

Environmental Health & Safety

SafetyMatters

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Let Your Right Hand Know What Your Left Hand is Doing

by Christopher Aston

While we may not have reason to believe that humans first walked upright to free their hands to perform laboratory research, we in the research community certainly use our hands for every conceivable part of our daily work. That is why it is important to avoid injuring them and to ensure they do not become vehicles for transmitting cross-contamination to fomites and infection to others. Let's examine a series of proverbs that may or may not have been written with hand safety in mind:

According to the German proverb, "Many hands make quick work," but when working with sharps, less may actually be more! EH&S investigates numerous needle stick accidents annually and typically finds such injuries are caused by a sharp in one hand injuring the other hand. Consider how difficult it would be to cause such an injury if you were just working with one hand! Ask yourself whether you can perform a procedure with one hand behind your back, out of the way. Then think about what device could be used to substitute for the use of your second hand; this could be an animal restraint or a pair of locking forceps, and always eliminate altogether risky procedures such as recapping of needles.

According to the Asian proverb, "When fate throws a dagger at you, there are only two ways to catch it; by the blade or by the handle." As your colleagues transport plates of cells, electrophoresis gels or other materials around your laboratory, take note of how many times people open a door wearing gloves. Think about what might be on their gloves, what they are leaving on the door handle and how you are going to get out of the room without getting that material on your skin. Then ask yourself whether you have ever done the same thing before. Good laboratory practice dictates that gloves should be removed when moving from one room to another. Durable transport containers with lids should be employed to move materials around the laboratory, these outer containers can be cleaned between uses, allowing it to be carried with clean, bare hands, and also provide secondary containment in the event of a spill or leak. If this is totally impractical in your laboratory, consider implementing a one-hand policy, where one ungloved hand is used to open the door and the other gloved hand carries the material.

Finally, according to the Greek proverb, "One hand washes the other and both wash the face." This could not be more true in the context of hand washing in the laboratory. Hand washing is the most effective means of infection control, so much so that the New York State clinical regulations require washing with soap and water over use of alcohol-based hand cleansers. Remember that you may have touched your wrist when removing your first glove, so pay attention to washing your wrists and the backs of your hands. Ask yourself whether you would want to touch your face after washing your hands. If not, you may want to spend a little more time at the sink.



Safe Use of Hydrofluoric Acid by Muhammad Akram

Hydrofluoric acid is one of the most hazardous chemicals used in research laboratories at Columbia University and elsewhere. The actual users and first-responders are at the greatest risk of exposure to incidents involving releases and spills. Gaseous hydrogen fluoride and hydrofluoric acid have nearly the same toxicological properties and can be considered interchangeable; the term "HF" is often used to denote either the gas or the liquid acid.

HF interacts corrosively with a wide variety of materials, making it both useful and hazardous. Most metals, natural rubber, rock, concrete, glass, fiberglass, ceramics and glazes are dissolved by HF. HF does not attack metallic lead and platinum, and importantly for laboratory use and storage, polyethylene, polypropylene, Teflon, PLEXIGLAS (acrylic), or wax.

HF burns are unlike other acid burns, where injury is caused predominately by dissociated H⁺ ions. HF readily penetrates skin, corroding soft tissue and bone. Inhaled HF vapor/gas can cause delayed pulmonary edema. Systemic HF poisoning removes Ca²⁺ from soft tissues and bones resulting in hypocalcaemia. Ca²⁺ regulation is critical for normal cell function, neural transmission, bone integrity, blood coagulation and intracellular signaling. Death following acute HF exposure is possible. Exposure to dilute solutions may not cause any pain on contact and may go undetected for hours, but delays in first aid/treatment of HF exposure result in painful, slow-to-heal burns and systemic HF poisoning. Any skin contamination or vapor inhalation, therefore, must be taken seriously and treated as an emergency. In case of skin contamination, immediately flood areas of exposure with copious amounts of water, followed by an application of calcium gluconate first aid gel, which must be on hand wherever HF is used. Seek medical help immediately.

The only place to work with HF safely is in a properly functioning chemical fume hood. Procedures involving even small quantities of dilute HF solutions must not be performed on an open laboratory bench. Prevent contamination by using plastic trays or bench paper on work surfaces before starting HF procedures. Always use a lab coat and/or acid resistant coverall/apron, gloves and goggles. Make sure you have received HF Safety training before use, and consult the HF policy on EH&S website (<http://www.ehs.columbia.edu/hfPolicy.html>), or call if you have any question.

Recent EPA @Nevis Inspection by Hazardous Materials Team

EH&S would like to congratulate Nevis on a successful inspection by EPA on February 2, 2012. EPA arrived at Nevis unannounced with the intention of inspecting the campus' hazardous waste and universal waste management practices. Nevis leadership immediately contacted EH&S when EPA arrived and 3 EH&S professionals were deployed to liaison with the EPA inspector. After a very brief inspection, for which no findings were documented or recommendations offered, EPA departed. This should serve as a reminder that EPA (or any other regulatory agency) can make an unannounced inspection at any time and we must remain vigilant in our efforts to maintain a high level of compliance at all times. Keep up the strong waste management practices!

We would also like to remind everyone of the training and education programs are essential to ensuring that the regulatory requirements for hazardous materials are easily understood and applied in a consistent manner. Please visit <http://ehs.columbia.edu/Training.html> for EH&S training requirements.

THE FDNY LABORATORY UNIT PERFORMS REGULAR, WEEKLY INSPECTIONS IN ALL CHEMICAL LABORATORIES ACROSS COLUMBIA UNIVERSITY'S NEW YORK CITY CAMPUSES, AND HAS THE AUTHORITY TO ISSUE VIOLATION ORDERS OR NOTICES OF VIOLATION FOR NON-COMPLIANCE WITH CODE REQUIREMENTS.

ALL LABORATORIES IN NYC REQUIRE A FDNY PERMIT TO OPERATE; THESE PERMITS ARE RENEWED EACH YEAR AFTER THE FDNY ANNUAL INSPECTION, AND WILL BE WITHHELD UNTIL ALL OPEN VIOLATIONS HAVE BEEN CORRECTED.

TOP VIOLATIONS 2011

- ◆ CERTIFICATE OF FITNESS – (C-14)
- ◆ CHEMICAL STORED IMPROPERLY
- ◆ EXTENSION CORD MISUSE

For Lab Fire Safety Prevention tips, check out:

FDN(wh)Y Me @

[http://](http://www.ehs.columbia.edu/FDNYMe.html)

www.ehs.columbia.edu/FDNYMe.html

Columbia University Guidelines for Short-term Visitors in Research-related Activities

by Tasha Hightower

Columbia University has revised its guidelines for visitors involved in research-related activities. As spring and summer breaks approach, EH&S would like to remind the research community about the University's policy regarding the presence of minors in laboratories. The policy still includes special provisions for minors, defined as individuals less than eighteen years of age, performing research-related activities in University laboratories (as opposed to being present during a tour for strictly observational purposes). These provisions include:

- ◆ A Registration Form and a Parental Consent Form, signed by a parent or guardian of the minor volunteer or observer, prior to them performing any research related activities.
- ◆ No one under the age of fourteen is allowed in any University laboratory (except if present on an organized tour or field trip for strictly observational purposes, provided hazards are minimized).
- ◆ Provided there is direct supervision by the principle investigator, minors between ages 14 and 17 may perform certain research-related activities in lab, so long as they have completed applicable safety training.
- ◆ No one under the age of eighteen is allowed to be alone in a laboratory.
- ◆ No one under the age of eighteen may handle human blood, human cell lines or any other material defined as "other potentially infectious materials" by OSHA (Bloodborne Pathogens Standard 29 CFR 1910.1030).
- ◆ No one under the age of eighteen may handle radioactive materials.
- ◆ No one under the age of eighteen may work with animals.

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A Little DAB Will Do You

by Courtney Drayer

3,3'-Daminobenzadine tetrahydrochloride (DAB) is an organic molecule that is oxidized by hydrogen peroxide in the presence of hemoglobin to produce a dark brown color that histologists can use to stain nucleic acids and proteins. DAB comes from a class of molecules (benzadines) which are known carcinogens. In fact, all benzadines that have been studied have been determined to have mutagenic properties by the US National Toxicology Program. Interestingly, neither the US Environmental Protection Agency (EPA) nor the New York State Department of Environmental Conservation (NYS DEC) specifically regulates DAB waste. Nonetheless drain disposal of these materials is not appropriate.

In New York City, the Department of Environmental Protection (DEP), governs and enforces the Rules of the City of New York (RCNY), which includes the regulation for "*Materials and Substances Excluded from Public Sewers*" found in Title 15, Chapter 19-03. This chapter describes materials not permitted to be discharged down the drain and states: "Toxic substances in such quantities, which the person knows or has reason to know, may when discharged from a single source or in combination with other sources; (iii) be detrimental to the health of human beings, animals, or aquatic life" are prohibited from sewer disposal. Since benzadines are known carcinogens, they are thus detrimental to the health of humans and animals and are prohibited from drain disposal. Columbia University's [Policy on the Drain Disposal of Chemicals](#), which prohibits essentially all chemicals from being disposed of via sewer, is largely based on DEP's regulation, as well as various EPA and DEC rules. Accordingly, DAB, regardless of quantity or concentration, must be collected as hazardous waste for off-site treatment, and ultimate disposal as a toxic material.

Hazardous Compressed Gas Storage in Laboratories by Rob Velez

Following a recent laboratory incident involving a defective cylinder of compressed fluorine gas - which fortunately is stored and used only within a chemical fume hood - EH&S has strengthened its partnerships with other laboratories storing and using hazardous gases, establishing and reinforcing best storage and monitoring practices.

Hazardous gases are regulated by a complex set of rules and standards at all levels of government, including the New York City and State Fire Code, Building Code, Mechanical Code, Fire Code of New York State and the National Fire Protection Association's Standard on Fire Protection for Laboratories Using Chemicals (NFPA 45). Together, these rules establish possession quantity limits and storage requirements, including specific ventilation and leak detection conditions.

In order to ensure the continued safety of the University research community, EH&S is partnering with Morningside's Capital Project Management team to develop a set of guidelines to assist laboratories in safely storing lecture bottles and cylinders containing hazardous gases based on current infrastructure, as well as for future projects.

In general, the quantity of flammable, toxic and oxidizing gases in any laboratory at a given time is limited to a specific amount of gas, measured cubic feet, or for gases in lecture bottles, which often contain the most highly toxic and reactive substances found in labs, a maximum of 25 individual lecture bottles per laboratory. Automatic leak detection systems are required for toxic and highly toxic gases, as well as flammable gas systems. The use of mechanical ventilation is required where dangerous gases are used. Toxic gases in lecture bottles can be kept in a functioning fume hood or ventilated fume hood cabinet (EH&S recommends the use of racks for storing lecture bottles) and larger toxic gas cylinders must be stored in a ventilated cabinet. Please contact EH&S with any questions related to the storage or use of compressed gases in your lab.

Your Options to Control & Extinguish a Fire by Harry J. Oster

In order to be successful at controlling and extinguishing a fire, one must first know and understand the components - known as the "fire tetrahedron" - required for a fire to occur: *fuel, heat and oxygen*; the removal of any one of these items breaks the chain reaction required to ignite a fire. When this happens, the fire can be controlled and extinguished.

For example, the use a fire extinguisher would remove the *heat* from fire thus cooling the materials and the fire is extinguished. However, if a fire extinguisher was not available, what other options might you have to successfully control and extinguish a fire?

Let's consider the example of a lit Bunsen burner. Simply and safely turning off the gas supply valve, removes the *fuel*, and thus extinguishes the fire. If a container of flammable material is on fire, simply and safely covering the container with a non-combustible cover, smothering the air supply, would remove the fire's *oxygen*, extinguishing the flames.

Whether in the lab, on-campus, or at home, knowing and understanding the components required for a fire to occur reveals other options besides the use of a fire extinguisher that can be utilized to successfully control and extinguish a fire.

Finally, remember: before attempting to control or extinguish any fire, your first action should be to activate the building's fire alarm by pulling the red colored fire alarm box located at each stairwell and at the ground floor exits of the building.

Cryovial Roulette by Greg Kwolek

Cryopreservation, the use of ultra-low temperatures to preserve cell lines and other critical biological materials, has become common practice in modern research. The associated physical hazards of liquid nitrogen and other cryopreservatives, however, carry the risk of serious injury, infection, and specimen contamination in the event of an incident involving cryopreserved materials. Cryogenic storage vials, specifically, have the potential to rupture and become projectiles, or to violently disperse their contents upon removal from liquid phase nitrogen storage. Liquid nitrogen can leak into the vials during immersion and rapidly expand when removed from storage and warmed to room temperature. With a liquid to gas expansion ratio of 1 to 700, the rapid evaporation of liquid nitrogen creates a pressure gradient far too great for the thin high-density polyethylene (HDPE) walls of cryogenic storage vials to contain. Nalgene, Nunc, and Corning, among other popular brands of cryovials used at Columbia University, all warn against the storage of their products in liquid phase nitrogen for these very reasons.

A recent laboratory incident highlights the research safety implications of cryopreservation. A graduate student was struck in the face when a cryovial, recently removed from storage under liquid nitrogen, violently ruptured. The shattered vial narrowly missed the affected student's eye, impacting their cheek and potentially contaminating their skin with the cells preserved within the vial. A similar vial ruptured in a separate incident, sounding as loud as a gunshot and leaving the affected student with a temporary ringing in the ears. Any of the thousands of vials immersed in liquid nitrogen on campus today present these same hazards, regardless of their manufacturer, design, or size.

Cryopreservation in liquid phase nitrogen presents additional risks to researchers beyond personal injury. Documented cases of bacterial and viral cross-contamination through liquid nitrogen from leaking containers have been published. In one case, bone marrow harvested for transplantation became contaminated with Hepatitis B virus (HBV) present in the liquid nitrogen, causing a small outbreak in the patients receiving the treatment. Just as alarming was the presence of the harvested patients' DNA in the liquid nitrogen, affirming that contaminants can move both in and out of storage containers.

Storage temperatures must be consistently maintained below the glass transition temperature (T_g) of water to ensure successful long-term cryopreservation. Liquid phase nitrogen is very effective at cooling samples to a frosty -196°C (60°C below T_g), the temperature at which biological activity, including the mechanisms responsible for cell death, ceases. However, several safer alternatives to liquid phase nitrogen storage are available. Mechanical and liquid nitrogen refrigerated vapor phase storage systems are available in a variety of temperature ranges, price points, and storage capacities. Current generation mechanically refrigerated cryogenic freezers can maintain storage temperatures to -150°C uniformly throughout the storage chamber. Specimens are thus maintained safely below T_g without the use of liquid nitrogen, protecting the specimens from cross-contamination and preventing the researcher from engaging in a game of cryovial roulette.

More commonly, liquid nitrogen refrigerated vapor phase storage solutions are employed. Cryogenic freezers or liquid nitrogen dewars are partially filled, relying on the slow evaporation of liquid to cool the storage chamber. When liquid nitrogen levels are managed appropriately, the vapor within the storage chamber can be maintained below -150°C , safely preserving the specimens.

While not the preferred method for cryopreservation, some laboratories may still be faced with immersing vials in liquid phase nitrogen due to research or other operational constraints. When it is necessary to use this storage method, a variety of safety precautions must be closely adhered to. Despite improving vial designs, such as internal threading and silicon o-rings, liquid nitrogen may still leak into vials through the cap threads. Preventing direct contact between the cap threads and liquid nitrogen by hermetically sealing the vials inside heat-shrink tubing is the manufacturer approved method for safe liquid phase nitrogen storage.

To further enhance safety, vials should first be removed to vapor phase storage for 24 hours to allow trapped liquid nitrogen to slowly boil away, before being moved to a biological safety cabinet or other suitable enclosure for further thawing. Anyone manipulating cryogenic material or equipment should be wearing a buttoned laboratory coat, safety glasses, a full-face shield, and insulated gloves for personal protection.

Radiation User Permits – To Terminate or Inactivate? by Thomas L. Morgan

Investigators who use radioactive materials are issued a permit by the Radiation Safety Officer. With this permit comes a variety of responsibilities, including monthly contamination surveys in the lab, annual radiation safety refresher training for personnel, and maintaining logs of radioactive material use and waste. When radioactive materials have not been used for some time and there are no specific plans to do so in the future, the Investigator has 2 options – termination or inactivation of the permit.

Termination. Permit termination occurs most often when the Investigator retires or leaves the University. However, it can occur when the focus of the laboratory’s research moves away from procedures requiring radioactive materials. Upon termination, the laboratory surrenders all radioactive materials, including stored stock vials and all waste. Equipment and laboratory spaces must be surveyed to ensure there is no residual contamination present. If the Investigator decides to use radioactive materials again in the future, a formal application to the appropriate Radiation Safety Committee must be presented (see <http://www.ehs.columbia.edu/RequestAddIsotopeLicense.pdf>).

Inactivation. Investigators may choose to temporarily suspend the use of radioactive materials. Like termination, all radioactive materials must be surrendered and a comprehensive survey of laboratory spaces must be performed. In addition, during the inactivation period, in lieu of monthly surveys the laboratory must document their lack of use of radioactive materials, and the lab remains subject to an annual audit. In contrast to termination, however, the Investigator may request re-activation of the permit at any time by simply contacting the Radiation Safety Officer in writing. If the permit expires while it is inactive, it will not be automatically renewed.

If you have questions about these policies, please contact Radiation Safety at 212-305-0303 (CUMC) and 212-854-4442 (Morningside, Barnard College, Nevis Laboratories, and Lamont Doherty Earth Observatory).

Think Sharp by Rebecca Lonergan

The University has recently updated disposal procedures for chemically contaminated “sharps.” “Sharps” are contaminated items from research that may tear a red bag during transport, including: hypodermic needles, syringes, scalpel blades, slides, cover slips, serological pipettes (glass or plastic), Pasteur pipettes, pipette tips and blood vials. All chemically contaminated sharps that contain no free liquids must be disposed of into puncture resistant “sharps” disposal containers. Containers are provided and removed by the University’s regulated medical waste vendor, Stericycle. For information on sharps collection, or to obtain containers, visit our website at: <http://www.ehs.columbia.edu/bsSharpsContainers.html>.

As a reminder, sharps containers must not be filled to the point where pipettes stick out through the top. Please ensure that the laboratory has a sufficient number of containers on-hand to prevent overfilling. Red bags (i.e., Regulated Medical Waste) are to be used only for ‘soft’ items, such as contaminated paper towels and Petri dishes that will not puncture or tear the bag. Do not use red bags or sharps containers for “regular” trash (e.g., packaging materials, papers, cardboard boxes, and unwanted or broken plastic or glass bottles that are otherwise free of biological contamination). Full containers should be placed in the appropriate location for removal by the University’s regulated medical waste vendor.



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