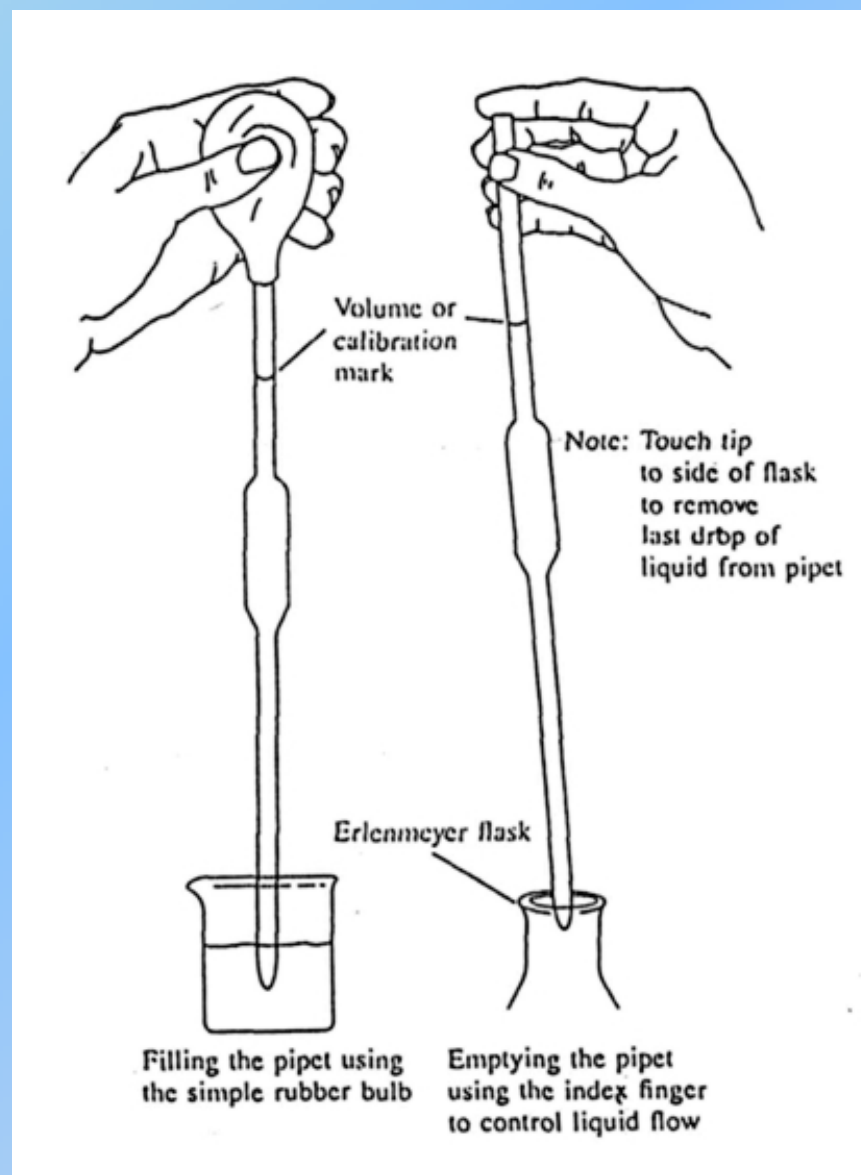


A pipet
safety bulb



A pipet
pump

PIPETTING LIQUIDS



Always know what you are doing in the laboratory.

Make sure you have read and understand the experimental procedure. If you are unsure about anything, ask your instructor for assistance. There is no such thing as a *dumb question* in the laboratory as the safety of yourself and your classmates depends on your proper procedures.

Never work in the laboratory without proper supervision

It is important to have someone present who can help out in the event of difficulties or an accident.

Proper behavior is expected in the laboratory.

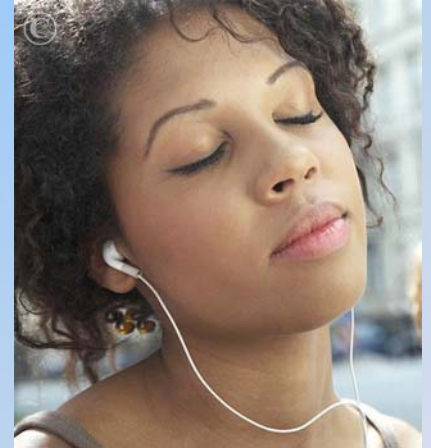
Each student is expected to maintain a wholesome, businesslike attitude in the laboratory. Horseplay, pranks, and other acts of mischief are dangerous and cause harm to yourself, as well as others. Violators will face severe penalties.

Be aware of your neighbor's activities. If they are using improper and/or unsafe techniques, mention it to them. If they persist, advise your instructor. Safety in the laboratory is more important than you not wanting to report a fellow student's hazardous behavior.

Do not wear headphone sets in the laboratory.

Laboratory procedures require your complete attention.

Listening to music or other material on your iPod or MPG headphones diverts your attention and can prevent you from hearing alarms in case of any accident.



Cell phones can be a major distraction in the laboratory.

A ringing phone can divert your attention from a critical operation or procedure resulting in a spill or other accident.

Talking on a cell phone also diverts your attention away from your work.

Turn off cell phones in the laboratory.

If you must make a telephone call, turn off all apparatus and step out of the laboratory to make the call.



Unauthorized experiments are not permitted

Without the information or experience, there is no way of knowing if an unauthorized experiment is safe to carry out.



Cleaning up

Always clean up your work area after completing each part of an experiment, as well as at the end of the laboratory experiment.

Minimize the apparatus and materials on the bench top to eliminate sources of accidents.

Always clean up around the laboratory balances before taking chemicals back to your work area.

This prevents contact with unidentified laboratory chemicals.

If the person in front of you does not clean up spilled chemicals at the balance, ask him/her to do so.

Please report any infractions to your instructor.

Cleaning up

Clean your glassware.

Brushes are available in your apparatus drawer and detergent is located on each lab bench.

This includes any special equipment used for the experiment.

Rinsing with water does not remove all residues from glassware.



At the end of the laboratory session, **clean up your bench area.**

- Wash and wipe down your bench top.
- Be sure that the gas and water valves are turned off.
- Any electrical equipment, with the exception of instrumentation such as pH meters and Spectronic 20's, should be turned off.
- Return any special equipment to the location from which you received it, with the exception of any equipment that is still hot to the touch, such as hot plates and iron ring supports.

One should always take the precaution of washing the hands, with soap, upon leaving the laboratory.

At the end of a laboratory session, it is also recommended that both hands and face be washed, particularly if the individual was wearing any make-up that would absorb chemical vapors.



CONSTRUCT A SAFETY MAP SHOWING LOCATION OF SAFETY EQUIPMENT AND EXITS IN THE LABORATORY

- Show the location of all laboratory benches, desks or other furniture in the laboratory.
- Identify all exits from the laboratory and write **EXIT** next to each doorway.
- Mark the location of all fire extinguishers with the words **FIRE EXTINGUISHER**.
- Mark the location of the fire alarm with the words **FIRE ALARM**.
- Mark the location of the eye wash station with the word **EYEWASH**.
- Mark the location of the safety shower with the words **SAFETY SHOWER**
- Mark the location of the fire blanket with the words **FIRE BLANKET**
- Mark the location of the first aid kit with the words **FIRST AID KIT**
- Mark the location of the waste hood with the words **WASTE HOOD**
- Mark the location of the glass disposal box with the words **GLASS DISPOSAL**
- Mark the location of each of the fume hoods with the word **HOOD**

With proper preparation and attention to what you are doing, the chemistry laboratory can be a safe place to work.