

Working with Carcinogens and Reproductive Toxins



Overview

This Update aims to help identify chemicals known or suspected of causing carcinogenic or reproductive health hazards. It also outlines best practices for handling these chemicals to minimize the chances of exposure and adverse health effects.

Use this document as a general Standard Operating Procedure (SOP) in addition to the WCM [Chemical Hygiene Plan](#). More specific High Hazard Operating Procedures (HHOP) may need to be developed based upon a complete hazard review of the chemical(s), its properties, and the lab's experimental plan. For more information, please consult the EHS [High Hazard Operating Procedure](#) Update.

Per the OSHA Laboratory Standard, prior to conducting work with particularly hazardous substances (i.e., select carcinogens and reproductive toxins), consideration must be given to the following:

- Establishment of a designated area;
- Use of containment devices such as fume hoods or glove boxes;
- Procedures for the safe removal of contaminated waste; and
- Decontamination procedures.

This document will cover WCM procedures and guidelines to meet the above criteria. **Any deviations from this SOP requires prior approval from the Principal Investigator.**

Applicability

This Update applies to all WCM laboratory students, faculty, staff, and visitors working with reproductive toxins or carcinogenic compounds.

Responsibilities

Principal Investigators (PIs) and Laboratory Supervisors are responsible for approving experiments and developing standard operating procedures for work that involves Particularly Hazardous Substances (PHS). They must verify that staff working with PHS receive the proper training, understand the hazards, and have access to the appropriate personal protective equipment (PPE). Ensuring safe lab operations includes:

- Maintaining a chemical inventory in Salute.
- Guaranteeing Safety Data Sheets are readily accessible to lab personnel.
- Ensuring that lab personnel complete Laboratory Safety Training annually.

Laboratory Personnel must complete all applicable trainings, adhere to guidelines of the laboratory's standard operating procedures, utilize PPE, and ask questions if anything is unclear.

Environmental Health and Safety (EHS) develops the guidelines in this update, provides annual laboratory safety training, and assists labs with creating SOPs and HHOPs. EHS also offers technical assistance to lab personnel about the safe handling, storage, and disposal of chemicals.



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Definitions

Particularly Hazardous Substances are defined in the Occupational Safety and Health Administration (OSHA) Hazardous Chemicals in Laboratories Standard (29 CFR 1910.1450) as substances including select carcinogens, reproductive toxins, and chemicals with high acute toxicity.

Carcinogens are chemicals or substances capable of causing cancer. They are chronically toxic in that they cause damage through repeated or continuous exposures. The effects of exposure may only become apparent after a long latency period.

Select Carcinogens are defined by the following criteria:

- It is regulated by OSHA as a carcinogen; or
- It is listed under the category "known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
- It is listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals as specified by any of the following:
 - (A) After inhalation exposure of 6-7 hours per day, five days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m³;
 - (B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or
 - (C) After oral dosages of less than 50 mg/kg of body weight per day.

Reproductive toxin refers to chemicals that affect the reproductive capabilities, including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring.

Mutagen refers to chemicals that cause permanent changes in the amount or structure of the genetic material in a cell. If the mutation occurs in a germ cell, the effects can be heritable.

Teratogen refers to those substances that can cause malformations, alterations, or permanent birth defects in a developing embryo.

Under the Globally Harmonized System (GHS), chemicals that are known or suspected carcinogens are assigned the H-codes: H-350 and H351. Chemicals that are known or suspected reproductive toxins are assigned the H-codes: H-360, H361, and H-362. The hazard pictogram denoted for these categories is



Chemicals with a High Acute Toxicity* are defined as:

- A chemical with a median lethal dose (LD₅₀) of 50 mg or less per kg of body weight when administered orally to certain test populations.
- A chemical with an LD₅₀ of 200 mg less per kg of body weight when administered by continuous contact for 24 hours to certain test populations.
- A chemical with a median lethal concentration (LC₅₀) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

*The primary focus of this update is carcinogens and reproductive toxins. Chemicals with high acute toxicity are covered in more detail as part of the EHS Update on [High Hazard Operating Procedures](#).



Guidelines for Conducting Work with Particularly Hazardous Substances (PHS)

ESTABLISHMENT OF A DESIGNATED AREA

Laboratories should establish a designated space to restrict the area where PHS are stored and used. Setting a PHS work location helps protect employees by minimizing the chance for exposure and limiting the area where contamination might occur. The size and the location of the designated area will vary based on the lab and experimental plan, but should be known to all laboratory members as the approved allocated space for working with a PHS.

The designated area may be a portion of the laboratory or a specific room within the laboratory suite. It might be a smaller area such as a particular chemical fume hood, a glove box, or another containment device. **Work with a PHS should not be conducted outside of this designated area.**

The location of the designated area must be clearly communicated and reviewed with staff as part of laboratory-specific training. It must also be included in any of the lab's standard operating procedures and have signage created to alert personnel to the hazards present in that work location. Signage should read something similar to the following:

**DANGER – DESIGNATED AREA for (define chemical & hazard)
Authorized Personnel Only**

If an entire room is allocated for work with PHS, laboratories should contact EHS to create or update the Health and Safety Door Sign for the area.

The designated work area should be decontaminated after work with the PHS is complete. Upon leaving the designated area, remove PPE and wash hands with soap and water.

USE OF CONTAINMENT DEVICES SUCH AS FUME HOODS OR GLOVE BOXES

Containment devices, such as chemical fume hoods, glove boxes, or glove bags, should be used when handling PHS.

Containment is critical when transferring or manipulating a PHS, such as weighing out a powder or pipetting a mixture. These simple procedures can inadvertently cause hazardous dust to become airborne or generate hazardous aerosols.

Chemical fume hoods are designed to capture chemical vapors and mitigate inhalation hazards. Chemical fume hoods used for work with PHS must be labeled as designated areas and kept uncluttered to maintain proper airflow. The hood sash acts as a splash shield and should be kept as low as possible while working to provide maximum protection. The EHS Update regarding [Toxic Powder Weighing](#) offers more detailed guidance to protect yourself while weighing out powders and describes the tare method that must be used if that the lab's balance is located outside of the chemical hood.

PROCEDURES FOR SAFE REMOVAL OF CONTAMINATED WASTE

Particularly hazardous substances and mixtures, including contaminated materials (i.e., pipette tips) and empty reagent bottles, must be appropriately labeled and collected as hazardous chemical waste and disposed of through the [EHS hazardous waste program](#).

Some PHS may also require special disposal procedures. These disposal procedures must be developed as detailed in the EHS [Waste Disposal Procedures manual](#), included in laboratory-specific training, and outlined in the lab's standard operating procedures or high hazard operating procedures. EHS should be consulted if there is any question on how to dispose of PHS waste or other waste materials contaminated with a PHS.

DECONTAMINATION PROCEDURES

Consult the safety data sheet (SDS) before starting work with any PHS to determine if special decontamination procedures are required. This decontamination information should be included as part of the lab's standard operating procedures or high hazard operating procedures and staff training. Lab personnel must use the approved decontamination method to clean equipment, non-disposable items (i.e., glassware), and work surfaces immediately after work with the PHS is complete. To protect work surfaces and aid in cleaning, the lab may choose to use plastic-backed absorbent pads, trays, or bench protectors that can be easily decontaminated



or discarded. These disposable covers should be changed daily and discarded as hazardous waste if they are contaminated. **Any equipment used with or near PHS must also be fully decontaminated before it can be removed from the designated area.**

PERSONAL PROTECTIVE EQUIPMENT

Proper lab attire is required to work in the laboratory:

- Clothing worn to the laboratory should be chosen to minimize the amount of exposed skin.
- Legs should be covered and closed-toe shoes worn.
- The PPE worn for a particular experiment should be chosen based on hazard analysis of the chemical, experimental setup, and likely exposure routes.

Detailed information regarding PPE is found in Section 22 of the [EHS Program Manual 4.1- Laboratory Chemical Hygiene Plan](#).

Lab coats, closed-toe shoes, clothing that covers the legs, and chemical-compatible gloves are the minimum PPE requirements for all personnel working in the lab. Based on the chemical properties of the PHS, other personal protective equipment (i.e., disposable lab coats, double gloves, chemical-resistant gloves, tight-fitting splash goggles, face shield) may be necessary. If the experiment requires PPE beyond the minimum requirements listed, this must be documented in the lab's standard operating procedures or high hazard operating procedures and staff training.

[Consult EHS](#) for questions about PPE selection, and contact EHS if the risk assessment shows the need for respiratory protection. Use of respiratory protective equipment requires pre-approval from EHS as the Respiratory Protection Program requires training, fit testing, and medical exam consistent with the OSHA Respiratory Standard (Title 29, Code of Federal Regulations, Part 1910.134). More information is available in the [EHS Program Manual 7.1 – Respiratory Protection Program](#).

PPE should be removed and hands should be washed with soap and water prior to leaving the designated area.

General Considerations

Apply the following best practices when working with PHS. Additional guidelines outside of what is listed here require prior approval and should be documented in the lab's SOPs and HHOPs, with staff trained accordingly prior to starting work.

PRIOR TO STARTING WORK

- **Plan new experiments carefully.** Obtain prior approval from the PI before ordering a new PHS, and receive lab-specific training on any SOPs or HHOPs before working with a PHS for the first time.
- **Review chemical hazard information prior to starting work.** This includes reading the safety data sheet to review signs and symptoms of exposure, review storage requirements, plan proper decontamination methods, and assess additional PPE requirements. Contact EHS at ehs@med.cornell.edu with any questions.
- **Review appropriate emergency procedures,** including the location of the nearest emergency equipment (e.g., safety shower, emergency eyewash station, spill kit).

PURCHASING

- **If possible, substitute a less hazardous chemical in place of working with a PHS.**
- **Purchase and work with the minimum amount of the PHS required to conduct the experiment.**
- **When possible, purchase the PHS as a pre-weighed powder,** adding buffer directly to the container, or purchase a pre-diluted solution to minimize handling of the chemical.

STORAGE, USE, AND TRANSPORT

- **Do not eat, drink, chew gum, apply cosmetics while near or within chemical use or storage areas.**
- **Do not work alone and do not leave experiments unattended.**
- **Utilize the appropriate PPE.**
- **Access to PHS should be restricted.** Store in an approved secure location with secondary containment and separated from incompatible chemicals.
- **Clearly label containers with the name of the chemical and its hazardous properties.**



- **Keep the work area clean and free of obstructions.** After each use or at the end of the day wipe down and decontaminate the work area and equipment to prevent build-up of chemical residue.
- **Work over disposable spill pads, liners, or trays that can be easily changed at the end of the experiment or the end of the day.** This will also prevent the build-up of chemical residue.
- If powders need to be weighed-out, use a balance located inside of a containment device, such as a chemical fume hood. When this is not possible, use the tare method described in the EHS Update: [Toxic Powder Weighing](#).
- **Use unbreakable secondary containment to transport samples.**
- **Practice good hand hygiene.** After the experiment is complete and upon leaving the designated area, remove PPE and wash hands with soap and water.

Spill Response

Never attempt to clean up a spill if you are alone. Call EHS at 646-962-7233 for assistance.

Basic emergency equipment such as a spill kit, eyewash station, safety shower, and fire extinguisher must be present in the work area. If any of this basic equipment is not immediately available, contact EHS.

Prior to starting cleanup, review the SDS in order to determine if any additional equipment is needed to clean a spill. Verify that the laboratory is equipped with the proper emergency supplies for the particular PHS, and document specialized spill clean-up or neutralization procedures in the lab's SOP or HHOP. Lab staff may attempt to clean a small spill inside of a containment device if they are not alone, if they are properly trained, and if they have the proper PPE. **Report the spill to the PI and EHS.**

In the event of a large spill or spill outside of containment, call EHS at 646-962-7233 immediately for assistance. Do not attempt to clean this type of spill. Turn off all ignition sources and evacuate the laboratory immediately. Alert others in the area and place signage on the door to indicate that no one should enter.

More guidance can be found in the [EHS Program Manual 4.3 Chemical Spill Planning and Response](#).

Exposure Response

Medical services are available through NYP Workforce Health and Safety, WCMC Student Health Service, or NYP Emergency Department. All employees who work with hazardous chemicals have access to medical attention and first-aid, including any follow-up examinations which the examining physician determines to be necessary.

In the event of chemical exposure, the exposed laboratory worker should get help from a nearby coworker. Remove any contaminated articles and use safety equipment (e.g., eyewash or safety shower) to flush the area for 15 minutes.

For minor injury or exposures, bring the Safety Data Sheet and go to one of the following as soon as possible:

- Employees: Workforce Health & Safety (212-746-4370), 1315 York Ave, Payson House Basement Level.
- Students: Weill Cornell Student Health Services (646-962-6942), 230 East 69th Street.
- During off-hours and weekends, go to the NYP Emergency Room, 525 East 68th Street.

If you are seriously injured, incapacitated, or need onsite medical assistance, call NYP EMS (212-472-2222) and provide lab location, hazardous material involved, and extent of exposure/injury. If you are able to, go directly to the NYP Emergency Room at 525 East 68th Street.

In addition to a known exposure event, laboratory workers should seek medical attention when:

- Signs or symptoms associated with a hazardous chemical exposure are experienced, or
- Exposure monitoring reveals an exposure level routinely above acceptable levels, or
- A spill, leak, explosion, or other event results in the likelihood of hazardous exposure.

Exposure to some PHS may require specific first-aid or emergency procedures; such as the administration of an antitoxin.

The lab's SOP or HHOP must include information on first-aid procedures, supplies and emergency contacts beyond basic first aid; as well as any requirements for follow-up medical consultations or examinations. If you are unsure what emergency/first-aid procedures are required for the material used, contact EHS for assistance.



References

- OSHA Code of Federal Regulations Title 29, Part 1910.1450 – [Occupational Exposure to Hazardous Chemicals in Laboratories](#)
- [Prudent Practices in the Laboratory](#)
- EHS Program Manual 4.1 – [Laboratory Chemical Hygiene Plan](#)
- EHS Program Manual 4.3 – [Chemical Spill Planning and Response](#)
- EHS Program Manual 5.2 – [Waste Disposal Procedures](#)
- EHS Update – [High Hazard Operating Procedures](#)
- EHS Update – [Toxic Powder Weighing](#)

Examples of Carcinogens and Reproductive Hazards

(This list is not all-inclusive)

1,2-Dibromo-3-chloropropane	Chlorambucil
1,3-Butadiene	Chloroform
1,4-Butanedimethylsulfonate	Chloromethyl methyl ether
2- Acetylaminofluorene	Chromium and chromium compounds
2-Methoxyethanol	Cyclophosphamide
3,3'-Dichlorobenzidine	Diethylstilbesterol
4,4'-Methylene-bis{2-chloroaniline}	Dimethyl formamide
4-Aminobiphenyl	Dimethyl sulfate
4-Dimethylaminoazobenzene	Ethylene dibromide
4-Nitrobiphenyl	Ethylene oxide
Acetaldehyde	Ethylenimine
Acrylamide	Formaldehyde
Acrylonitrile	Hexamethylphosphoramide
Aflatoxins	Hydrazine
α -Naphthylamine	Lead (inorganic compounds)
Aniline	Melphalan
Arsenic and arsenic compounds	Methyl Chloride
Asbestos	Methylenedianiline
Azathioprine	Mustard gas(bis(2-chloroethyl)sulfide)
Barium Chromate	N,N-Bis(2-chloroethyl)-2-naphthylamine
Benzene	Nickel carbonyl
Benzidine	N-Nitrosodimethylamine
Bis (chloromethyl) ether	Propylene glycol monomethyl ether
β -Naphthylamine	Propylene oxide
β -Propiolactone	Thorium dioxide
Cadmium	Vinyl chloride