Appendix M

Laboratory Management Guide

Safe work habits and general guidelines that apply to various types of laboratories are included in this section. Principal Investigators and Laboratory Supervisors are encouraged to develop laboratory-specific rules from the general guidelines or the references that have been incorporated into this safety manual.

The general rules are directed primarily toward prevention of toxic exposure and do not include rules and procedures for prevention of physical injury. Safety in Academic Chemistry Laboratories, contains recommended techniques for safety operation of equipment such as: electrical equipment, glassware, distillations, low and high temperature operations, vacuum and high-pressure operations, emergency procedures, etc.

Fundamental Rules for Laboratory Hygiene

- General Lab Rules
    - Do not eat, drink, smoke, chew gum, or apply cosmetics in the laboratory.
        - Do not bring food into the laboratory.
    - All laboratory personnel must also be careful to restrict other actions (such as applying lip balm, rubbing eyes, or using personal electronics such as cell phones) which could inadvertently cause exposure to research materials.
    - Consuming alcohol or taking illegal drugs in a research laboratory are strictly prohibited as such actions potentially endanger the health and safety of not only the user, but everyone in the building. Infractions will be met with serious disciplinary action.
    - Do not put any objects, i.e., pencils, fingers, swabs, etc. in the mouth, ears or nose.
        - Mouth pipetting is forbidden.
    - Cover all cuts, abrasions, open sores and bruises with waterproof tape or disposable gloves and report all injuries to your supervisor.
    - Do only authorized work; no horseplay should take place in the laboratory.
    - Read all labels and warning signs.
    - Keep the work area tidy and free of unnecessary equipment and materials.
    - Clean up all spills and leakages immediately (if you can do so). See all Emergencies and Exposures and Spills sections.
    - All electrical equipment should be grounded and kept in good condition.
    - Keep all corridors, doorways and emergency exits free from hazards and accessible.
    - Acquaint yourself with local procedures in case of fire, incident, explosion or other emergency, by learning the layout of your building.

- Laboratory Dress Code
    - Long pants/skirts and closed toe/heel shoes are required in all areas where hazardous materials are stored and used. Exposed skin should be minimized, especially when working with hazardous material.
        - Shoes that leave the top portion of your foot exposed are NOT acceptable footwear.
    - Synthetic clothing should be avoided, especially around flammables. A flame-resistant hood can be added if using a cotton religious garment is not an option.
    - Before leaving the laboratory, remove lab personal protective equipment/clothing (gloves, lab coat, etc.) and wash hands thoroughly. Do NOT wear laboratory gloves, lab coats, or scrubs in public spaces such as hallways, elevators, or cafeterias.
        - Keep your lab coat buttoned while working in the laboratory.
    - Hair should be tied back if shoulder length or longer.

Safe Work Habits

Housekeeping

General housekeeping is an integral part of chemical hygiene and a good safety practice. A clean work area is much safer than a cluttered or dirty one. Some appropriate housekeeping measures include:

- Keep all aisles, hallways, and stairs clear of all chemicals.
- Keep all work areas, especially work benches, clear of all clutter and obstructions.
- All working surfaces and floors should be cleaned regularly (if possible).
- Access to emergency equipment, showers, eyewashes and exits should **NEVER** be blocked.
- Wastes should be kept in the appropriate containers and labeled promptly and properly.
- Laboratory personnel should be considerate and aware of housekeeping staff.
    - The typical housekeeping staff is not properly trained in the handling of chemicals and should not face situations where they must make decisions regarding the proper handling or storage of chemicals.
    - ALL chemicals should be placed in proper storage areas by the end of each workday; all spills should be promptly cleaned up with arrangements made for waste disposal; and all chemicals should be properly labeled.
    - OR the regular trash bins and recycling bins should be placed outside of your laboratory at the end of each workday.

Lighting and Noise Levels

Lighting - it is essential that each work area have sufficient lighting.

Noise levels - should not exceed those recommended by OSHA, generally 85 db.

If the noise level is in excess of the standard, efforts must be made to reduce the level. (Possible solutions are enclosing noisy equipment, acoustical treatment of walls or ceiling, vibration damping of noisy machines, replacing metal to metal contact with synthetic material to material contact).

Electrical and Thermal Equipment

Electrical Equipment

- Always read the instructions before attempting to assemble apparatus or to operate it.
- All equipment must be U.L. approved and have three prong plugs.
- Do not use cords with worn insulation. Replace connections immediately when there is any sign of thinning insulation.
- Make sure the wire is dry before plugging it into any circuit.
- Electrical units which are to be operated in an area where to flammable vapors may be present should be explosion proof.
- Disconnect all electrical equipment before servicing. Electrical service supply should be well grounded with adequate circuit protection.
    - Bench tops made of conducting material e.g. (stainless steel) should be grounded.
    - No connections to the main service lines should be made by anyone but a licensed electrician.
- Multiple adapters which can lead to overloading and bad connections should never be used.
- Fuses or circuit breakers of the correct rating should be used on all equipment at all times, but "ground" connections must never be fused.

- Labs should have sufficient outlets, suitably spaced to allow for convenient connection of each item of electrical equipment likely to be used at one time.
- The following signals are indicative of electrical hazards and should be corrected if found:
    - Shock received when touching any part of electrical equipment.
    - Power receptacles which are the non-grounded type (two wire instead of three wire) or are cracked or do not hold the plug securely.
    - Power plugs having only two prongs which are connected to a receptacle through a "cheater" (grounding plug to non-grounded receptacle adapter) or have bent or broken pins.
    - Power cords which are frayed, burned, nicked, cracked, or otherwise damaged or are so short that they require an extension cord. Power cords having lengths in excess of the distance between the equipment and the electrical outlet must be neatly coiled. Power cords running across the floor where personnel must walk.
    - Equipment which is dirty or shows evidence of fluid spillages or has been obviously damaged.
    - Multiple electrical equipment attached to an adaptor.
    - Electrical noise shown on meter readings, scope patterns and strip chart recorder traces making them difficult or impossible to read.
    - Wet or moist surfaces on electrical equipment.

Outlets

- Should be checked for grounding using a circuit tester every three (3) months as part of routine laboratory inspection.
- **Electrical Shock** - Turn off electricity first. If the patient is not breathing, begin artificial CPR immediately and then phone for emergency assistance.

Thermal Equipment

- Heating baths
    - Be sure the thermoregulator works properly.
    - Water baths must be checked daily for temperatures and water level.
        - Do **NOT** use a water bath for temperature up greater than 70°C as a dry glass bath can break when used on hot plates at high temperatures.
    - Oil baths
        - Mineral or silicone oil is typically used for reactions required heating/reflux temperatures up to 200°C.
        - Provides more uniform heating, however the flask is more slippery to handle, and oil can degrade or turn brown over time
        - Oil baths should be used in aluminum or stainless-steel pan, heavy porcelain dish or thick-walled Pyrex glass to withstand possible breakage or accidental spill.
        - should not be used without a variable autotransformer, known commonly as a variac.
            - Variacs control the voltage and can be adjusted to increase or decrease temperature setting of the oil bath.
            - Heating mantles should **NEVER** be plugged directly into an outlet
            - Inspect variacs thoroughly before use – check for any burnt odor, damaged power cords and connectors.
            - To prevent the static electricity and protect the coils from contacting the enclosure or core, ground the transformer.
    - Sand baths
        - Can be used for temperatures up to 500°C.
        - Easier to clean up and reuse and is inert to organic materials.

        - For vacuum distillations – do **NOT** let distillation flask become dry as at high temperatures and vacuum, dry glass flask can become soft and implode.
- Autoclaves/ovens – use appropriate PPE and heat-resistant gloves when handling and using autoclaves and ovens
    - Do **NOT** use or place any flammable, combustible, reactive, corrosive, toxic, or radioactive materials with or inside of autoclaves/ovens.
    - For autoclaves,
        - Check for plastics that are compatible – not all plastics can be autoclaved.
        - Check glassware for cracks – do not autoclave compromised glassware
        - With liquids, leave caps loose or cover with foil to allow steam penetration and prevent explosion
        - For bagged items, loosely tape or tie closed and leave an opening for steam to penetrate the bag.
        - Autoclaves must be tested. Contact with the Biosafety Program Manager for more details.
    - For ovens,
        - If oven is operating outside of normal parameters, it must be taken out of service until repairs can be made. Place “DO NOT USE. OUT OF ORDER” signage.
        - Inspect oven prior to use
            - Check cords for damage
            - Check oven calibration to ensure the temperature read-out is accurate (NEVER use a mercury thermometer for this)
            - Check the door seal
        - Arrange samples evenly throughout oven and do not place too close to interior walls.
        - Do **NOT** load bottom of interior to avoid risk of overheating samples placed there.
        - Check that oven is set to appropriate temperature required for use during either experiment or for drying glassware.
            - **DO NOT** place wet glassware or glassware with solvent inside of oven.
        - Do NOT store combustible materials such as plastics, paper, and cardboard on top, under, behind, or next to the oven.
        - Do NOT store any flammable chemicals near the oven.
- Hot plates
    - Do not use a hot plate for refluxing or distillation – use the appropriate bath for your experiment.
    - Inspect hot plate prior to use
        - Check cords for damage or fraying
        - Check the hot plate is heating appropriately
    - If heating a flask or beaker on a hot plate - Do **NOT** leave unattended.
    - Check experimental set up that any tubing or electrical cords are not in direct contact with the hot plate.
    - Once done with hot plate, UNPLUG and ensure that the hot plate has cooled down prior to moving.
        - **NEVER** leave a hot plate plugged in or on if unattended. Hot plates can sometimes heat uncontrollably regardless of temperature setting or whether controls are in the off position.

Laboratory Ventilation

Laboratory ventilation is a key factor in controlling employee exposure to hazardous substances. Ventilation is provided in two ways: through the facility's heating and air conditioning system, and through fume hoods utilized in the laboratory.

Fume hoods – Details on use of Fume hoods can be found in sections under Physical Hazards.

- OSHA defines a fume hood as a "device located in the laboratory which is enclosed on five sides with a moveable sash or fixed particle enclosure on the remaining side.
- It is constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory.
- It allows chemical manipulation to be conducted in the enclosure without insertion of any part of the body other than the hand and arm.
- Walk-in hoods with adjustable sashes meet the above requirements if the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised, and employees do not work inside the enclosure during the release of airborne toxic substances.
- Following are additional requirements applying to fume hoods in the laboratory:
    - Ventilation will not be obstructed or modified except by qualified mechanical engineers.
        - Ventilation in areas where noxious fumes or flammable liquids are handled should provide a minimum of six air changes per hour.
    - Fume hoods are used for the safe handling of noxious, corrosive, or volatile chemicals.
    - Fume hoods are not to be used as a substitute for Biological Safety Cabinets (laminar flow hoods).
- The following policies concerning fume hoods in the laboratory will apply:
    - Toxic fumes: Whenever toxic substances, corrosive aerosols, carcinogens, mutagens or teratogens are handled in a fume hood, the minimum face velocity must be 100 cubic feet per minute (fpm).
        - For effective use, materials should be handled at least six inches away from the hood opening.
    - Inspection: All hoods will be inspected at least annually by a qualified, contracted engineer.
        - Anytime a fume hoods air handling system is altered or serviced, the hood must be inspected before being placed in service.
        - Any new fume hoods installed must be inspected by the contracted engineer before being placed in service.
        - Inspected hoods shall have a sign affixed to them stating the inspection interval, last inspection date, average face velocity, location of the fan that serves the hood, and the inspector's name and dated initials.

Signage

- Signage is required for all containers, designated work areas and storage locations (see chemical labeling).
- Sign wording must state the following, or similar, as appropriate for the specific chemical hazard: “DANGER, CANCER HAZARD – SUSPECT AGENT” “DANGER, CANCER HAZARD – REGULATED CARCINOGEN” “DANGER, REPRODUCTIVE TOXIN” “DANGER, ACUTE TOXIN”
- Entrances to designated work areas and storage locations must include signage, “AUTHORIZED PERSONNEL ONLY”, in addition to the above specific hazard warning wording.
- All labs must have the appropriate signage placed on each lab door including the Principal Investigator name and contact information, a secondary emergency contact that is present on campus, all hazards located within the lab, and required PPE for entry.
- Appropriate signage must be in place if laboratory has lasers or radiation hazards. Please contact the Radiation Safety Officer for more information.
- Signage for medical emergency information and insurance information should be posted in the lab.
- Signage is required for all refrigerators, freezers, and microwaves.

- If appliance is used for chemicals, chemical signage must be placed with associated hazards and warnings.
- If appliance is used for food, clean area signage must be placed.

Clean Areas (for labs that have desks inside of them and labs that do not have separated offices)

A clean area is an area within a lab room approved by RMS as safe for the storage and consumption of food and beverage.

To start implementing clean areas,

- Remove and permanently exclude all chemicals, select agents, and all equipment from area.
  - If necessary, relocate all hazardous materials use and storage and maintain separation (at least 5 feet) from the area).
- Ensure newly designated clean area has been cleaned or neutralized.
- Ensure that radiation exposure rate in the clean area is <0.05 mR/hr
- Once steps 1-3 are completed, contact RMS to review clean area.
  - Follow proper chemical hygiene and when entering clean areas, remove gloves and lab coats or other potentially-contaminated PPE and wash hands thoroughly.

Overnight / Late Experimentation

Overnight or late-night experimentation can be quite dangerous since oftentimes the lab personnel working late hours are working alone. Experiments that are left to run overnight have the potential for more dangerous incidents because no one is around. Plan experiments accordingly. If experiments will take a longer time to perform, do not start them late in the evening. It is better to start the next day than to work overnight or late night and alone. *It is recommended to NEVER work alone. It is also best to NOT work when exhausted or tired.* When a lab personnel is exhausted or tired and continues to work, it is more likely for an accident to occur.

Below is a guide to help those who wish to work overnight or those who work late nights stay safe.

- Make multiple people aware that you are working overnight or late.
  - PIs or Lab Supervisors are **required** to be aware of who is working overnight or late nights.
  - Let a lab member know that you will be working overnight or a late night.
- Set check-in times with a lab member or PI.
- Perform a risk assessment of your experiment (see Ch 4. Risk Assessment)
  - Work through preparing for emergencies if you are the sole person in the lab. This can look very different than usual emergency preparation.
  - Have the list of emergency numbers for campus on hand.
- Discuss the experiment with your PI to ensure the correct procedures are being performed.
- If an experiment is being performed overnight or is left overnight, post a notice on the door.
  - This notice should include hazardous procedures, chemicals being used in the reaction, and any other important information about the reaction (i.e., reflux, sublimation, potentially explosive, etc.)
  - This notice should also include name and phone number of the person who set up and is running the experiment.
  - This notice should also include all emergency procedures if something were to occur
    - When performing the risk assessment of the experiment, ensure that preparing for emergencies takes into account that the person discovering the accident is potentially

NOT a lab member. Think about all potential possibilities during an incident or emergency and think of all of the steps to respond to possible emergencies or incidents.

- If running any highly exothermic reactions or potentially explosive reactions, make sure that proper engineering controls are in place to minimize the risk of an explosion.
    - Consider discussing these overnight reactions with RMS to ensure that all possible safety measures have been taken.