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COURS SUR : SÉCURITÉ DE LABORATOIRE

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This handout contains the content of a course taught in the Department of Chemistry at the Faculty of Exact Sciences of Mustapha Stambouli University of Mascara. It is intended for second-year Master's students in Macromolecular Chemistry.

Laboratory safety is a cornerstone of experimental chemistry. More than just following rules, it reflects a professional and scientific culture that every researcher must embrace from the start of their training. This course introduces second-year Master's students in Chemistry to the key principles of safety, including the management of chemical, physical, and biological risks, as well as accident prevention in research settings.

The goal is to develop responsible habits and a rigorous approach to experimental work, enabling future chemists to operate safely while respecting people, equipment, and the environment.

In today's context of intensifying research and stricter regulations, mastering laboratory techniques is not enough; students must also adopt behaviors and procedures that ensure ethical and safe practice.

This module combines theory, real-case studies, and practical exercises to firmly establish good safety practices that students can carry forward throughout their careers.

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Generalities
General Safety Rules

Generalities

General Safety Rules

Objectifs :

- **Identify hazards**
- **Understand prevention principles**
- **Adopt safe behaviors**
- **Be familiar with safety signage**
- **Master emergency procedures**
- **Comply with regulations**
- **Develop a proactive attitude**

The teaching of general safety rules aims to ensure the protection of individuals, laboratory facilities, and the environment during experimental activities. These objectives are intended to foster a genuine culture of safety within the laboratory.

1. **Finalité :**

The ultimate goal is to train chemists who are autonomous, aware of their responsibilities, and capable of integrating safety as a natural and essential component of their scientific practice.

1. Introduction

Over the past century, chemistry has enhanced our understanding of the physical and biological world, as well as our ability to manipulate it. Most of the things surrounding us in modern life result from synthetic or natural chemical processes, and the work carried out in chemistry laboratories around the world continues to drive significant advances in science and engineering.

Since the age of alchemy, laboratory chemicals have demonstrated both spectacular and hazardous properties. In the past, self-sacrifice in the name of science was considered acceptable. In a speech delivered in 1890, the great chemist August Kekulé stated:

"When I was working in his laboratory, Liebig told me: 'If you want to become a chemist, you must ruin your health. Whoever today does not ruin their health through study will achieve nothing in chemistry.'"

Today, this attitude seems as outdated as al chemy it self. Over the years, special techniques, procedures, environmental controls, and equipment have been developed to handle and manage chemicals safely. The development of a “safety culture” has led to laboratories becoming safe and healthy environments for teaching, learning, and research.

Creating a safety culture requires recognizing that the well-being of everyone depends on both teamwork and personal accountability. This culture must be internalized as part of each individual's attitude and should not rely solely on externally imposed regulatory requirements.

Learning to participate in routine risk assessment procedures, planning, and consideration of the worst-case scenarios (for oneself and for colleagues) is as much a part of scientific education as mastering theoretical context or the detailed protocols required for experiments. Cultivating prudent attitudes and habits is an essential component of chemical education at all levels and remains critical throughout a chemist's career.

University research and teaching laboratories bear a particular responsibility: to instill in their students an unwavering attitude of safety and caution in the laboratory. Teaching such practices must be a priority, especially as instructors prepare students for careers in industrial, governmental, academic, and medical laboratories. By promoting safety throughout the course of study, instructors influence not only their students but also everyone who will share their students' future work environments.

A safety culture within an institution establishes a solid foundation upon which a reliable laboratory chemical management program can be built. The success of a safety program requires the daily commitment of every individual in the institution. People at all levels must understand the importance of minimizing the risk of exposure to hazardous materials in the laboratory and must collaborate toward this goal.

2. Définition of a Laboratory :

A laboratory is a space designed for scientific, research, or analytical activities. Laboratories can be specialized (medical biology, chemistry, physics, etc.) and are intended for conducting experiments, analyzing samples, or carrying out research projects. The results obtained are used for medical diagnosis, quality control, or the advancement of scientific knowledge.

a. Key General Safety Rules in a Laboratory:

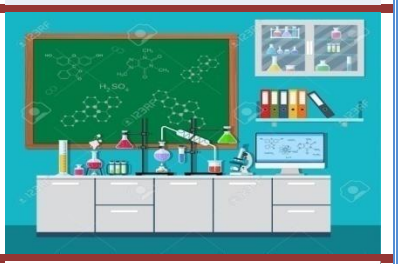
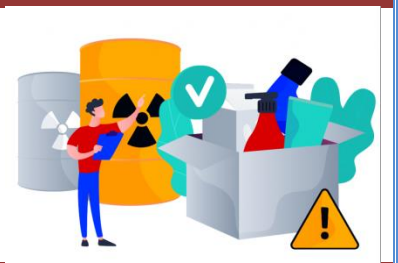
Safety is defined both by the absence of hazards and by a sense of confidence and peace of mind. In the laboratory, where manipulations involving complex equipment or toxic, flammable, or explosive substances are inherently risky, safety is of paramount importance. Such activities can lead to accidents or poisoning, with effects that may be immediate or delayed.

In the face of these risks, all personnel must develop a genuine safety culture. This involves:

- **Know and rigorously follow regulations.**
- **Understand the specific risks associated with each procedure.**
- **Be able to respond effectively in the event of an accident or fire.**

i. Obligations :

Wash hands thoroughly upon entering and leaving the laboratory, and before eating.	
Identify the locations of safety equipment: emergency safety shower, portable first-aid shower, fire extinguisher, eyewash station, fire blanket, fire hose, etc.	
Remove all jewelry, avoid wearing makeup, and tie back long hair.	
Wear a cotton lab coat rather than polyester (cotton burns when exposed to flame, while polyester melts and sticks to the skin).	

Use appropriate protection during procedures (wear safety goggles, mask, gloves, apron, etc.) to guard against heat, solvents, cuts, impacts, radiation, and other hazards. See Personal Protective Equipment (PPE).	
Do not leave any items on the floor or on the laboratory benches.	
Do not store hazardous containers (glass bottles, etc.) at height or near the edge of a surface.	
Avoid accumulating of large quantities of matérials (solvents, packaging, etc.) in the laboratory.	
Secure gas cylinders firmly and keep them away from any heat source. Store them outdoors (request external supply if needed).	
Store équipement as soon as it is no longer needed to avoid obstruction during subsequent procedures, and also learn to manage your workspace and available time effectively.	

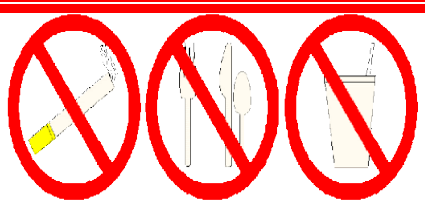
All containers **must** without exception have a label indicating the name, chemical formula, pictogram(s), and safety code(s) as defined by the Globally Harmonized System (GHS).	
Read the instructions for any commercial équipement or container.	
Inspect glassware before use (discard any cracked, chipped, or star-shaped glass).	
Refer to the pictograms when present and to the GHS codes.	
Place hazardous containers in secure, protected locations.	

THINKING

"SAFETY" MEANS THINKING BEFORE

ACTING.

ii. Interdictions :

Do not smoke, drink, prépare food, or eat in the laboratory.	
Do not work alone.	
Mouth pipetting is strictly prohibited in the laboratory due to the risks associated with chemicals. Always use a pipette aid (or pipette bulb) to draw, hold, and dispense liquid in a pipette.	
It is strictly forbidden to pour chemicals (flammable, hazardous, explosive, etc.), biological materials, or radioactive substances down the sink.	
Do not handle flammable substances near an open flame or hot surface.	
Do not run.	
Do not handle chemicals without appropriate safety goggles, lab coat, and gloves (depending on the substances: latex, nitrile, vinyl, etc.).	  

Any negligence exposes both the individual and their colleagues to potentially catastrophic consequences, fully engaging their responsibility. The following sections will address the two essential aspects of ensuring safety: prevention and response. By integrating prevention and response into everyday laboratory work, students and researchers develop a proactive safety mindset, reducing risks and ensuring a secure environment for everyone.

Laboratory safety encompasses multiple aspects, including technical prevention, adherence to basic instructions, personnel training, work organization, and the quality of interpersonal relations.

While performing their work, laboratory personnel are exposed to chemical, physical, biological, and radiological hazards.

These hazards can be avoided or minimized if basic safety rules are followed. In a laboratory, one must adopt a thoughtful attitude to avoid endangering one's own life or that of others.

3. Definition of Prevention :

Prevention is the first essential step in ensuring safety. Preventing accidents involves both:

- A thorough understanding of the tasks to be performed;
- Adherence to safety instructions and posted signs;
- Appropriate conduct in the laboratory;
- Effective use of personal protective equipment (PPE);
- Proper labeling, storage, and disposal of chemicals.

i. General Principles of Prevention

Occupational risk prevention aims to implement measures that protect the physical and mental health and safety of laboratory personnel, improve working conditions, and promote their well-being. This approach is based on the general principles of prevention:

- ✓ **Avoid** risks
- ✓ **Assess** risks that cannot be avoided
- ✓ **Combat** risks at their source
- ✓ **Adapt** work to the individual

- ✓ **Take** into account the state of technical development
- ✓ **Replace** what is dangerous with what is not, or with something less dangerous
- ✓ **Plan** prevention by integrating, in a coherent way, technology, work organization, working conditions, social relations, and environmental factors
- ✓ **Give** priority to collective protection over individual protection
- ✓ **Provide** appropriate instructions to laboratory personnel

ii. Understanding the Work to Be Performed:

It is essential to gather as much information as possible about the chemicals and equipment used, as well as the techniques and chemical reactions involved. In case of any doubt regarding the risks associated with a procedure, **one should seek advice from experienced personnel, consult the safety data sheets**, and strictly follow established protocols before undertaking any operation.

This thorough knowledge allows one to:

- **Identify** and anticipate potential risks.
- **Select** appropriate protective equipment.
- **Adapt** working methods to minimize hazards.
- **Ensure** the safety of oneself, colleagues, and the environment.

En résumé, In summary, thorough preparation and a complete understanding of the work to be performed are the essential **first steps in preventing accidents and ensuring laboratory safety.**

iii. Laboratory Prevention Approach

a. A Pragmatic Approach:

Risk prevention involves implementing concrete actions to protect the health and safety of laboratory personnel. It is based on the following principles:

- Assess risks before any procedure.
- Consider human factors in work organization.
- Monitor technological developments to adapt practices to new techniques.
- Continuously adjust preventive measures to the situations encountered.
- Prevent risks at their source and prioritize collective protection over post-incident corrections or individual protection alone.

b. A Dynamic Approach:

Laboratory prevention is a continuous process of improving working conditions and safeguarding against hazards. This improvement should:

- Take into account material and technical possibilities.

- Adapt to mission requirements and technological advances.
- Respect safety limits and avoid exceeding hazard thresholds.

c. An Organizational Approach

Effective prevention requires clear management and the participation of all laboratory members. This includes:

- **Organizing** work and planning tasks.
- **Arranging** suitable working conditions.
- **Promoting** communication and relationships within the team.
- **Considering** environmental and psychosocial factors.

d. Objectives and Priorities

The main objectives of laboratory prevention are:

- **Protect** the physical and mental health of all members.
- **Ensure** the safety of procedures, equipment, and substances.
- **Promote** cooperation and coordination among all participants.
- **Maintain** a continuous process of improving practices and working conditions.

Priorities to Follow:

1. **Eliminate** or reduce the risk at its source.
2. **Implement** appropriate collective protection measures.
3. **Use** individual protection for residual risks.

e. Practical Measures to Implement

To apply this approach, it is recommended to:

- **Assess** risks and adapt workstations and tasks to members' capacities.
- **Organize** and delegate prevention responsibilities.
- **Regularly** train and inform all members about risks and best practices.
- **Involve** members in decision-making and implementation of safety measures.
- **Plan and monitor** preventive actions in a coherent and continuous manner.

4. Safety is a Shared Responsibility

Safety can be defined as:

- A situation in which a person or object is not exposed to any danger, physical harm, or accident.
- A state that inspires confidence, characterized by the absence of accidents or unacceptable risks.
- A set of preventive and emergency measures essential to ensuring laboratory personnel protection under all circumstances.
- An approach that is not limited to specialists: everyone contributes.
- An individual responsibility, involving care for one's own safety and that of others.
- A daily behavior at all levels, particularly from laboratory supervisors.

Thus, anyone within the university community who handles or supervises hazardous materials must store, transport, use, and dispose of them in accordance with current laws and regulations. The objective is to safeguard personal health, safety, and physical integrity, protect colleagues, preserve the environment, and avoid harm to living organisms.

5. Intervention

5.1. Emergency Procedures in the Laboratory: Importance of Response

Response is a major pillar of laboratory safety. Rapid, structured, and appropriate action can limit the consequences of an incident, protect people, and prevent risk escalation. For this reason, every laboratory user must know the emergency procedures, understand their purpose, and know how to act according to the situation encountered.

5.2. Central Role of Response in Emergencies

Effective response relies on coordination between teams responsible for planning, training, and incident management. These groups together establish a comprehensive emergency response system covering chemical accidents, fires, spills, and technical failures. Training laboratory members is essential: everyone must be able to identify hazards, apply initial response measures, and support specialized teams' actions.

5.3. Immediate Reaction in an Emergency

In an emergency, response must be immediate. This includes:

- Contacting the safety service without delay.
- Providing clear information about the nature of the incident.
- Evacuating or securing the area if it can be done safely.

The speed of these actions allows intervention teams to act promptly and reduce hazards.

5.4. Response During Evacuation

When an alarm sounds or an evacuation order is given, the response consists of leaving the premises in an organized manner and following instructions from supervisors. They direct occupants to assembly points and ensure that no one remains exposed in hazardous areas.

a- Shelter-in-Place Response

Depending on the nature of the hazard, the appropriate response may be to remain indoors. Shelter-in-place protects occupants when external risks make evacuation dangerous. Instructions include closing openings, limiting movement, and awaiting directions from supervisors.

b- Response to Hazardous Spills

A spill requires a response proportional to its magnitude:

- For a small spill, trained laboratory members can intervene following established procedures.
- For a major spill, immediately alert safety supervisors and evacuate nearby personnel. Informing colleagues, securing the area, and avoiding unnecessary exposure are integral parts of a proper response.

c- Importance of Safety Data Sheets (SDS) in Response

SDS are an essential reference: they indicate emergency measures to apply in case of contact, inhalation, fire, or spill. Consulting them beforehand allows personnel to know the necessary actions and respond effectively in critical situations.

5. Applications

Exercise 1 — Responding to a Hazardous Substance

Question :
Which emergency protective equipment should be used when working with sulfuric acid? Consult the corresponding Safety Data Sheet (SDS) and identify:

- The essential protective equipment,
- The response measures in case of contact or spill.
- Immediate actions to prevent the risk from worsening.

Exercise 1 Solution: Emergency Response to Sulfuric Acid

1. **Required Emergency Protective Equipment :**
   When handling sulfuric acid, the SDS recommends using the following equipment:

- **Personal Protection**

- Gloves resistant to corrosive chemicals (thick nitrile, butyl, or PVC, according to SDS instructions).
- Safety goggles or face shield to prevent highly dangerous eye splashes.
- Laboratory coat or apron resistant to chemical agents.
- Closed-toe shoes (ideally slip-resistant and splash-resistant).
- Respiratory protection if ventilation is insufficient or vapors are present (appropriate mask with cartridge for acid vapors).

- Nearby Collective Equipment

- Safety shower
- Eyewash station
- Fume hood for procedures generating vapors
- Kit de déversement :
  - Acid neutralizer,
  - Compatible chemical absorbents,
  - Recovery bucket.

2. Response in Case of a Spill

a) Small Spill
You can intervene directly if you are trained:

1. Immediately wear appropriate protective equipment.
2. Confine the area and inform nearby personnel.
3. Neutralize with a suitable acid-absorbing product (never use pure sodium carbonate, which reacts violently if added too quickly).
4. Absorb and collect the substance in a container designed for this purpose
5. Clean the area with plenty of water.
6. Dispose of waste according to chemical waste management procedures.

b) Major Spill

One must respond without putting one self at risk:

1. Evacuate the area immediately.
2. Alert the safety supervisors or emergency response team.
3. Ventilate if possible without risk (turn off heat sources).
4. Do not attempt cleanup if untrained or inadequately protected.

3. Response in Case of Contact

a) Skin Contact

- Rinse immediately with plenty of water for at least 15 minutes.
- Remove contaminated clothing.
- Call for medical assistance or go to a medical facility.

b) Eye Contact

- Continuously rinse eyes at an eyewash station for a minimum of 15 minutes.
- Keep eyelids open during rinsing.
- Seek medical attention immediately.

c) Inhalation

- Move the person to a well-ventilated area.
- Consult a healthcare professional.

d) Ingestion (rare but possible)

- Never induce vomiting.
- Rinse the mouth with water.
- Call emergency services immediately.

4. Immediate Actions to Prevent Risk Escalation

- Alert all personnel in the area.
- Restrict access to the contaminated zone.
- Turn off heat sources or ignition points.
- Ensure adequate ventilation if it can be done safely.
- Notify the emergency response team or laboratory supervisors.
- Provide the SDS to the response team to facilitate their intervention.

EXERCISES ON EMERGENCY RESPONSE

Exercise 1 – Spill of a Corrosive Substance (Scenario)

A student is handling hydrochloric acid. A bottle falls, causing a significant spill on the floor. An irritating odor spreads.

Questions:

1. What is the first action to take?
2. Who should be notified immediately?
3. Which actions are prohibited in this situation?
4. What should the emergency response team do upon arrival?

Exercise 2 – Fire on a Laboratory Bench
A small fire breaks out due to a Bunsen burner and a flammable solvent.

Questions:

1. Which emergency equipment can be used?
2. In which cases should the fire extinguisher not be used?
3. What should a person do if the fire becomes uncontrollable?
4. What procedure should be followed after the fire is extinguished?

Exercise 3 – Chemical Splash in the Eyes
A technician gets a drop of ammonia in their eye.

Questions:

1.What is the immediate intervention to apply?

2.For how long should the eyes be rinsed?

3.Should help be called? Why?

Exercise 4 – Emergency Alarm
The alarm siren sounds in the building.

Questions:

1. What immediate actions should be taken?
2. Where should one go?
3. What role do the evacuation supervisors play?
4. What risks does a person face if they refuse to leave their workstation?

LABORATORY SAFETY

EXERCISES ON LABORATORY PREVENTION

(Designed to assess understanding of good practices before a hazard occurs.)

Exercise 5 – Identifying Prevention Errors

In the following scene, several prevention errors are made:
- A bench cluttered with papers, solvents, and glassware.
- A fume hood used as storage space.
- A student wearing neither a lab coat nor safety goggles.
- A chemical product with no label.
- An open bottle of flammable solvent near a heat source.

Question:
List all prevention errors and explain why each one is hazardous.

Exercise 6 – Safety Data Sheet (SDS) Analysis

Choose a Safety Data Sheet for a product used in the laboratory.

Questions:

1. What hazards are listed in the “Hazards” section?
2. What preventive measures are recommended?
3. Which PPE must be used?
4. What storage conditions are required to prevent accidents?
5. What first-aid measures are recommended in case of exposure?

Exercise 7 – Risk Assessment for an Experiment

A reflux setup is used to heat an alcoholic solution.

Questions:

1. What potential risks does this procedure involve?
2. What preventive measures must be taken before starting?
3. What protective equipment should be used?
4. Which safety rule helps prevent a fire?

Exercise 8 – Collective vs. Individual Prevention

Classify the following items as collective prevention or individual prevention:
- Fume hood
- Fire extinguisher
- Safety goggles
- Eye-wash station
- Lab coat
- General ventilation system
- Protective gloves
- Smoke detectors

Exercise 9 – Proper Behavior in the Laboratory

A group of students is preparing a solution. One is eating a sandwich, another is using a mobile phone over the bench.

Questions:

1. Which behaviors are prohibited?
2. Why do they pose a danger?
3. Which prevention rules should have been followed?

Exercise 10 – Preventing Accidents Involving Chemical Products

For each situation, propose an appropriate preventive measure:

1. You receive a product in an unlabelled container.
2. You must transfer a concentrated acid.
3. You must work with a toxic volatile product.
4. You notice a crack on a bottle of flammable solvent.
5. You must heat a flammable solution.

CORRECTIONS — EMERGENCY RESPONSE

Exercise 1 – Spill of a Corrosive Product

1. **First action:**
   → Move away immediately and evacuate the area without exposing yourself.
2. **Who to alert?**
   → Safety officers / emergency response team / laboratory supervisors.
3. **Prohibited actions:**
   • Do not touch the product.
   • Do not attempt to clean a major spill yourself.
   • Do not inhale vapors.
   • Do not pour water directly onto concentrated acid.
   • Do not remain in the contaminated area.
4. **Actions by the response team:**
   • Secure and delimit the area.
   • Ventilate if possible.
   • Neutralize and absorb with suitable materials.
   • Collect waste in approved containers.
   • Assess residual risks.

Exercise 2 – Bench Fire

1. **Usable equipment:**
   • CO_2 or powder extinguisher
   • Fire blanket
   • Immediate shutdown of gas (if safe to do so)
2. **When not to use the extinguisher:**
   • If the fire is too large
   • If ceiling or furniture start burning
   • If smoke becomes dense
   → Evacuate and call emergency services.
3. **If the fire becomes uncontrollable:**
   → Evacuate, close the doors behind you, and alert the intervention team.
4. **After extinction:**
   • Ensure there is no re-ignition.
   • Ventilate the room.
   • Report the incident.
   • Clean and dispose of residues following procedures.

Exercise 3 – Chemical Splash in the Eyes

1. **Immediate action:**
   → Use the eye-wash station immediately.
2. **Rinsing duration:**
   → At least 15 minutes, keeping eyelids open.

3. **Should help be called?**
   → Yes. Chemical exposures can cause serious injury.
   Medical evaluation is essential.

Exercise 4 – Emergency Alert

1. **Immediate behavior:**
   → Leave the premises quickly and calmly.
2. **Where to go:**
   → Proceed to the assembly point.
3. **Role of evacuation supervisors:**
   • Guide occupants
   • Check rooms
   • Assist individuals needing help
   • Communicate information to intervention teams
4. **Risks of refusing to evacuate:**
   • Danger to personal safety
   • Interference with rescue operations
   • Endangering others
   • Possible disciplinary sanctions

Exercise 5 – Identifying Prevention Errors (Correction)

1. Cluttered bench → risk of tripping, fire, contamination.
2. Fume hood used as storage → blocked airflow, loss of effectiveness.
3. No PPE (coat/goggles) → exposure risk.
4. Unlabelled product → hazard cannot be identified.
5. Flammable solvent near flame → fire or explosion risk.

Exercise 6 – SDS Analysis (General Example)

1. Identified hazards: corrosive, toxic, flammable, irritant, etc.
2. Prevention: ventilation, PPE, use in fume hood.
3. PPE: gloves, goggles, lab coat, respirator if needed.
4. Storage: ventilated cabinets, away from heat and incompatibles.
5. First aid: rinsing, medical assistance, evacuation of the area.

Exercise 7 – Risk Assessment

1. Risks: fire, burns, toxic emissions.
2. Prevention: fume hood, removing ignition sources, proper equipment.
3. PPE: goggles, coat, gloves, thermal protection if needed.
4. Rule: never heat a flammable solvent in open air; use a closed reflux system.

Exercise 8 – Collective vs Individual Prevention

Collective prevention:
- Fume hood
- Fire extinguisher
- Eye-wash station
- Ventilation system
- Smoke detectors

Individual prevention:
- Safety goggles
- Lab coat
- Gloves

Exercise 9 – Proper Behavior

1. Prohibited behaviors: eating, using a phone.
2. Why dangerous: contamination, exposure, loss of focus.
3. Rules not respected: no eating, no distractions, hygiene and vigilance rules.

Exercise 10 – Preventing Chemical Accidents

1. Unlabelled flask → do not use; discard or relabel per procedure.
2. Transferring acid → use a funnel, proper gloves, eye protection, ventilation.
3. Toxic volatile product → work in a fume hood.
4. Cracked solvent bottle → isolate and dispose per procedure.
5. Heating flammable solution → never use open flame; use water bath or heating plate.

MCQ – Laboratory Safety (20 Questions)

1. **Laboratory safety mainly depends on:**
   A. The supervisor only
   B. Each member of the laboratory
   C. Safety equipment only
   D. Written procedures only

2. **Prevention essentially consists of:**
   A. Reacting after an accident
   B. Avoiding the accident before it occurs
   C. Punishing careless people
   D. Tidying the laboratory

3. **A cluttered workbench can lead to:**
   A. Better productivity
   B. A pleasant atmosphere
   C. Risks of accidents or contamination
   D. No real risk

4. **Personal protective equipment (PPE) does NOT include:**
   A. Lab coat
   B. Safety goggles
   C. Gloves
   D. Open-toed shoes

5. **Chemical products must always be:**
   A. Stored on the workbench to save time
   B. Labeled and stored according to their nature and hazards
   C. Mixed to optimize space
   D. Left open to avoid internal pressure

6. **A Safety Data Sheet (SDS) is used to:**
   A. Provide only the chemical formula
   B. Understand hazards, handling procedures, and first aid
   C. Replace training
   D. Identify the color of the product

7. **In case of a major spill of a hazardous product, the first action is to:**
   A. Clean immediately
   B. Leave and secure the area
   C. Add water
   D. Ignore the incident

8. **When a chemical splashes into the eyes, rinsing must last:**
   A. 30 seconds
   B. 2 minutes
   C. 5 minutes
   D. At least 15 minutes

9. **A solvent fire should preferably be extinguished with:**
   A. Water
   B. Hands
   C. A CO_2 or powder extinguisher
   D. A damp cloth

10. **In an evacuation situation, one must:**
    A. Run to get out faster
    B. Go back to retrieve personal items
    C. Proceed calmly to the assembly point
    D. Turn off the lights before leaving

11. A fume hood must be used for:
    A. Colorless products
    B. Volatile, toxic, or irritating substances
    C. Distilled water
    D. Sugary solutions

12. Storage incompatibilities concern:
A. Products that react with each other
B. Products of the same color
C. Expired reagents only
D. Solvents diluted in water

13. Gloves are ineffective if:
A. They are suitable for the product
B. They are clean
C. They are torn or unsuitable
D. They are worn for a long time

14. Risk assessment consists of:
A. Identifying hazards and estimating associated risks
B. Guessing possible accidents
C. Reading only the SDS
D. Tidying the laboratory

15. A cracked bottle containing a hazardous product must be:
A. Ignored
B. Used quickly
C. Thrown in a regular trash bin
D. Set aside and handled according to procedure

16. Collective prevention includes:
A. Safety goggles
B. Lab coat
C. Fume hood
D. Gloves

17. Individual prevention includes:
A. Ventilation system
B. Safety shower
C. Gloves and goggles
D. Fire extinguisher

18. Which behavior is prohibited in the laboratory?
A. Eating or drinking
B. Wearing a lab coat
C. Tidying one's workspace
D. Consulting an SDS

19. Before using a chemical product, you must:
A. Rely on intuition
B. Read its label and SDS
C. Work without gloves if in a hurry
D. Heat the product to observe it

20. Emergency intervention aims to:
A. Worsen the risks
B. Protect people and limit damage
C. Test personnel skills
D. Frighten laboratory members

Solution :

1	2	3	4	5	6	7	8	9	10
B	B	C	D	B	B	B	D	C	C
11	12	13	14	15	16	17	18	19	20
B	A	C	A	D	C	C	A	B	B

Specific Hazards

Safety hazards exist in every workplace, but how do you know which ones have the most potential to harm workers? By identifying hazards at your workplace, you will be better prepared to control or eliminate them and prevent accidents, injuries, property damage, and downtime.

First of all, a key step in any safety protocol is to conduct a thorough safety hazard assessment of all types of environments and equipment. Before getting started with the list below, we encourage you to download a copy of our hazard assessment Guide. You can walk through the steps necessary to assess your workplace safety hazards and print out our supplied blank worksheet for your own assessment.

In a safety hazard and risk assessment, it is important to be as thorough as possible because after all, you can't protect your workers against hazards you are unaware of and unprepared for. Avoid blind spots in your workplace safety procedures by taking into consideration these 6 types of workplace hazards.

6. What defines a hazard?

A hazard, within the context of workplace health and safety, is "any source of potential damage, harm or adverse health effects on something or someone." They go on to say that a hazard can include the potential for harm or adverse effect such as to people as health effects, to organizations as property or equipment losses, or to the environment."

There are general occupational safety hazards such as slips, trips, and falls, however, as you'll read further, it is up to the employer to conduct regular hazards assessments to identify its own unique hazards and risks.

6.1. Hazards and risks

So what's the difference between safety hazards and safety risks?

What are hazards? A hazard is any source of potential damage, harm, or adverse health effects on something or someone. The CCOHS says, "***risk is the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard***."

What are risks? **Risks are described as a "probability or likelihood of developing a disease or getting injured, whereas hazard refers to the agent responsible."**

How do we categorize hazards?

Regardless of where you work or which industry you are in, workplace hazards can be categorized into seven sections, making them easier to mitigate and to stay organized when tackling them.

No matter what hazards your team may be facing, they will fall into one of the categories below and we will show you how to identify and mitigate them as a result.

6.2. What are 7 common workplace hazards?

The 7 common workplace hazards are:

1. **Safety hazards**
2. **Biological hazards**
3. **Physical hazards**
4. **Ergonomic hazards**
5. **Chemical hazards**
6. **Work organization hazards**
7. **Environmental hazards**

1. Safety hazards

Safety hazards are number one on the list of 6 types of workplace hazards. These hazards play an effect on employees who work directly with machinery or on construction sites. Safety hazards are unsafe working conditions that can cause injury, illness, and death. According to the National Safety Council, in 2016, 34,673 people in North America have died in falls at home and at work. Safety hazards are the most common workplace risks. They include:

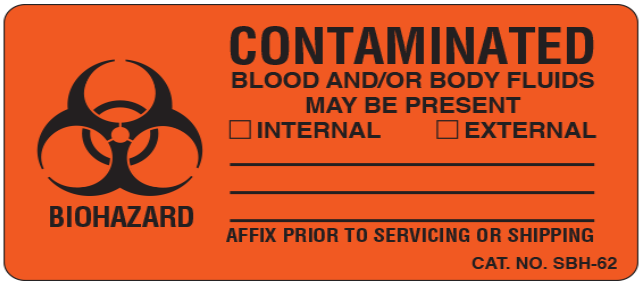
- ✓ Anything that can cause spills or trips, such as cords running across the floor or ice
- Anything that can cause falls, such as working from heights, including ladders, scaffolds, roofs, or any elevated work area.
- Unguarded and moving machinery parts that a worker can accidentally touch.
- Electrical hazards like frayed cords, missing ground pins, and improper wiring Confined spaces.

2. Biological hazards

The definition of biological hazards, commonly known as biohazards, can be any biological substance that could cause harm to humans. Biological hazards include exposure to harm or disease from working with animals, people, or infectious plant materials. Workplaces with these kinds of safety hazards include, but are not limited to, work in schools, daycare facilities, colleges and universities, hospitals, laboratories, emergency response, nursing homes, or various outdoor occupations.

❖ **Types of things you may be exposed to for biological hazards:**

- **Blood and other body fluids**



- **Fungi/mold**

- **Bacteria and viruses**

- **Plants**

- **Insect bites**

- **Animal and bird droppings**

3. **Physical hazards**

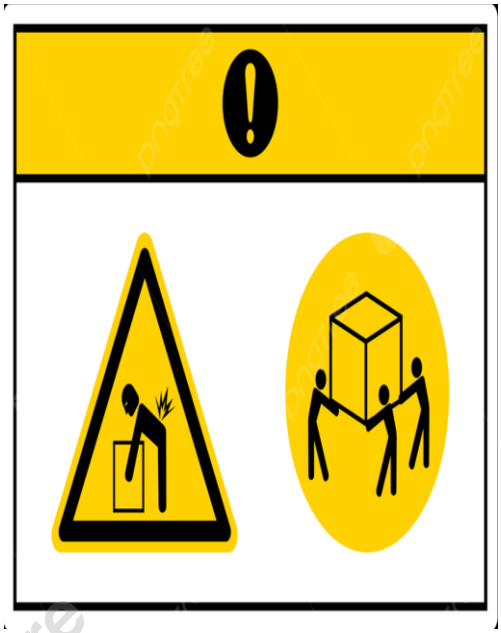
Of all the hazards in your workplace, physical hazards might be the least obvious. Despite their name, physical hazards aren't always something that you can see or touch. Physical hazards affect workers in extreme weather conditions or harmful working environments. Workers who are exposed outside in the sun for a prolonged period of time can suffer physical hazards which can cause long-term effects to their health. Physical hazards can be any factors within the environment that can harm the body without necessarily touching it.

❖ **Physical hazards include:**

- Radiation: including ionizing and non-ionizing (EMF's, microwaves, radio waves, etc.) materials
- High exposure to sunlight/ultraviolet rays
- Gases under pressure
- Temperature extremes – hot and cold
- Constant loud noise

4. **Ergonomic hazards:**

Ergonomic safety hazards occur when the type of work, body positions, and working conditions put a strain on your body. They are the hardest to spot since you don't always immediately notice the strain on your body or the harm that these hazards pose. Short-term exposure may result in "sore muscles" the next day or in the days following the strain, but extended exposure can result in serious long-term issues.



Ergonomic Hazards include:

- Improperly adjusted workstations and chairs
- Frequent lifting
- Poor posture
- Awkward movements, especially if they are repetitive
- Having to use too much force, especially if you have to do it frequently
- Excessive vibration

5. Chemical hazards

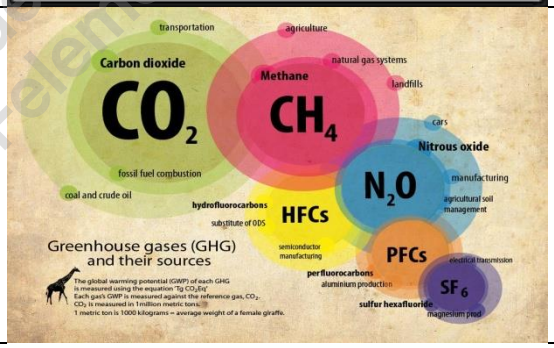
Chemical hazards are present when a worker is exposed to any chemical preparation in the workplace in any form (solid, liquid or gas). Some are safer than others, but to some workers who are more sensitive to chemicals, even common solutions can cause illness, skin irritation, or breathing problems.

❖ **Chemical hazards can be present in the following:**

- Liquids like cleaning products, paints, acids, solvents – particularly if hazardous products are in an unlabeled container.

- Vapors and fumes that come from welding or exposure to solvents

- Gases like acetylene, propane, carbon monoxide, helium,



- Hazardous products and flammable materials like gasoline, solvents, and explosive chemicals

- Pesticides

6. Work organization hazards :

Safety hazards or stressors that cause stress (short-term effects) and strain (long-term effects). These are hazards associated with workplace issues such as workload, lack of control and/or respect, etc.

Examples include:

- Workload demands
- Workplace violence
- High intensity and/or pace
- Respect (or lack thereof)
- Flexibility
- Control or say about things
- Social support or relations

7. Environmental hazards

Last but definitely least are environmental hazards which are constantly changing with increasingly unpredictable – and extreme – weather and climate. The bad news is that they are mostly out of our control, but the good news is weather challenges and hazards are somewhat predictable with the change in seasons and advances in meteorology.

Examples include:

- Extreme temperatures (dangerous heat and cold)
- Extreme precipitation (rain and snow)
- Dangerous levels of noise

- Dangerous levels of radiation
- Pollution (air and chemical)
- Unstable infrastructure
- Biological hazards
- Violent members of the public
- Dangerous animals

LABORATORY SAFETY RULES:

The following safety rules must be followed at all times in the laboratory. The chemical laboratory is not necessarily a dangerous place. Intelligent precautions and a proper understanding of techniques to be followed make the chemistry laboratory no more dangerous than any other classroom.

1. Safety goggles (department approved) must be worn in the lab at all times. Glasses and contact lenses are not acceptable eye protection. Students who do not follow this rule will be asked to leave the lab immediately.
2. Never eat or drink in the lab. Food may pick up toxic chemicals.
3. Never inhale fumes or vapors. Use fume hoods for dangerous or irritating chemicals. Always waft odors toward your nose with your hand.
4. Never taste any chemical. Some chemicals are very corrosive and poisonous in very small quantities.
5. Never perform an unauthorized experiment and never work in the lab without an instructor in charge. An accident may happen when mixing simple chemicals.
6. Never remove anything (chemicals, glassware, etc.) from the lab. It is illegal!
7. Label all containers to identify their contents.
8. Never put anything back into a reagent bottle. Once a reagent has passed the mouth of its container, it has passed the point of no return. Always take as little of a chemical as possible. Use only clean, dry spatulas for removing chemicals from bottles. Properly dispose of excess chemicals.
9. Leave chemicals in their proper place. Do not carry original containers of chemicals to your benchtop. 10. Avoid touching hot objects. Burns are a common accident in the chemistry lab. Be careful when using hot plates and objects which have been heated on them. Use beaker tongs to remove hot containers from the hot plate.
10. Rinse spills off skin immediately. Rinse off any chemicals spilled on the skin immediately with large amounts of water.
11. Clean up broken glassware immediately. Place it in the labeled crock at the front of the lab. Obtain replacement glassware from the instructor.
12. Properly dispose of waste chemicals. Certain liquids can be poured into the sink and flushed with water while others are poured into designated waste containers. Most solid wastes are placed in designated crocks. Your instructor will provide disposal instructions each lab.
13. Notify your instructor immediately of all accidents.
14. Learn to locate and operate (if applicable), the safety shower, fire extinguisher, eye-wash fountain, fire blanket, and fire exit.

LAB PROCEDURES: The following are procedures that must be followed for all lab sessions. Many are safety issues as well.

a. Dress properly for lab. Wear clothing that covers as much skin as possible. Sandals are not permitted. If possible, wear older clothes on lab day. All loose clothing and long hair must be confined.
b. Read the entire experiment before coming to lab. The instructor will briefly discuss the experiment at the beginning of each lab.

c. Arrive on time for lab. If a student arrives late for lab and misses a substantial portion of the introductory discussion and safety precautions, the student may be a threat to themselves and others in the lab. The instructor may deny the student the privilege of completing the assigned experiment.
d. Work independently unless otherwise instructed
e. Keep the benchtop uncluttered. Only those personal items pertinent to the lab work (lab manual, etc.) are to be on the benchtop at a students work station. Book bags, coats, etc. are not to be placed on the benchtop or on the floor close to the lab benches. Place all such items in the designated areas near the entrance to the lab.
f. Keep drawers closed. Drawers and cabinets are to be kept closed except when items are being taken from or returned to these drawers.
g. Take only planned breaks. If the need arises to take a short break, you may do so at any time during the experiment with these points in mind; try to plan the break during a less critical time in the experiment (e.g. while something is cooling); make sure that your hot plate is turned off; inform a neighbor and the instructor.
h. Do not come to lab under the influence of drugs. If, in the judgement of the instructor, a student presents a safety hazard to himself or his fellow students because the student is affected by medication, alcohol or other factors, the instructor may refuse to allow the student to continue working in the lab that day. If the situation is noted more than once, the student may be permanently removed from the course.
i. Clean up at the end of lab. At the end of all lab sessions return clean glassware to your drawer, clean your benchtop and finally wash your hands thoroughly. Be sure all electrical devices and water are turned off.

Safety / danger