

# Safety Guidelines for Students in Chemistry Laboratories

## Introduction

1. The goal of these guidelines is to teach students about proper and safe behavior in the lab, and to introduce them to the dangers of the lab, as well as the safety infrastructure and safety equipment that is at their disposal. We briefly detail how to deal with dangerous scenarios and how to assist in case of injury in the lab. These guidelines do not cover all of the hazards and do not excuse the student from being alert to additional hazards in the lab. Each student must bear in mind at all times, that he or she is not alone in the lab, and that their actions have consequences to other people around them.
2. These guidelines are aimed at all students in the physical chemistry labs in the department. Any behavior that does not follow these guidelines can be grounds for expulsion of the student from the Technion.
3. All students must read these safety instructions and sign the attached confirmation slip. Any student who has not done so, will not be allowed to enter the lab. The senior instructor of the lab will certify that the student has participated in the safety tutorial at the beginning of the lab, by signing the authorization slip. The student will retain his or her copy of these guidelines, and his/her signed confirmation slip will be kept in the department offices.

## General guidelines

1. Every student must be familiar with the safety infrastructure and with the emergency procedures, in case of an event, including:
  - a. Emergency exits and escape routes from the lab and the building.
  - b. Location of emergency switches to cut off electricity to the lab.
  - c. Location of main gas line to the lab.
  - d. Location of telephone and/or emergency call button and phone number in case of emergency.
  - e. Location and how to operate emergency showers and eyewash stations.
  - f. Location and how to operate fire fighting equipment.
  - g. Location of first aid equipment, its contents and how to use them.
  - h. Treatment of lab waste, including location of waste containers for solvents and sharp objects.
  - i. Location and how to operate equipment for neutralization and absorption of hazardous substances.
2. Students are allowed to work in the lab only when a lab employee, who is familiar with the work and its hazards, is present. In any case of doubt, consult your instructor or the supervising academic staff member.
3. You must know how to operate and turn off every device or instrument you use. Do not use any machine, equipment, device or substance that is broken or damaged. Inform your instructor immediately of any malfunction.
4. Plan your work ahead of time. Make sure you understand all of the procedures you will be performing. In any case of doubt, consult your instructor for detailed explanations.
5. Do not start any experiment without obtaining your instructor's permission.

6. It is forbidden to perform any experiment, measurement or procedure that has not been authorized by your instructor.
7. Do not touch any equipment, experiment system or chemicals that are not part of the lab you are performing.
8. Do not place any personal item at your lab station. Clear the work space from any object that is not part of the experiment being conducted.
9. Do not pour chemicals or any other substance into the sink or the water-pressure system, unless your instructor authorizes you to do so.
10. If you need to work with radioactive materials, you may do so only according to appropriate guidelines.
11. Volatile solvents must be kept in the fumehood at all times.
12. Do not bring food into the lab. Eating, drinking, and smoking in the lab are prohibited at all times.

### Personal safety equipment

Each student must use personal safety equipment at all times, including:

1. Safety glasses/goggles.
2. Do not work in the lab while wearing contact lenses.
3. Long lab coat, closed and with long sleeves.
4. Closed shoes, preferably leather or plastic (not fabric). Under no circumstances are you to wear sandals or flip-flops in the lab.
5. In some cases, you may be required to wear additional safety gear (safety mask, apron, or gloves), as per your instructor's guidelines.
6. Hair must be adequately tied back (and preferably, covered) during work in the lab.
7. Wash your hands frequently.

### Completion of work in the lab

1. When you are finished working in the lab, disconnect all systems and equipment from gas, water, electricity, according to your instructor's guidelines.
2. Return all chemicals and moveable equipment to their place, as soon as you are done using them.
3. Verify that there are no remnants of chemicals on the work surface or the floor. Clean any glassware and dirty surfaces according to your instructor's guidelines.
4. Decontaminate the work space and your personal safety gear, according to your instructor's guidelines. Wash your hands with soap and water when you are done working.
5. In case a chemical liquid or powder has been spilled, use the designated equipment to treat the spill, according to your instructor's guidelines. Before using any neutralization or absorption equipment, protect yourself with safety gear.
6. Handle chemical waste according to your instructor's guidelines. For example: neutralize acidic/basic waste; pour organic solvents into appropriate waste containers.
7. Systems that work continuously without presence of user:
  - a. Systems that are intended for continuous use and do not require the presence of the user will be located in the "night work" room only.
  - b. The system will be checked by an authorized person, to ensure all necessary safety measures.

- c. You must obtain written authorization from your instructor before using the system, and must work only according to your instructor's guidelines.

### Fire safety

1. Working in a laboratory naturally presents an increased fire hazard. You must act to minimize the chances of fire. Working with an open flame is allowed only with authorization from your instructor. Never leave an open flame unattended. Turn off the burner as soon as you finish working with it.
2. Always be prepared and ready to put out a fire. Memorize the location of the fire-extinguishing equipment and the emergency call button, and be familiar with the escape routes.
3. Use a fire extinguisher to put out fires. In case you made use of an extinguisher, let your instructor know immediately, to ensure it will be refilled. Do not use fire-extinguishing equipment for any other purpose.

### Electricity

1. Before using any electrical device, study the operating instructions.
2. Locate the emergency switch and learn how to use it. In case of electrocution or any malfunction, treat any electrical wire as though it is "live".
3. Do not modify or alter any electrical machine or device, or perform any modifications on the lab electrical system.
4. Do not use a device, plug, or any part of a system if it is broken or defective. Alert your instructor immediately.
5. Never touch an electrical instrument or device, wire, or plug with wet hands. In case the instrument or the area around it is wet, alert your instructor immediately.
6. If a flammable liquid has been spilled on or around an electrical device, there is danger of fire. Immediately remove people from the surroundings and alert your instructor. Do not turn on or off any electrical switches in the presence of a flammable liquid or a gas leak.
7. When you are finished working, disconnect all electrical devices, according to your instructor's guidelines.

### Chemicals

1. Bringing in or removing any chemicals from the lab will be done by the instructor or lab employees, only. Do not enter the chemical storeroom without authorization.
2. All chemicals must be transferred in appropriate vessels, which can contain them. Bottles and containers must be held appropriately (not by their necks).
3. Bottles and containers will be closed by a lid or stopper, except when their contents are being used. Never remove a stopper forcefully. If the stopper cannot be removed easily, consult your instructor.
4. Bottles and containers of chemicals must be placed at least 10 cm away from the edge of the table, and you must verify that they are positioned stably.
5. Before using any chemical, read the safety information on its label, box, or Material Safety Data Sheet.

6. If there is any concern that a chemical or its container may be defective or contaminated, alert your instructor immediately.
7. Working with flammable liquids (alcohols, ethers, acetone, etc.)
  - a. You may only work with these liquids in a fumehood.
  - b. Never place a container of these liquids near an open flame, heat source, or spark source. Keep acids and reactive substances away from flammable liquids.
  - c. For distillation, use only the equipment authorized by your instructor, and use it only inside the fumehood.
  - d. Remember that the vapor of a flammable liquid can spread and be ignited (by any source, including a spark, heat source, or open flame), even from a distance of several meters away.
8. Working with acids and bases
  - a. Remember that dilution of acids and bases can be highly exothermic. Therefore, never pour water into an acid, rather, dilute the acid by pouring it into water, while constantly stirring and cooling.
  - b. When using a concentrated acid or base, protect your eyes with safety glasses. Protect your skin with gloves and appropriate clothing (like an apron), according to the manufacturer and your instructor's guidelines.
  - c. Neutralize acidic and basic waste before discarding them, according to your instructor's guidelines.

### Working with pressurized gas

1. Before you work with gases in the gas tanks, obtain detailed instructions from your lab instructor, including how to open and close the valves and regulators. Use only designated equipment that is appropriate for gas tanks.
2. Before operating a gas system, obtain your instructor's authorization and verification that the system is in working order.
3. Gas tanks must be anchored to a wall or table (with a chain or other suitable setup). You may not move gas tanks, unless specifically instructed by your instructor.
4. When opening or closing the valves of a gas tank, stand at the opposite end of the tank, and wear appropriate safety gear for your eyes and face. When working with corrosive gases, HBr and HCl, you must wear gloves and a face mask and perform the procedure in a fumehood.
5. When you are finished using the gas, close the tank's valve. Dismantling the connections will be done according to your instructor's guidelines.
6. In case of a malfunction, close the valve of the tank as far as you can and notify your instructor immediately.

### Working in the fumehood

1. Any action that may result in release of vapor, gas, or spray must be performed in a working fumehood.
2. Any action that may result in spread of powder must be done in a closed environment, such as a non-working fumehood.
3. Before beginning to work in a fumehood:

- a. Familiarize yourself with the location of the various switches that control the fumehood (ventilation, electricity, gas, pressurized air, vacuum, etc.).
  - b. Turn on the ventilation and verify that the alarm system indicates proper air flow. Report any malfunction to your instructor immediately.
1. Leave at least 10 cm of space between the edge of your workspace and the edge of the fumehood.
  2. Keep the sash window of the fumehood closed (down) as much as possible, especially when working with systems under pressure, vacuum systems, and/or extreme temperatures.

### Miscellaneous

1. Do not use your mouth to suction off any chemical. Use only designated pumping equipment.
2. Check each glass or plastic container before you use it, to make sure it is not cracked, broken, dirty or otherwise defective. Never use a defective container.
3. When inserting a glass tube into a rubber tube, stopper, or similar item, protect your hands with an appropriate glove (thick) or cloth. If the insertion does not occur easily, ask your instructor for help. Do not use excessive force.
4. Before using a chemical, learn what happens to that chemical upon contact with water. For example, alkaline metals cannot come into contact with water. The symbol of a substance that reacts with water: W.
5. Wash all of the glass and plastic-ware you used during the experiment, only after removing all remnants of the reaction, according to your instructor's guidelines. For example: neutralization of acids and bases, removal of organic solvents to waste containers.
6. When using a vacuum pump, place the outlet tube outside the lab (or into a working fumehood). Check with your instructor where the gas trap is located and what type of trap it is, if dangerous gases may be released during the experiment.

### Emergency procedures

1. In any case of an emergency (spill, spray, ignition, etc.) remove people from the area and notify your instructor immediately. If the hazard spreads rapidly, immediately evacuate the lab.
2. In case of an emergency, notify the campus security headquarters immediately. Make sure to report the type of emergency, its location, and the name of the lab supervisor.
3. In case there are any wounded people, after administering first aid on the spot, evacuate them to the nearest hospital.
4. In case of contact with a chemical, the type of first aid depends on the type of hard:
  - a. Foreign body or chemical in the eye  
Wash the eye thoroughly at the eyewash stand for at least 15 minutes. It is mandatory for the wounded person to see a doctor. First aid will be administered on the spot by one of the peers/friends.
    - (1) Acid in the eye - Wash immediately and thoroughly with copious amounts of water, using the designated cup or eyewash stand. Try to keep your eyes open.
    - (2) Base in the eye - Same as before, but also wash with 1% boric acid solution
    - (3) Bromine in the eye - Wash immediately and thoroughly with copious amounts of water and then with 1% sodium bicarbonate solution.

(4) Glass in the eye – remove the piece of glass gently with tweezers or by washing. Call a doctor **immediately**.

b. Damage to the skin by chemical reagents

Remember! Immediate treatment of the damaged tissue, with the appropriate washing substance, is critical and can prevent greater damage and future pain to the victim.

(1) Acid on the skin – wash immediately with copious amounts of tap water, then with saturated bicarbonate solution, and finally with water again.

(2) Base on the skin – wash with copious amounts of water, then with 1% acetic acid solution, and finally with water again. If the wound is serious, evacuate the victim to the hospital immediately.

(3) Bromine on the skin – wash well with petroleum ether (80-100), then rub with glycerol. Make sure to rub the glycerol in well, so that it will penetrate the skin and react with the bromine. Wipe, dry, and apply burn ointment. An alternative treatment: pour saturated sodium thiosulfate solution on the wounded area and then wash with water.

(4) Phenol on the skin – wash immediately with copious amounts of ethanol.

(5) Other chemicals – wash immediately with arzol and then with soap and warm water.

c. Damage to the skin by chemical powders. Remove the contaminated clothing immediately, brush the powder off with a soft brush. Wash the damaged area for at least 15 minutes.

d. Burns

(1) Minor burn – the skin is intact – immerse skin in ice-bath.

(2) Serious burn – the area of the burn is large or the skin is broken – remove clothing from the area by cutting off and evacuate the victim to the hospital.

5. Emergency procedure in case of fire

a. Using the extinguisher – allowed only to those who have been instructed on how to use the extinguisher. Using a water hose to put out a fire is forbidden.

b. Clothes on fire –

(1) Prevent the burning person from running around and exacerbating the fire.

(2) Smother the fire by wrapping the person with a thick blanket or lab coat. If possible, use an emergency shower or strong current of water.

(3) Do not extinguish the fire with an extinguisher.

c. Chemical fire

(1) Immediately extinguish all of the flames in the area, unplug all electrical devices from their sockets, and remove flammable substances and solvents.

(2) Small fire – smother the fire with a container such as a beaker, Erlenmeyer, or oil bath.

(3) Large fire – put the fire out using an extinguisher containing CO<sub>2</sub>. Aim the extinguisher at the edges of the fire first, then move towards the center.

(4) Do not use water to extinguish a chemical fire. Water not only does not help, it often exacerbates the fire.

(5) In case of oil or organic solvent fire. Use sand to put out the fire.

## 6. Cuts

- a. If the cut is not deep, let it bleed for a few minutes, check to see that no more pieces of glass remain in the cut and disinfect with alcohol, then bandage with gauze or a band-aid.
- b. In case of a deep cut – evacuate the victim to the nearest hospital. On the way, check to see if the cuts is bleeding by pressing around the wound.
- c. Wound resulting from contact with chemicals – wash immediately with copious amounts of water to remove any remnants of the chemical and prevent worse pain at a later stage.
- d. If the wound was caused by a contaminated item, check the victim's vaccination status against tetanus.

## Affirmation and Agreement

I, \_\_\_\_\_, hereby confirm that I have read the Safety Guidelines for Students in the Physical Chemistry Laboratories”, which were given to me at the beginning of the course, and certify that:

I affirm that I understand that guidelines and, in addition, that I have been instructed on proper work in the chemistry laboratories. I affirm that I know and understand the safety guidelines and I accept responsibility for acting in accordance with these guidelines and any further guidelines I will receive, either printed or verbally, by lab employees.

I am aware that there are various hazards in working in a chemical lab, which can be caused by my own actions, the actions of my peers and lab employees, or by exposure to chemical substances, or by technical equipment in the lab.

I am aware that during my work in the chemical lab, I might be exposed to chemical substances that are known to be dangerous, including: explosives, toxins, flammable materials and carcinogens (most chemical compounds are dangerous at some level). I affirm that I will do everything possible, within the guidelines, in order to minimize my exposure and the exposure of others to these substances.

I am aware that chemical substances that are considered safe today, may turn out to be hazardous in the future. Future research may show that substances that currently have low danger ratings are actually extremely dangerous.

I am aware that operating machinery and equipment in the lab may result in injury, as a result from incorrect or unsafe usage, committed by myself or others, or from malfunctions in the equipment.

I do not suffer from a medical condition or any other handicap that may affect my work in the lab or affect my own personal safety or the safety of others. Specifically, I do not suffer from poor eyesight or coordination problems.

For persons wearing eyeglasses: I have adjusted to my eyeglasses and they fully correct my eyesight.

I do not suffer from a medical condition that may be exacerbated or cause me harm during my work in the lab.

If you suffer from a medical condition, or are allergic to any substance, you must contact an occupational physician and obtain written authorization to work in the lab. Your signature on this document certifies that you obtained the necessary permission from an occupational physician.

I affirm that I will notify the Technion, in writing, of any change that may occur in my condition or ability to adhere to this agreement, as soon as I become aware of it. In addition, I affirm that I will immediately notify the Technion, in writing, of any malfunction, defect or problem I may encounter, which may affect the wellbeing, health or safety of the people working in the lab or in the surrounding areas.

Surname: \_\_\_\_\_ First name: \_\_\_\_\_

ID #: \_\_\_\_\_ Department: \_\_\_\_\_

Date: \_\_\_\_\_ Student's signature: \_\_\_\_\_

Name of instructor: \_\_\_\_\_ Instructor's signature: \_\_\_\_\_