LABORATORY SAFETY STANDARDS

2019 Edition

Prince Sultan Military College of Health Sciences

Prepared By:

WO. Salem Al Qahtani

Mr. Muhmmad Idrees

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KINGDOM OF SAUDI ARABIA

PREFACE

This Laboratory Safety Standards has been written to educate and promote safety awareness amongst all the students, staff and faculty of the Prince Sultan Military College of Health Sciences. It is designed according to the rules and regulations set forth by OSHA-Occupational Safety and Health Administration for the protection of employers, employees and environment. It encompasses all the science teaching laboratories of the college and provides information on the basic laboratory safety standards. A keen attempt has been made to make this booklet useful and interesting by focusing only on essential things.

The Laboratory Safety Standards also depicts the mission of the ***Brig.Gen./Dr.Edan Musa Al- Zahrani-College Director*** for a safe and healthy nation. His continued support and love for the improvement of college standard have always been a source of motivation for all the faculty and staff.

Any suggestion towards its further improvement shall be welcomed and incorporated in the next incoming edition Insha Allah.

WO. Salem Al Qahtani
Laboratory Superintendent
Prince Sultan Military College of Health Sciences

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ACKNOWLEDGEMENT

We are immensely grateful to ***Brig. Gen. /Dr. Khaled Al Jubran,*** Vice Dean of Academic Affairs***,*** *Prince Sultan Military College of Health Sciences* for sharing the pearls of wisdom and valuable advices with us in the accomplishment of Laboratory Safety Standards. We also highly appreciate ***Mr. Muhmmad Idrees,*** Science lecturer, and other colleagues for their contribution to the first edition of Laboratory Safety Standards. ***Mr. Salem Al Qahtani***, Laboratory Superintendent, Prince Sultan Military College of Health Sciences would wish to equally acknowledge the contributions of other scholars whose work has been embedded in this booklet.

WO . Salem Al Qahtani,
Laboratory Superintendent
Prince Sultan Military College of Health Sciences

INTRODUCTION

Laboratory settings represent an extremely important part of effective science learning. Articles and diagrams can bring across a huge amount of knowledge and information, but students learn more when they watch and observe experiments in labs. Although dangers may arise from scientific experiments, being cautious and following proven safety practices greatly reduce the chance of sudden accidents. Knowing the possible risks and taking preventive steps are the basis for creating a safe learning atmosphere. To improve overall campus safety, particularly of all the college laboratories, *Mst. Sergeant Salem Al Qahtani,* Laboratory Superintendent of Prince Sultan Military College for Health Sciences and his team updates and improves safety techniques for the betterment of the students, staff, and faculty.

The Good Laboratory Safety Practices Policy is a step towards the achievement of a safe and healthy work and study environment on the college campus. No reference point has been established as to what constitutes a truly safe and hazard free atmosphere in laboratories. It is impossible to remove all dangers from a laboratory; therefore, we should strive to make the laboratory reasonably safe. In 1990, the Occupational Safety and Health Administration (OSHA) introduced the Laboratory Standard to protect employees working in laboratories. For decades, the topic of chemical safety was included at the margins of laboratory courses, mostly taught only in passing as a footnote to various laboratory experiments and procedures. Instilling a strong positive attitude towards safety requires continuous reinforcement of the importance of safety in every experiment that is conducted. A person who has a strong understanding of safety recognizes hazards, has the ability to assess how exposures to these hazards might occur, and knows how to manage and control hazards so that exposure and risk are minimized. Learning about emergency procedures, how emergency equipment operates, and how to make decisions about emergencies can bring a better understanding for the need for safety and at the same time encourage the person to work more carefully in the laboratory, preventing incidents from occurring. The practices and procedures in this Laboratory Safety Standards can be used by departments as a guide to enhance safety in their laboratories and other areas of responsibility. This Laboratory Safety Standards describes general guidelines that should be followed to keep laboratory accidents to a minimum. Students should practice these guidelines to ensure their safety in laboratories and apply these habits into their future workplace.

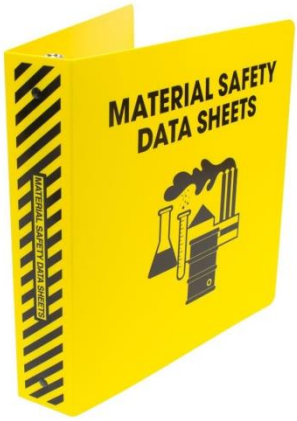
GENERAL INFORMATION

WHAT IS MATERIAL SAFETY DATA SHEET (MSDS)?

The Material Safety Data Sheet (MSDS) is a document that contains information on all possible dangers that can be found in the laboratory environment and how to properly use chemicals and laboratory equipment. The MSDS provides more detailed information about the chemicals compared to the chemical bottle labels. The MSDS is prepared by the supplier or manufacturer of the chemical to describe what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if sudden accidents happen, how to recognize signs of overexposure, and what to do if such accidents take place. This is an important document that should be available in ALL college laboratories.

WHEN SHOULD I USE MSDS?

Always be familiar with the DOs and DONTs when using a product BEFORE you start using it. You look into the MSDS corresponding to the product you are going to use, by matching the name of the item/chemical on your container to the one on the MSDS. Be aware of the risks, understand safe handling and storage instructions, and know what to do in an emergency in a chemical accident.



HAZARDS IN THE LAB

- ✓ **BIOLOGICAL**
  - Exposure to blood and body fluids and specimens that harbor HIV, HBV, HCV etc.
- ✓ **CHEMICAL**
  - Acids, alkalines, toxic chemicals
- ✓ **RADIOLOGICAL**
  - Ineffective radioactive waste disposal

- ✓ **PHYSICAL**
    - Using sharps like needles, syringes, blades, laboratory glass, scalpel, razor blades, microscope slides etc
- ✓ **FIRE**
- ✓ **ELECTRICAL ACCIDENTS**

BIOSAFETY LEVELS

There are FOUR Biological Safety Levels (BSL). They are categorized according to the activities that take place in particular biological labs. These "shields" protect the people working in the labs as well as the surrounding environment and community. These levels are scaled from ONE to FOUR based on the agents or organisms used in the experiment. For example, a basic lab setting, which deals with nonlethal agents that present a minimal potential threat to lab workers and the environment is generally considered BSL-1—the lowest biosafety lab level. A specialized research laboratory that deals with possible deadly infectious agents like Ebola would be ranked as BSL-4—the highest and most severe level.

BIOLOGICAL SAFETY LEVEL 1(BSL-1)

It is the basic lab setting, which deals with the agents or microorganism not known to cause disease in healthy humans. Wearing Personal Protective Equipment such as eye protection, gloves and a lab coat is the minimum requirement to work in this lab. Open bench top or open work station can serve the purpose.

Figure 1 Biological Safety Level 1

BIOLOGICAL SAFETY LEVEL 2 (BSL-2)

This level is associated with a lab setting involving mild to moderate disease in humans, which is dangerous if accidentally inhaled, swallowed, or exposed to the skin. Personal Protective Equipment such as eye protection, gloves, lab coat, and biological safety cabinet are needed for this lab. Basically, the equipment for BSL-1 plus other equipment and methods for decontamination are needed in this level. Biohazard warning signs must be posted outside this lab.

Figure 2 Biological Safety Level 2

BIOLOGICAL SAFETY LEVEL 3 (BSL-3)

This designated lab is suitable for the study of biological agents that are associated with serious or possibly deadly disease in humans. General requirements for BSL-3 include personal protective equipment, biological safety cabinet, and respirators. This kind of laboratory needs a particular kind of safety design features, like sealed windows, self-closing double door access, and specialized ventilation systems. Some of the microbes, which are handled in this lab are yellow fever, West Nile virus, and the bacteria that causes tuberculosis. Access to a BSL-3 laboratory is restricted and controlled at all times.

Figure 3 Biological Safety Level 3

BIOLOGICAL SAFETY LEVEL 4 (BSL-4)

BSL-4 labs are very few in the world. These labs are used to study lethal microbes in which no vaccine or therapy is available. Infections caused by these types of microbes are fatal, and have no known treatment so far. Ebola and Marburg viruses are examples of such microbes. They incorporate the BSL-3 laboratory safety features with

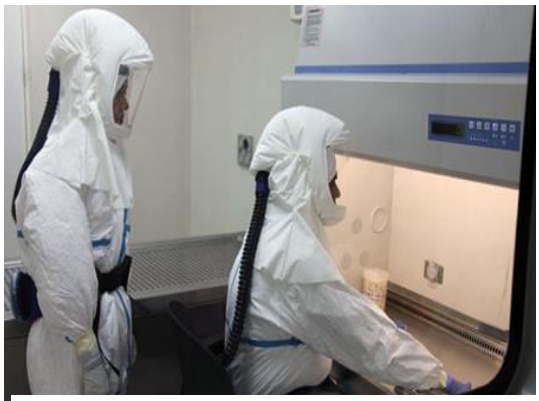


Figure 4 Biological Safety Level 4

additional safety features such as full body suits ventilated by life support systems or use of a glove box.

RESPONSIBILITIES OF THE TEACHING STAFF

The most important safety rule in any laboratory is that every person involved in a laboratory operation, from the teacher to the student, must have safety in mind. It is impossible to design a set of safety rules that will cover all possible dangers and incidents. Safety awareness can only become a part of everyone's habits only if safety issues are discussed over and over again. All concerned lab staff must accept the responsibility of his or her job in accordance with best safety practices. The laboratory education provides a pivotal role in teaching science because students can acquire concrete knowledge regarding different kinds of science related subjects. Normally, new students are initially advised of general safety issues at the start of each academic year. If some students are absent from this event, it is the responsibility of the teacher to give them a separate lecture in an appropriate time. All concerned teaching staff is responsible for identifying hazards and minimizing risks to students during practical classes.

RESPONSIBILITIES OF LABORATORY WORKERS (LABORATORYASSISTANTS/ATTENDANTS)

Laboratory workers are, in many cases, the "first line of defense" with regards to lab safety. The laboratory staff must read and understand all the laboratory standards and procedures. They should report immediately any possible hazardous accident to the office of the laboratory superintendent and provide the necessary assistance to rectify any problems.

At the same time, all workers have the right to be informed of the known physical and health hazards of the hazardous chemicals and apparatus in their work areas and to receive adequate training to work safely with such substances and equipment.

LABORATORY SECURITY

Laboratory security is an integral part of an effective laboratory safety program. Laboratory Assistants and Laboratory Attendants are required to follow these procedures to ensure the security of the laboratory.

1. Keep laboratory doors locked when unoccupied. Unauthorized persons must not be allowed inside the lab. This information must be posted outside the lab doors.
2. Keep stocks of organisms locked during off hours or when the laboratory is unoccupied.
3. Keep an accurate record of chemicals, stocks, cultures, project materials, growth medium, and other items that support such experimental activities.
4. Inform the College Security through the office of the Laboratory Superintendent if materials are missing from the laboratory.
5. Inspect all packages arriving at the work area.
6. When any Lab Activity/Research is completed for the day, ensure that chemicals and biological materials have been properly stored and secured.
7. Ask strangers (someone not recognized as a co-worker or support staff) for identification. If they are not authorized to enter the lab, ask them to leave.
8. Keep high hazard materials under lock and key. Highly hazardous materials include radioisotopes, carcinogens, etc.
9. Maintain a catalog for receiving, using, and disposing of highly hazardous materials and these must be documented at all times.

CLEANING STAFF AND REPAIR WORKERS

The cleaning staff routinely cleans the lab, but they have very poor knowledge of laboratory hazards. We can avoid any unpleasant incident only if we follow the safety guidelines and correctly disposal procedures. The laboratory infectious waste can be disposed in conjunction with the adjacent ***JCI-approved King Fahad Military Medical Complex hospital***, which is within the premises of the college. Make sure that the laboratory staff, and *not* the cleaning staff, are responsible for cleaning laboratory work surfaces, refrigerators,

freezers, and apparatus. Arrange the separate bins according to "ordinary" waste and to "hazardous" waste. All bins must be clearly labeled.

HOUSEKEEPING

Good housekeeping helps to avoid many safety and health problems. Used absorbent pads must be discarded and the workstation tops must be wiped at least once a day. Clear the bench tops of all unnecessary glassware and materials. Keep the floors free of boxes, instruments, and supplies by storing them at their right places.

DISABLED PERSONS

Particular safety issues may arise for disabled students, workers, and visitors. It is best to review these on a case-to-case basis according to college safety guidelines to avoid accidents.

ACTION PLAN FOR IMPLEMENTING SAFETY PRACTICES

- ✓ Identify hazards.
- ✓ Assess level of risks and prioritize the risks accordingly.
- ✓ Establish and implement safety policies and procedures.
- ✓ Conduct and prioritize safety specific training by doing practice drills.
- ✓ Communication is the key in the execution of the safety training.
- ✓ Perform regular audits and assessments of the safety guidelines.

BEFORE THE EXPERIMENT

- ✓ Be ready for the emergency beforehand.
- ✓ Familiarize with exposure-specific policies.
- ✓ Keep post exposure medicine available.
- ✓ Check periodically for stock and expiry of medicine.

IN CASE OF EXPOSURE

- ✓ Report immediately.

- ✓ Go to the nearest available doctor.

POST EXPOSURE

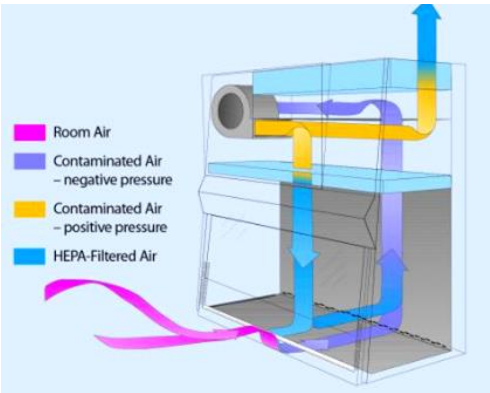
- ✓ Write a report and reasons for accident.
- ✓ Recommend actions that should be taken to avoid future accidents.
- ✓ Revise the safety guidelines and conduct additional training.

THREE KINDS OF BIOSAFETY CABINETS

A biological safety cabinet basically provides three kinds of protection:

I. Personal protection from the hazardous agents inside the cabinet;
II. Product protection to avoid contamination of work, experiment, and other processes; and,
III. Environmental protection from contaminants contained within the cabinets.

Figure 5 Class II Biosafety Cabinet



a) **Class I** - a ventilated cabinet for personal and environmental protection, with a non-recirculated airflow away from the operator. It is similar to fume hoods, except it may or may not be connected to an exhaust duct system. There is no product protection. May be used for Biosafety Level 1, 2, or 3.

b) **Class II** - a ventilated cabinet for personal, environmental, and product protection with an inward HEPA filtered airflow for personal protection. May be used for Level 1, 2, or 3.

c) **Class III** - a totally enclosed, ventilated cabinet of gas-tight construction. Operations in the cabinet are used through attached rubber gloves. The cabinet is kept under a slightly negative air pressure. Supply air is HEPA filtered and the exhaust is double HEPA

filtered or a combination of HEPA filter and incineration. May be used for Biosafety Level 4.

EMERGENCY TELEPHONE NUMBERS

Department/Venue	Phone No/Ext
Fire Brigade	4444/6000/5940
Ambulance	4444/4463/4732
Hospital Casualty	4444
Office of the Laboratory Superintendent	6943

GENERAL SAFETY RULES

1. Each student should use personal protective equipment that includes, as a minimum, safety goggles, chemical resistant gloves, and a laboratory coat. Laboratory coats protect clothes and prevent students and workers from "bringing home" dangerous chemicals or pathogenic organisms. Remove laboratory coats when leaving the laboratory. Change laboratory coats immediately upon significant contamination and do not wash laboratory clothing at home.
2. Safety goggles should be worn at all times when working in any laboratory, especially when experiments involve dangerous chemicals that could splash on the eyes. Particularly hazardous operations are the mixing or dilution of strong acids and alkalis, and the opening of sealed containers, especially those which have been shaken or heated.
3. Do not touch the face, apply cosmetics, adjust contact lenses, or bite nails during any experiment. The use of contact lenses in science laboratories is strongly discouraged because the capillary action of solutions causes rapid spreading of the solution under contact lenses and possibly delay the removal of the lenses. Quick removal of contact lenses is very difficult under adverse conditions. When laboratory activities are

anticipated, prescription glasses should be worn unless a student cannot see without contact lenses. Contact lenses are also not to be worn when a dust or vapor hazard exists unless vapor-resistant goggles are available. It is essential to provide approved, non-vented protective goggles promptly to students, teachers, and visitors wearing contact lenses and ensure that the goggles are worn regularly.

4. Wash arms and hands immediately after working with allergens, carcinogens, pathogenic organisms, or toxic chemicals. Wash exposed skin well before leaving the laboratory.
5. Clean all spills and leaks quickly. Spill kits should be purchased and used to assist in clean-up operations.
6. Do not store or consume food and beverages in laboratories or near chemicals.
7. Do not smoke in laboratories.
8. Avoid smelling or tasting chemicals.
9. Avoid using damaged glassware. Broken glassware should be discarded in sealed boxes.
10. Used needles and syringes, razor blades, Pasteur pipettes and other sharp equipment should be placed in special containers labeled “sharp”.
11. Do not engage in practical jokes, horseplay, or other acts of carelessness in the lab.
12. Oral pipetting or mouth suctioning of hazardous, caustic, toxic, radioactive, cancer causing chemicals, or biological specimens is prohibited.
13. Tie long hair and fix loose clothing. Avoid wearing finger rings/jewelry that may become contaminated, react with chemicals, or be caught in the moving parts of equipment.
14. Wear shoes at all times in the laboratory. Sandals, flip-flops, perforated shoes, open-toed shoes, or canvas sneakers are prohibited in the laboratory.
15. Each individual is responsible for keeping the work area clean.
16. Chemicals and equipment should be clearly and correctly labeled as well as properly stored.
17. Clean work area upon completion of a procedure. Make sure that everything is clean in the laboratory at the end of each day.
18. Appropriate warning signs must be posted by the instructor conducting the experiment near any dangerous equipment or experiment.

19. The laboratory staff must ensure that the interior connecting doors between laboratories are unobstructed and unlocked at all times.
20. Adequate, skid-proof footstools and stepladders should be used by the laboratory staff for reaching upper shelves. Do not stand on chairs or other easily movable objects.
21. All equipment must be inspected by the instructor, who is planning to conduct the experiment, for its defects prior to use.
22. Gas, air, and vacuum services should be turned off at the bench service valve when such equipment are not in use.
23. Be alert in unsafe conditions and correct them when detected.
24. Minimize the use of sharps. Use needles and scalpels according to appropriate guidelines and precautions.
25. Use appropriate pest-control methods for rodents, insects, etc. Disinfect the bench before and after the lab session with a disinfectant known to kill the organisms. Use disinfectants according to manufacturer instructions.
26. Avoid working alone in the laboratory.
27. Avoid using personal items (cosmetics, cell phones, calculators, pens, pencils, etc.) while in the lab.
28. Safety in the laboratory should be taught and reinforced to the students throughout the year by the faculty members associated with the laboratory work.
29. In case of any accident, the concerned faculty member should ensure that all injuries/exposure are documented according to college safety policies. Laboratory Incident Report forms are available in the appendix. A copy of incident report must be sent to the Office of the Laboratory Superintendent.

Figure 6 Educating Students on Lab Safety Rules - Prince Sultan Military College of Health Sciences

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment are regarded as the most essential in Laboratory Safety Standards. Students must be reminded constantly about the use of PPE during any lab session. PPE must not be worn outside the labs as they might be contaminated and become a source of infection.

Figure 7 Students are encouraged to wear PPE at Prince Sultan Military College of Health Sciences

Figure 9 Use PPE only inside the laboratories.

Figure 8 PPE in the dental laboratory.

Figure 10 Emergency Eye Wash

GENERAL HANDLING AND STORAGE OF CHEMICALS

Figure 11 Laboratory Personnel labeling chemicals at Prince Sultan Military College of Health Sciences

The primary objectives of the OSHA are to ensure that everyone in the nation is safe, the working environment is healthy, and human resources are conserved by encouraging employers and employees in their efforts to reduce the number of occupational safety and health hazards at their workplaces. Occupational safety and health administration emphasizes on the safety practices in these workplaces. Since chemicals and other biological organisms are stored in lab refrigerators or freezers, we must not store food in such places. Refrigerators and freezers must be labeled appropriately, ("NO FOOD" or "FOOD ONLY - NO CHEMICALS") depending on the intended purpose of the equipment. All chemical storage containers must be labeled with the name of the contents and appropriate hazard warnings. The label must contain the full chemical name, not abbreviations or chemical formulas. Chemicals must be stored based on compatibility. Chemicals should not be stored in alphabetical order, but should be stored by danger-related class. In other words, flammables, acids, bases, oxidizers, reactives, poisons, etc, are some of these classes that should be separated from each other. For example, Nitric acid is an oxidizing agent and should be stored away from other acids.

Figure 12 Laboratory Personnel arranging chemicals at Prince Sultan Military College of Health Sciences

Accidents in laboratories happen. How we prepare for them makes the difference. Being prepared is the first line of defense in a disaster.

Figure 13 Student handling chemicals at Prince Sultan Military College of Health Sciences

STOCK CULTURE REQUIREMENTS

According to the safety standards recommended by the "Centers for Disease Control and Preventions" and "Biosafety in Microbiological and Biomedical Laboratories", we must develop a habit of safe handling of microbes in any college laboratory. By doing so, the safety perception of the students turns into habit. We must educate and promote a safety awareness and culture among the students and staff. The following guidelines may help us regarding stock culture activities:

- It is best to request cultures from approved, commercial, or reputable sources. Cultures separated from clinical samples must not be used.
- Keep and update all the documents about stock organisms, sources, and handling of stock cultures.
- Arrange fresh stock cultures of microorganisms every year (e.g., purchased or revived from frozen stock cultures) to be certain of the source culture, to minimize spontaneous mutations, and to reduce contamination.

Figure 14 Laboratory culture medium

EMERGENCY EXIT

Any hazard in the lab could be deadly if we are not prepared to deal with it due to lack of knowledge and safety awareness among the students. It is the responsibility of the concerned teacher to increase the students' knowledge about safety and to repeatedly emphasize the standard safety practices in the lab. The students must be informed about the emergency exit route to deal with emergency situations. Many scientific studies have

revealed that accidents occur when safety guidelines are overlooked. Now, due to the growing rate of lab accidents in the teaching labs, the interest has begun to grow in lab safety. Emergency shower and eye wash are the basic emergency equipment. They must be located within 10 seconds of unobstructed approach in the working area where eyes and body of the worker may be exposed to injurious, corrosive materials during the lab activity. The emergency shower and eye wash must be periodically checked to ensure proper usage when required. The College Engineering Department has been requested to update all the ***"Escape Route Board"*** posted on the walls***.***

FIRE EXTINGUISHER

All employees must be well informed and trained on how to use fire extinguishers. Fire extinguishers must be readily available in all the buildings particularly in the labs to deal with the sudden onset of fire. The fire extinguisher is very easy to use if we remember the acronym PASS, which stands for **P**ull, **A**im, **S**queeze and **S**weep. In case of fire, also pull the fire alarm and **call 4444** to report the location of fire. When you hear the fire alarm, EVERYONE must quickly proceed to a nearest exit for safe evacuation. All teaching staff should announce and illustrate the location of the nearest exit at the beginning of the class during each semester. Everyone should aid physically disabled individuals to reach a safe location. The installation of fire extinguishers must be done according to the OSHA standards and the college lab safety department may arrange the demonstration and training session for interested staff.

FIRE BLANKET AND STOP_DROP_ROLL

If a student's clothing catches fire, the student should not run. He or she should stop, drop, and roll on the ground quickly while other students should try to wrap him/her in a fire blanket to get rid of the flames. The blanket should

Figure 15 Stop Drop and Roll in case one's clothing is on fire.

be wrapped close to the neck to keep the flames away from the head and hair. Water may be used with the fire blanket to get rid of the fire. Do not use a fire extinguisher directly on the victim; some serious chemical reactions or frostbite may occur because of it.

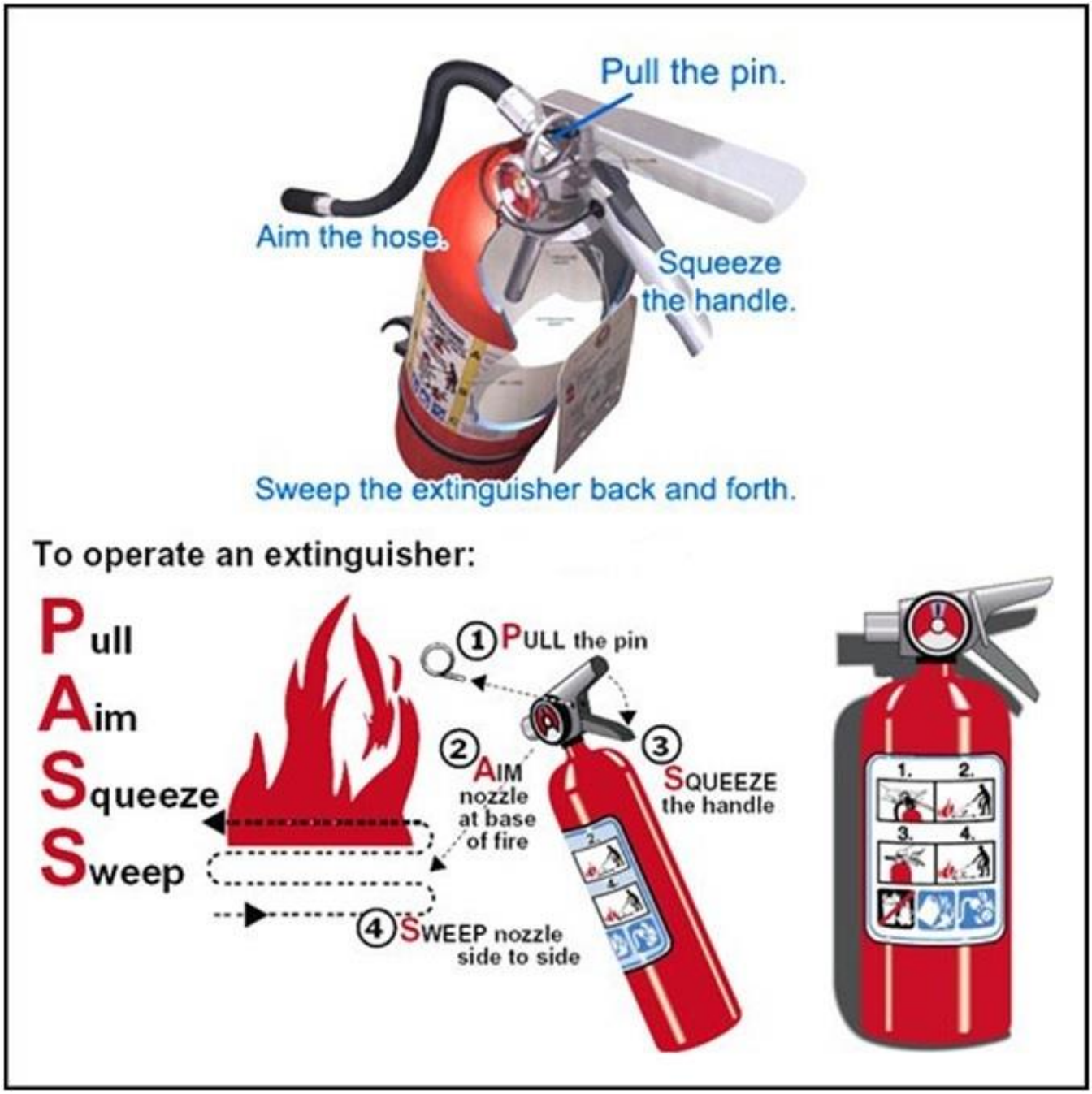


Figure 16 Operating a Fire Extinguisher

Figure 17 Fire blanket

IN CASE OF SEVERE WEATHER-WINDSTORM/SANDSTORM.

All the students must be informed and trained of what to do in case of severe weather conditions. Generally, stay away from windows, doors, outside walls and protect your head. Use a face mask to help breathe properly. After the severe weather emergency passes, the faculty/staff should notify the proper emergency personnel of any damages or injuries by **calling 4444**.

All college property damages or injuries must be reported to the Office of the Laboratory Superintendent through the Lab Incident Report Forms, available in all the labs.

FIRST AID KITS

The first aid kit is the most important part in the lab safety contents as students might encounter chemical, physical or health hazards during the course of an experiment. It helps to protect staff, students and the college property. It demands trained and knowledgeable staff to deal with the emergency situations in the lab. There must be someone who is capable to do initial emergency procedures before proper treatment is available. If an emergency occurs in the lab, the instructors are expected to act in an efficient way with minimal display of emotion. They are required to evaluate the problems with great attention and initiate actions according to the victim's symptoms. They should take measures to lessen the anxiety or fear of the injured student/students. The first aid kit must be readily available in all labs to avoid any medical mishaps. The kit must be legibly marked as "FIRST AID" along with the safety information sign. If an aspect of the sign gets faded or damaged, it must be replaced. Immediately call the emergency hotline by **dialing 4444** once an accident happens. Follow the assistance from your colleagues if necessary, and be calm, composed, and collected since most accidents are not deadly. Avoid giving liquids/medicines to an unconscious person. Don't self-diagnose and get help from the medical professionals. Emergency contact numbers should also be posted on the walls and corridors of the labs. A written incident report must be sent to the Office of the Laboratory Superintendent when such incidents occur. Lab Incident Report forms are available in the appendix. A simple first aid kit includes, but not limited to the following items:

1. Gauze pads (at least 4 x 4 inches)
2. Two large gauze pads (at least 8 x 10 inches)
3. Alcohol rub (hand sanitizer) or antiseptic hand wipes
4. One package gauze roller bandage at least 2 inches wide
5. Two triangular bandages
6. Wound cleaning agent such as sealed moistened towelettes
7. Scissors
8. At least one blanket
9. Tweezers
10. Adhesive bandages- most commonly used items in first aid kit
11. Latex gloves
12. Resuscitation equipment such as resuscitation bag, airway, or pocket mask
13. Clinical thermometer

14. Cotton Swab
15. Safety pins
16. Directions for requesting emergency assistance

Figure 18 First Aid Items (a) Symbol; (b) Pelican First Aid Kit; (c) Adhesive Bandage; (d) Gauze Pads

FUME HOODS

Fume hoods must be available in all those labs, which are dealing with flammable, toxic, volatile chemicals, or deadly microbes. They are designed to provide personal protection against all such potential hazards. The fundamental purpose of the fume hood is to capture the harmful fumes, gases or microbes present in the air and throw them out of the lab. Mixing of volatile chemicals must be done inside the fume hood to minimize the inhalation exposure. According to OSHA (29 CFR 1910.1450), fume hoods must be maintained and should be functioning properly when used.

Figure 19 Fume Hood

UNATTENDED/OVERNIGHT EXPERIMENTS

Safety education and training play a vital role in the pursuit of a safety standard at any workplace. In the past years, some fatal incidents in the academic labs have convinced those who were reluctant in laboratory safety education. Studies have revealed that a large number of students and staff have frequently faced laboratory related injuries. This mainly suggests the need to enhance safety awareness since it can dramatically help change possible disastrous outcomes. In order to overcome any safety lapses, it is appropriate to follow all safety guidelines. There are some of the experimental works which require adequate time and sometimes experiments run unattended overnight. A key principle to conduct such experiments is to rely on an automated system, which can safely shutdown the machine or service as soon as the machine detects any error. Make sure that all the electrical wirings are working and plugged in with the proper fuse rating. All water hoses must be sound and preferably reinforced securely with the apparatus. Avoid using gas heating. Any heating must be done electrically. Use graphite bath or silicon oil bath if any heating bath is required to minimize the risk of fire. All the supports must be strong, tight, and securely fitted. Any gas cylinder to be used must be safely and securely clamped. A warning sign about the harmful

contents of the experiment must be posted to inform any visitor of the laboratory. The best safe practice is to avoid working alone in the lab.

EMERGENCY PROCEDURES

Students are our assets and we intend to prepare them in terms of their knowledge, skills and safety attitude for their workplaces. Laboratory safety skills should be the main components of any practical science curriculum. This should clearly define all the laboratory safety rules and regulation. Students must be reminded several times in a semester about safety standards and its policy and procedures. Past studies have revealed that the highest ranked safety item is "PPE" or Personal Protective Equipment. A chemical spill is the most common accident in a science lab, which could occur while dealing with chemicals. It can be cleaned by the lab attendant with minimal effort to avoid any kind of danger. According to the requirements of the OSHA Hazards Communication Standard, the lab attendants must be trained enough to deal with any kind of chemical spill with which they are working and they must know all the threats associated with the chemical spillage. Any spill, regardless of the amount, must be reported to College Lab Safety Department through the Lab Incident Report form. In case of a chemical spill, all actions must be taken to confine the spill by using absorbent pads. All the available fume hoods must be turned on immediately and all the staff/students should safely leave the area. All victims should meet in a safe area and wait for the emergency response personnel. While waiting, the lab staff should try to retrieve a copy of all relevant Material Safety Data Sheets. All workers who work in college labs must be trained enough to control any chemical spill, and its clean-up operation and disposal. The Department of Lab Safety (DLS) must be informed about any spill immediately by **calling 4444** to report the spill. DLS will inform the college security officer. The caller should provide information about the spill, especially what chemical was spilled and the amount spilled. All college labs must have cleaning material available all times like absorbent pads, acid/base neutralization chemicals, wipers, drain stoppers, safety shovels, plastic pans & brooms, barricades and warning signs. The faculty and staff must be well informed and trained with the use of all hazardous chemicals available in the college labs. Newly inducted staff must be given an orientation and necessary training on how to deal with emergency situations in the lab. The instructor conducting any lab activity is fully responsible for the

required education and training of the staff and students about lab safety standards and operating procedures.

IN CASE OF BURN

The science laboratory in a college is a place where students gain hands-on experience on dealing with heat sources as well as strong acids and bases. In experiments using these chemicals, students getting burned may occur. In case of a chemical burn, quickly wash the affected area with plenty of water. Use the shower to wash the burnt area slowly and avoid washing it with high pressure water, which may lead to further injury. Cut the clothing, but never pull the clothing to avoid further injury since burnt clothing may be stuck to the affected area. If the hands, legs, or feet of a student get burnt, raise them above the heart level. Don't try to neutralize the chemicals as this may cause further injury due to chemical reactions. Apply some clean, dry, and loose dressing over the affected area and call the **emergency hotline 4444** for medical assistance.

MERCURY- A POISONOUS MATERIAL

Figure 20 Handling mercury spills

Mercury is a poisonous material and students must be careful dealing with mercury or mercury containing apparatus in the labs. Properly labeling the equipment and containers will help prevent accidents. All work involving mercury must be done in a tray to contain possible spills. A mercury spill must be cleaned quickly. When this element spills, it breaks into beads instead of clumping in puddles. These beads are very small and difficult to handle. Mercury is unlike the usual liquids. If you try to clean the spill with regular absorbents, you could make the spill worse by spreading it. A special mercury spill kit must be used to control the

spill following the instructions included in the kit. Any lab incident must be documented and a copy of lab incident report must be sent to the CLSD (College Lab Safety Department).

TEACHING SCIENCE MODELS

Posters and models may be used in the science labs to demonstrate the concepts. These teaching materials are interactive tools of learning, and can help students concentrate, pay attention, and improve their thinking abilities.

Safety measures must be followed when using fragile, sharp, and pointed models to avoid any unpleasant incident. Lab assistants are responsible for the up keeping of the teaching models.

Figure 21 Teaching models at Prince Sultan Military College of Health Sciences

Figure 22 Teaching models used at Prince Sultan Military College of Health Sciences

WHAT ARE SHARPS?

"Sharps" are objects that have points or edges that can cut or puncture something. Examples of these are needles, syringes, blades, laboratory glass, scalpel and razor blades, microscope slides and covers, glass capillary tubes, Pasteur pipettes, pipetman tips, pointy scissors, microtome knives, any broken glass or plastic lab-ware with sharp edges or other such objects. "Biomedical Waste Sharps" means sharps that have been in contact with human or animal tissue, blood, and any kind of body fluid, generated by human or animals.

Figure 23 Examples of Sharps

HAZARDS WITH SHARPS

Needles and other sharps expose us to the risk of getting our skin punctured and cut, which can lead to an infection. Some experiments with sharps can produce sprays and aerosols. Contaminated sharps are the potential sources of infection. Sharps are hazardous for both the user and those who come in contact with sharps that are not disposed properly.

WHAT IS OPIM?

OPIM stands for "Other Potentially Infectious Material". OSHA defines OPIM as (1) Human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any bodily fluid that is visibly contaminated with blood, and all other body fluids in situations where it is difficult or impossible to differentiate between body fluids; and (2) Any unfixed human tissue or organ from a human. Biohazard warning signs must be posted in the area where OPIM is present and work with OPIM must not be conducted on an open bench. (**OSHA 3404-11R 2011**).

Figure 24 Biohazard warning sign

NEEDLESTICK INJURIES

Bloodborne Pathogens are infectious microorganisms present in human blood and can cause several diseases in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV). Needle stick injuries are very common in healthcare professionals and place them at high risk with work related exposure of blood. Physicians, nurses and technicians should have enough knowledge of hazards associated with the injury of sharps. It is extremely important for all those who perform any biological procedure or use sharps in teaching labs to follow the lab standards to avoid biohazards. According to OSHA standard 1910.1030, as of March 1, 1992, all employees handling bloodborne pathogens must be vaccinated for HBV/HCV within the

first week of their employment. If you sustain an injury with a sharp, take appropriate action to minimize the lab-acquired infection risk**.** The following measures may be taken if any student/staff sustain needle stick injury.

- Remove any contaminated clothing.
- Thoroughly cleanse the wound with soap and water. Then, cover it with a bandage.
- Identify the source of sharp and assess the risk associated with the sharp.
- Report the injury to your College Lab Safety Department (CLSD) as soon as possible.
- Call the **emergency 4444** for medical attention.
- As per severity of the skin damage, report to the hospital for blood screening and follow-up.

GENERAL BEST PRACTICES FOR ALL SHARPS USE

Actions we should take to minimize the sharp injuries especially needle stick injuries:

- Identify all the sharps which you intend to use in your experiment and look for alternatives if available.
- Use a sharp with an engineered safety design whenever possible in your experiments. The "safer" sharps devices are readily available nowadays.
- Get trained in the proper use of sharp devices and the biohazardous materials since improper use of sharps and poor knowledge about sharps increase the risk of injuries.
- Use disposable blades in the experiments since this eliminates the need to change the blade. Keep the sharp container close to you so that it can be immediately disposed after use. Use a blade with a handle as it helps to control the blade efficiently.
- Do not leave the blades on the work station regardless of what they were used for.
- In case of reusable sharps like scissors and knives, store them in a bucket or enclosed tray.
- If you need to cap the needle syringe, always adopt the one-handed scope technique.
- Do not put sharps in your pockets.
- Do not try to bend or break the sharps since it may result in injuries.

- Use proper sharp containers for each kind of sharp: e.g broken glass, needles, blades etc. They must be made of heavy duty plastic, leaked proof, and have biohazards symbol on them.
- Sharp containers must not be overfilled and sharps must not be forced into these containers. Sharps should fall freely from their containers. Sharp containers must be disposed properly when they are broken.
- Non-sharp items such as gloves, gauze etc., must not be placed in the sharp containers.

Figure 25 Use the one hand scoop technique when handling needles.

Figure 26 Proper waste disposal: (a) Container for scissor blades; (b) sharp container; (c) sharp container; (d) infectious medical waste storage; (e) physically hazardous waste material storage.

ELECTRICAL HAZARDS

Laboratory accidents can happen even if we are using the appropriate apparatus and following the safety guidelines. It is hard to say that a lab is completely hazard-free, but by being alert, keeping cool in emergencies, and having basic sound knowledge of lab safety, we can make everyone safe in the lab. Safety procedures in the laboratory need periodic review to fix the loopholes; hence this is a continuous process. In some labs, we use electricity to run certain machines. Before the use of any electricity-powered apparatus, make sure that all aspects of the device is checked. All damaged or cracked wires must be replaced. Avoid putting the electrical devices near the heat source or sharp objects. Identify all the potential electrical hazards in your labs and post warning signs near them. All switches must be labeled as "ON" and "OFF". Be careful not to spill any liquids near the electrical sockets. Extension wires may be used only temporarily; but, never use them as permanent wire. Make sure the rating of the extension wire is good enough to withstand with the power load. Personal protective equipment must be worn to avoid any life threatening incident while dealing with any electrical operations.

Figure 27 Electrical Hazards

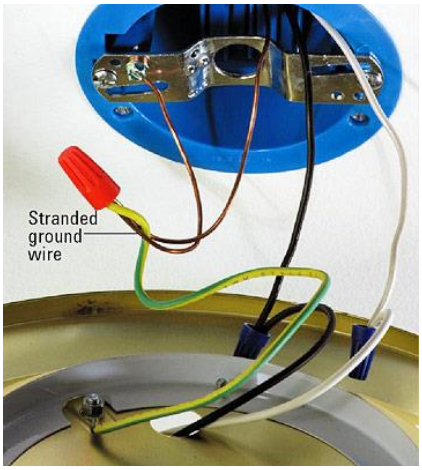


Figure 28 Grounded wire (green or yellow)

ELECTRICAL HAZARDS IN BIOMEDICAL TECHNOLOGY LABS (BMT)

In general, safety means the absence of any threat or risk in the product or process. Safety is a big concern for all those who work in the laboratory. Whether an action is safe or not depends on all the risks associated with it. If we eliminate all the associated risks from an activity, we may call it "safe", which however is not possible at all because complete freedom from risks does not exist in a laboratory. The first step towards safety is to identify the sources of electrical hazards in the lab, thereby minimizing the accidents. There are some electrical hazards in the biomedical lab, which are not identified and assessed by the workers on their own due to the lack of experience and training. Thus, it is best to instill safety and make it become second nature to all laboratory workers through continuous trainings and awareness campaigns. Prior to the use equipment, workers need to develop the habit of going through the manufacturer as described in the MSDS to fully understand the safe operation of a machine as proper dealing with the laboratory equipment provides adequate safety.

BMT TEACHING LABS

In the BMT lab, students learn how to install, maintain, calibrate, and repair the medical instruments. All medical instruments in the lab run in electricity and electrical currents could be hazardous. It is important to identify all the electrical hazards in the lab and post warning

signs near them. Make sure all equipment are properly grounded as it eliminates chances of electric shocks. “Grounding” is regarded as the highest safety measure in laboratories. Many studies reveal that accidents in workplaces occur, when electrical equipment are not properly or completely de-energized before maintenance or repair work. Improper grounding of electrical components results in electrical hazards. Most electrical accidents result from one of the following three factors:

- unsafe equipment or installation,
- unsafe environment, or
- unsafe work practices.

We can prevent such electrical hazards through the use of insulation, guarding, grounding, electrical protective devices, and safe work practices.

Figure 29 BMT Lab at
Prince Sultan Military College of Health Sciences

GENERAL BEST PRACTICE RULES IN THE BMT LAB

- Avoid working alone in the lab especially when working with high voltage or energized electrical equipment.
- When using rotating machinery, place neckties or necklaces inside your shirt or better yet, remove them.
- Make sure the power is turned off as soon as you finish your experiment/activity in the lab. Capacitors may store dangerous amount of charge so discharge them fully by means of a well-insulated jumper.
- Keep a safe distance from the energized parts of the equipment.
- Encourage students and staff to wear slip-resistant shoes as it provides dual safety from slips and electric shocks.
- All workstation tops must be ceramic type to avoid the electrical hazards.
- Do not overload an outlet by placing many adapters. Overloading can cause fire.

- Avoid heat dissipating surfaces of high wattage resistors and loads because they can cause severe burns.
- Take extreme care when using tools that can cause short circuits if accidental contact is made to other circuit elements. Only tools with insulated handles must be used.
- Make sure that the lab instruments are at ground potential by using the ground terminal supplied on the instrument. Never handle wet, damp, or ungrounded electrical equipment.
- Never touch electrical equipment while standing on a damp or metal floor.
- Wearing a ring or watch can be hazardous in an electrical lab since such items make good electrodes for the human body.
- Do not attempt to open field circuits of D-C motors because the resulting dangerously high speeds may cause a "mechanical explosion" and injuries.
- In an emergency, all power in the laboratory must be switched off by pushing the large red button on the main breaker panel. Locate it and it must be used for emergencies only.
- Never use water on an electrical fire. If possible switch power off, then use CO2 or a dry type fire extinguisher. Emergency exit route map must be posted on all access corridors.
- Use the correct cable connectors or couplers to join cables together and do not use tape for the joints.
- Electrical installations should be done, maintained, and regularly checked by a competent person.
- Fixed electrical equipment should have a clearly identified switch to cut off power in an emergency.
- Ensure fuses are appropriate as they explode and cut off the electricity when the current exceeds its rated capacity. It is important to ensure that a correct fuse is being used for any medical instrument.
- De-energized state of all the electrical components must be confirmed before any maintenance work.
- If a person comes in contact with a high voltage, immediately shut off power. Do not attempt to remove a person in contact with a high voltage unless you are insulated from them. **Immediately call 4444** for medical help. The severity of the incident must be discussed with the Laboratory Superintendent.

- Make sure all lab incidents are documented and notified to the Laboratory Superintendent. The Lab Incident Report form is available in the appendix.

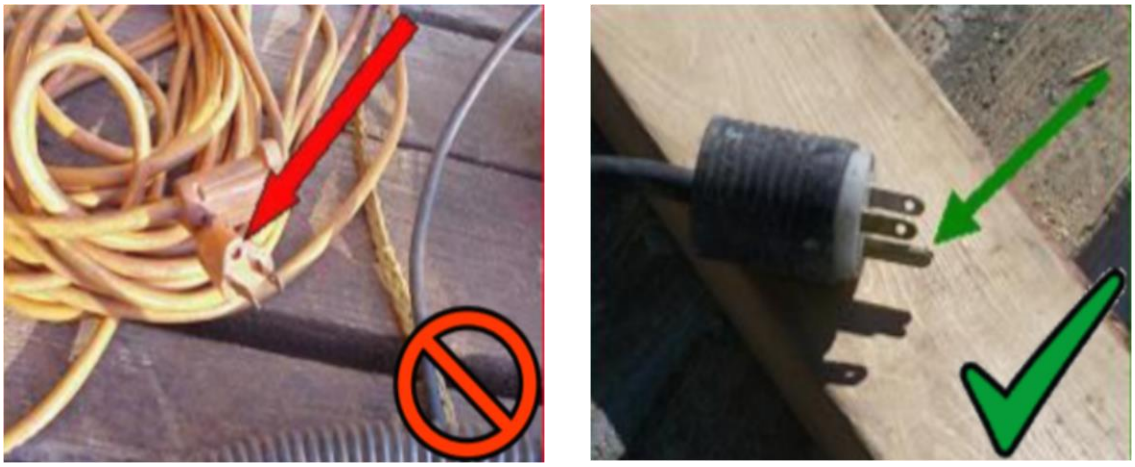


Figure 30 Plugs (a) without ground pin (b) with ground pin

Figure 31 BMT Lab at Prince Sultan Military College of Health Sciences, Dhahran

CONCLUSION

Safety guidelines are actually our life lines and we should not ignore them. Their importance must not be underestimated and these are vital to develop a safety attitude to avoid accidents. Safety is a protection only if we follow the rules!

APPENDIX A

LABORATORY INCIDENT REPORT

PRINCE SULTAN MILITARY COLLEGE OF HEALTH SCIENCES

INCIDENT REPORT

To Be Filled By The Faculty Member

Please use this form to report any laboratory incidents/accidents. Fires should also be reported, particularly when fire extinguishers are discharged.

Name of Person involved in this incident: _____

Put a tick:

Instructor: ___ Student: ___ Laboratory Staff: ___Housekeeping Staff: ___Maintenance Staff: ___Visitor/other: ___

Instructor Name: _____ Contact No: _____

State your location at time of incident: _____

Location of Incident: _____ Date/Time of incident: _____/_____

Number of students in lab at time of accident: _____

Personal Protective Equipment being used: Yes ____ No____

How did the incident come to your attention?

___ I was involved

___ Reported to me

___ Others: _____

(A) First Aid

- ✓ Wash
- ✓ Burn spray
- ✓ Band-aid
- ✓ Eye wash
- ✓ Other

(B) Treatment

- ✓ Sent to hospital
- ✓ Requested ambulance
- ✓ Note Time help arrived: _____

(C) Clean up **(D) Fire extinguisher** **(E) Evacuation**

Details of Incident: (nature of incident, e.g., illness, accident, injury or chemical spill). Indicate any substances (e.g., amount and kind of chemical) or objects involved.

_____
_____
_____

Name/Signature: _____

PRINCE SULTAN MILITARY COLLEGE OF HEALTH SCIENCES

SHARP INJURY REPORT

To Be Filled By The Faculty Member

Please use this form to report any laboratory incidents/accidents. Fires should also be reported, particularly when fire extinguishers are discharged.

Name of Person involved in this incident: _____

Put a tick

Instructor: ___ Student: ___ Laboratory Staff: ___ Housekeeping Staff: ___ Maintenance Staff: ___ Visitor/other: ___

Instructor Name: _____ Contact No: _____

State your location at time of incident: _____

Location of Incident: _____ Date/Time of incident: _____/ _____

Number of students in lab at time of accident: _____

Personal Protective Equipment being used: Yes ____ No____

How did the incident come to your attention?

___ I was involved

___ Reported to me

___ Others: _____

(C) First Aid

- ✓ Wash
- ✓ Burn spray
- ✓ Band-aid
- ✓ Eye wash
- ✓ Other

(D) Treatment

- ✓ Sent to hospital
- ✓ Requested ambulance
- ✓ Note Time help arrived: _____

(C) Clean up **(D) Fire extinguisher** **(E) Evacuation**

Encircle the Required Field

Type Of Injury/Exposure	Involved Body Part	Exposure Occurred
✓ Needle stick ✓ Lancet/blade/knife ✓ Glass ✓ Blood/Other body fluid_____	✓ Arm/hand ✓ Face/Neck/Head ✓ Leg/Foot ✓ Other body part:_____	✓ Before use of the sharp ✓ After use of the sharp ✓ During use of the sharp

Prior Vaccines Received: Tetanus/Date: _____ HEP A/Date: _____ HEP B/Date: _____

Did the victim send for blood screening? Yes: ____ No: ____

Brief description of exposure/injury: Indicate circumstances and who was involved. (Back of the page may be used if necessary to write the details)_____

_____

Called the Medical help?/Details with time help arrived _____

Name/Signature: _____