University of Bahrain

College of Science

2019

Laboratory Safety Booklet For Students

THINK SAFE

WORK SAFE

BE SAFE

The purpose of this safety booklet is to ensure that all students working in and around the laboratory facilities are aware of laboratory conduct and emergency procedures. If you have any questions or comments regarding the information contained within this booklet, please direct them to your instructor.

Rules of Laboratory Conduct

1. Your concern for safety should begin even before the first experiment. Always read and think about each laboratory experiment before starting.
2. Perform laboratory work only when your instructor is present. Unauthorized or unsupervised laboratory experimenting is not allowed.
3. Know the location and use of all safety equipment in your laboratory. These should include the safety shower, eye wash, first aid Kit, fire extinguisher, and fire blankets.
4. Wear a laboratory coat and safety goggles for all laboratory work.
5. Dress properly during a laboratory session. Long hair, Hiijab and Gitra must be tied back, and dangling jewelry and baggy clothing must be secured. Shoes must completely cover the foot. No sandals are allowed in the lab.
6. Clear your bench top of all unnecessary materials. Such as books and clothing before starting your work.
7. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
8. Check chemical labels to make sure you have the correct substances. Pay attention to the hazard classifications shown on the label. See the hazard diagram below [1].
9. All chemicals are potentially harmful and should be treated with care. Refer to Material Safety Data Sheets (MSDS), http://www.msds.com, if you have concerns about toxicity or other characteristics of a chemical.
10. Never taste laboratory materials and never look directly down into a container, view the contents from the side.
11. Do not return any excess material to its container unless authorized by your instructor.
12. Report any accident (spill, breakage, etc) or injury (cut, burn, etc) to the demonstrator or instructor, no matter how trivial it seems. Do not panic.
13. In case of a chemical spill on your skin or clothing rinse the affected area with plenty of water. If the eyes are affected wash them immediately for 15 minutes and seek medical help.
14. Minor skin burns should be placed under cold, running water.

15. Never pour a waste chemical in the drain, or put it in garbage. Waste bottle are available in all labs. Always pour waste into the appropriate and labeled waste bottle.

16. Always wash your hands before leaving the laboratory. Do not wear gloves outside laboratory.

17. Before leaving the laboratory, ensure that gas lines and water faucets are shut off.

18. If in doubt, ask your instructor or demonstrator.

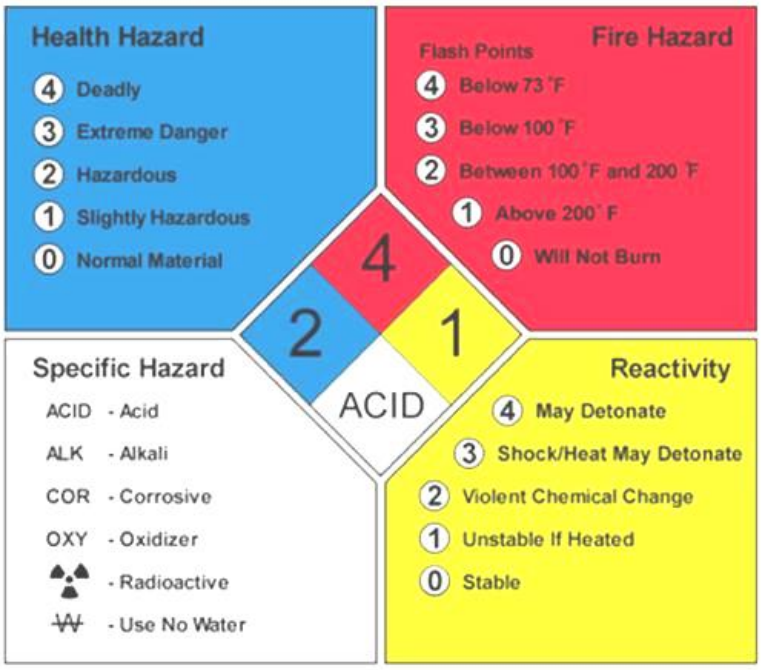
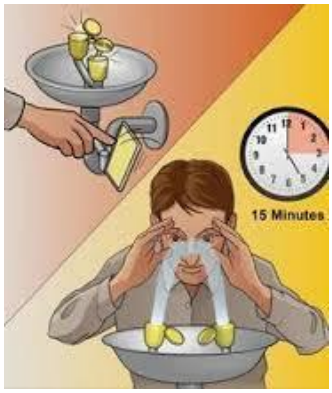


Figure 1: Hazard Diagram

Safety Equipment

In each lab you will find everything needed in case of an accident, injury or chemical spill [2]:

1- **Showers**-These are for use when corrosive liquids have spilled over large areas of clothes and skin.



2- **Eye-wash Fountains** - Should be used in the event that a chemical has been splashed into the eyes. Eyes should be washed for at least 15 minutes with eyeballs rolled to ensure thorough washing.

3- **First Aid Kits**- These kits contain typical first aid materials, along with solutions for chemical burns. However, chemical burns do not often become serious if the affected parts promptly washed with water. Water - lots of it- is the first treatment for all accidents in which corrosive chemicals have been spilled or splashed on the skin. First Aid Kits are checked on a regular basis to ensure that they are fully stocked at all times, and are located in all preparation rooms.

4- **Spill Kits** -Should be used when needed. These are for solvent, acid, or base spills. Make sure that you use the appropriate substance for the given spill!

5- **Fire Extinguishers**- They are very effective for fires involving organic liquids and electrical wiring. Small fires in beakers, flasks, etc. can usually be smothered with a heat resistant mat.

6- **Fire Blankets** – These blankets are located in the preparation room of each lab. They are made to wrap an individual whose clothing is on fire. Wrap the individual in the blanket and then Have him drop to the floor.

Gas Cylinders

Although gas cylinders are not being used in every lab within the **Chemistry and Biology Departments**, it is important that all students be aware of the proper handling of these items.

1. Ensure that you are using the correct cylinder. Go by the label on the cylinder and not by any color codes or labels on the valve.

2. Use the right regulator for the right gas. Know how to use the regulators properly.

3. Securely fasten the cylinder to a wall or table when it is not being transported.

4. Transport gas cylinders on a wheeled cart that allows the cylinder to be securely fastened to the cart.

5. Do not drag or pick up gas cylinders by the valve.

6. Keep the cylinders in ventilated areas away from sparks and heat sources.

Fire and Evacuation Procedure

Fire safety is everyone's responsibility.

Students are responsible for familiarizing themselves with fire safety guidelines and for complying with all fire safety rules.

In the event of a small fire, you or your instructor may use a fire extinguisher to extinguish the fire.

In a major fire:

- Remain calm.
- Alert people in the area and activate the nearest fire box.
- Close doors to confine the fire.
- Use stairs, **Do Not** use elevators.
- Proceed to the **Evacuation Assembly Point**. This point is located in front of the library of the Colleges of Science and IT.
- DO NOT re-enter the building until instructed to do so by safety personal.

Guide to Chemical Hazards [3]:

Chemicals can cause harm if they are not handled properly. For example, they can be toxic, flammable, corrosive, or reactive. Some chemicals are hazardous in only one of these ways, some is more than one. Every chemical, even water, is hazardous in at least one way. The degree of hazard varies; it can be great or small, or in between. For example, both gasoline and alcohol are flammable, but gasoline is much more flammable. Gasoline is easier to ignite and more likely to burn vigorously or explode than alcohol In all cases, you can work safely by taking the precautions that are described on the label and in the Material Safety Data Sheet (MSDS).The instructor in charge of your laboratory can explain the precautions that you will follow in your laboratory work.

Toxicity

It has long been known that anything ingested in sufficient quantity can be lethal. Any substance could be harmful to living things. But complex relationships exist between a substance and its physiological effect in humans. The major factors include the dose (the amount of a substance to which one is exposed and the length of time of exposure to the substance), the route of exposure (by inhalation, ingestion, absorption through the skin or eyes, or injection), and many other factors such as gender, stage in the reproductive cycle, age, lifestyle, previous sensitization, allergic factors, and genetic disposition. These and other factors can affect the severity of an exposure. If you don't know these details, as is often the case, it is prudent to act as though you could be susceptible to serious toxic consequences and therefore follow the necessary precautions when working with chemicals in the laboratory.

The toxic effects can be immediate or delayed, reversible or irreversible, local or systemic. The toxic effects vary from mild and reversible (e.g. a headache from a single episode of inhaling the vapors of ethyl acetate that disappears when the victim inhales fresh air) to serious and irreversible (e.g. birth defects from excessive exposure to a teratogen during pregnancy or cancer for excessive exposure to a carcinogen).

Toxic chemicals can enter the body by four routes:

- Inhalation through the respiratory tract (lungs) by breathing.
- Ingestion through the digestive tract. This can occur through eating; chewing gum ; applying cosmetics or smoking in the laboratory; using a contaminated beaker, say, as a cup for drinking coffee; or eating lunch without washing your hands after working in the laboratory.
- Absorption through body openings such as the ears or eyeball sockets, through cuts in the skin, or even through intact skin.
- Injection of a toxic substance through a cut made in the skin by a sharp, contaminated object. Possibilities include mishandling a sharp-edged piece of a contaminated broken glass beaker or misuse of a sharp object such as a knife or hypodermic needle.

When you work with chemicals in the laboratory

- Remember to read the labels before using chemicals
- Follow the precautions recommended in the Material Safety Data Sheets, and
- Always follow your instructor's directions.



Sources of Information:

Material Safety Data Sheets (MSDSs)
http://www.msds.com

The U.S. Occupational Safety and Health Administration (OSHA) has defined a hazardous chemical as any chemical that presents a hazard either under normal use or in foreseeable emergency.(As you probably have guessed, almost all chemicals are hazardous chemicals as defined by OSHA). The MSDS for a hazardous chemical describes its hazards and the precautions you must take to avoid harm.

OSHA does not require or prefer any particular format or ordered presentation of topics for an MSDS. OSHA only mandates that the MSDS be in English and that it includes:

- The name of the hazardous chemical (and if it is a mixture, the names of the hazardous components present at 1% or greater levels -0.1% if the component is a carcinogen);
- Some of the physical and chemical properties of the chemical (e.g. vapor pressure, boiling point, density);
- The physical hazards of the chemical (e.g. if it can catch fire or explode);
- The health hazards of the chemical (e.g. whether it is corrosive, an irritant, or harmful to the kidneys, and how it can enter the body [called "routes of entry" e.g. inhalation, ingestion];
- Whether or not the chemical can cause cancer;
- The precautions to take when using the chemical;
- The control measures, work practices, and personal protective equipment you should use;
- Emergency and first aid procedures;
- The date of preparation or, if revised, the date of the revision; and
- The manufacturer's name and address.

A Few Examples of Toxic Materials [3]:

Halogens: All halogens are toxic oxidizing agents- especially fluorine. It is too reactive to use as a reagent in a teaching laboratory. Chlorine also is a strong oxidizing agent; only if you have received special instructions should you work with chlorine. Bromine is a corrosive volatile liquid that causes serious burns on skin contact. Use it only in a laboratory hood.

Mercury: Spilled mercury evaporates, filling the air with toxic vapors. Mercury vapor is a cumulative poison. If spilled, mercury will roll when it hits a hard surface, usually breading into droplets, some of which are too tiny to be seen. Even visible droplets can adhere to smooth vertical surfaces; therefore, cleanup must be thorough.

Spilled mercury should be immediately and thoroughly cleaned up using an aspirator bulb or a special vacuum device. Do not use an ordinary vacuum cleaner; mercury vapor passes through the paper or cloth bag. Ask your instructor for help; a mercury clean-up unit is necessary to properly clean up the spill. Mercury spilled into floor cracks can be made nonvolatile by amalgamation with zinc dust or finely powdered tin.

Strong bases: These substances are all corrosive and can cause serious, destructive chemical burns, including blindness. Strong bases are insidious; even a concentrated solution of a strong base often causes no pain until the corrosive damage is quite severe. Although correctly classified as "dilute': saturated solutions of strong bases, such as $Ca(OH)_2$, also are extremely corrosive.

Formaldehyde: Formaldehyde is a colorless, water-soluble, pungent, and irritating gas. Do not breathe formaldehyde vapors; they are suspected to be carcinogenic and are a severe eye irritant, causing delayed affects that are not appreciably eased by eye washing. Formaldehyde should be used and handled only in a designated laboratory hood.

Cyanides and nitriles: Cyanides and nitriles are rapidly acting toxic substances. Overexposures can be fatal. Symptoms of toxicity occur if these materials are swallowed, inhaled, or absorbed through the skin. A few inhalations of hydrogen cyanide can cause mental deterioration; a few more can be fatal. Some metal cyanides are hydrolyzed in aqueous solution and form hydrogen cyanide; all are converted to hydrogen cyanide in the presence of acid.

Organic Peroxides and Peroxide formers Organic peroxides are a special class of compounds that pose unusual stability problems. These peroxides are among the most dangerous chemicals normally handled in chemical laboratories and manufacturing. As a class, organic peroxides are low power explosives. They are hazardous because of their extreme sensitivity to shock, sparks, heat, or other forms of accidental explosive initiation. All organic peroxides are extremely flammable, and fires involving bulk quantities of peroxides should be approached with extreme caution.

The following types of compounds form peroxides:

- Aldehydes
- Ethers, especially cyclic ethers, and ethers derived from primary and secondary alcohols. It is especially important to label the containers of ethyl or isopropyl ether with the date they are received, so that the user can destroy the contents of the container within three months after receipt. Never distill an ether unless it is known for certain to be free of peroxides, and even then do not distill to dryness.
- Compounds containing benzylic hydrogen atoms. Such compounds are especially susceptible to peroxide formation if the hydrogens are on tertiary carbon atoms [e.g. cumene (isopropyl benzene)].
- Vinyl and vinylidene compounds (e.g. vinyl acetate and vinylidene chloride).

Examples of chemicals that can form dangerous concentrations of peroxides when exposed to air:

- Cyclohexane, Cyclooctene, Decalin, (decahydronapthalene), *p*-Dioxane, Ethylether, Isopropyl ether, Tetrahydrofuran (THF), and Tetralin (tetrahydronapthalene).

Be sure that your instructor knows in advance if you plan to work with any of these compounds.

Waste Chemical Handling [4]:

Any chemical that you no longer use is considered as hazardous waste. All hazardous chemical wastes should be collected in the main hood of each lab room.

Chemical Waste Handling Procedures:

A waste is hazardous if it exhibits any of the following characteristic ignitability reactivity, corrosively and /or toxicity.

Waste bottles include:

- Aqueous Waste
- Organic Waste
- Recovery Jar – a bottle or jar in the main hood for the collection of product.
- Broken Glass
- Used Acetone

Waste rules:

- If you rinse a flask with water, use as little water as possible and always put the rinses in the aqueous waste bottle.
- When using acetone to rinse chemicals from glassware, use as little as possible (keep in mind that as soon as these rinses are placed in the hazardous waste container, they themselves become hazardous waste.
- Pay special attention to halogenated hydrocarbon waste bottles. Do not place water rinses in the halogenated waste.
- If you have a waste chemical whose disposal is not specified in the manual, ask your instructor or the Lab. Technician what you should do with it.

Proper segregation of wastes involves making sure that wastes within a bottle are compatible, but it also means that you should NEVER store the following types of wastes near each other:

- Acids and bases.
- Organics and acids.
- Cyanide, sulfide or arsenic compounds and acids.
- Alkali or alkali earth metals, alkyllithiums etc. and aqueous waste.
- Powdered or reactive metals and combustible materials.
- Mercury or silver and ammonium containing compounds.

If a bottle broke in a waste storage area where incompatibles were present, the results could be disastrous. Remember: incompatible bottles of wastes should be stored in separate cabinets, preferably as far apart as possible!

Chemical Waste Classification System

1. **Inorganic Acids -liquids and solids Examples**: Hydrochloric acid, Hydrofluoric acid, Sulfuric acid, Ferric Chloride, Copper (II)Sulfate.

2. **Organic Acids Examples**: Acetic Acid, Formic Acid, Acid and solvent mixtures, Trichloroacetic Acid, Acetic Anhydride.

3. **Oxidizing Acids** Examples: Perchloric Acid, Nitric Acid, Chromic Acid.

4. **Bases- Alkaline liquids and solids**. Examples: Hydroxides, Phosphates, Ammonia aqueous.

5. **Flammable Bases**- Amines, Silane Examples: Triethylamine, Ethylenediamine, Trimethylchlorosilane

6. **Flammable Liquids** Examples: Acetone, Toluene, Acetonitrile, Methanol, Ethyl Acetate, Heptane, Hexane, Oil Based Paint, Petroleum Distillates, Ethers (peroxide free), Tetrahydrofuran (peroxide free).

7. **Compressed** Gases and aerosols.

8. **Oil- pump** oil, crankcase oil, hydraulic oil.

9. **Toxic Organics** Examples: Chlorinated Solvents (non flammable), pesticides, Ethidium bromide, Acrylamide, Cyanides, Chloroform, Methylene Chloride(Dichloromethane), formaldehyde, phenol.

10. **Toxic Inorganic** Examples: Mercury, Lead, Zinc, Sodium Azide, Asbestos.

11. **Reactive**- reacts violently with water or air Examples: Grignard reagents (methyl magnesium bromide), Alkaline metals (Sodium, Potassium, Lithium), Reactive Halides (Acetyl Chloride), Sodium Borohydride.

12. **Oxidizers** Examples: All Nitrates (Sodium nitrate, silver nitrate, lead nitrate), Potassium Dichromate, Metal Peroxides.

13. **Organic Peroxides** Examples: Benzoyl peroxide, Methyl Ethyl Ketone Peroxide.

14. **High Hazard**- Peroxide Formers Examples: aged ether, tetrahydrofuran, 1,4-Dioxane, di- & tri- nitro compounds.

CHEMICAL HAZARD ASSESSMENT FORM

For Senior students carrying their projects, they have to fill a form before starting their experiments.

CHEMICAL HAZARD ASSESSMENT FORM For Senior project students		
Name	Date	Course
List all chemicals required for the project, including common chemicals, and amounts required		
Chemical name	Formula	Amount requested
Major hazards	Disposal	Personal Protective Equipment

Outline briefly what you intend to use these chemicals for.

CERTIFICATION:

I agree to follow department safety policies while using the material listed on this form.
I will use appropriate personal protective equipment for these material

Student's signature:	Date
Supervisor's signature:	Date

References

[1] "Safety in the Laboratory" Scilink from NSTA, 2005.

[2] "Safety Manual, Brock University':2005.

[3] "Safety in Academic Chernistry Laboratories', volume 1, 7th edition. Application of the American Chemical Society, 2003.
[4] MSM Chemical Waste Classification System, 2006.