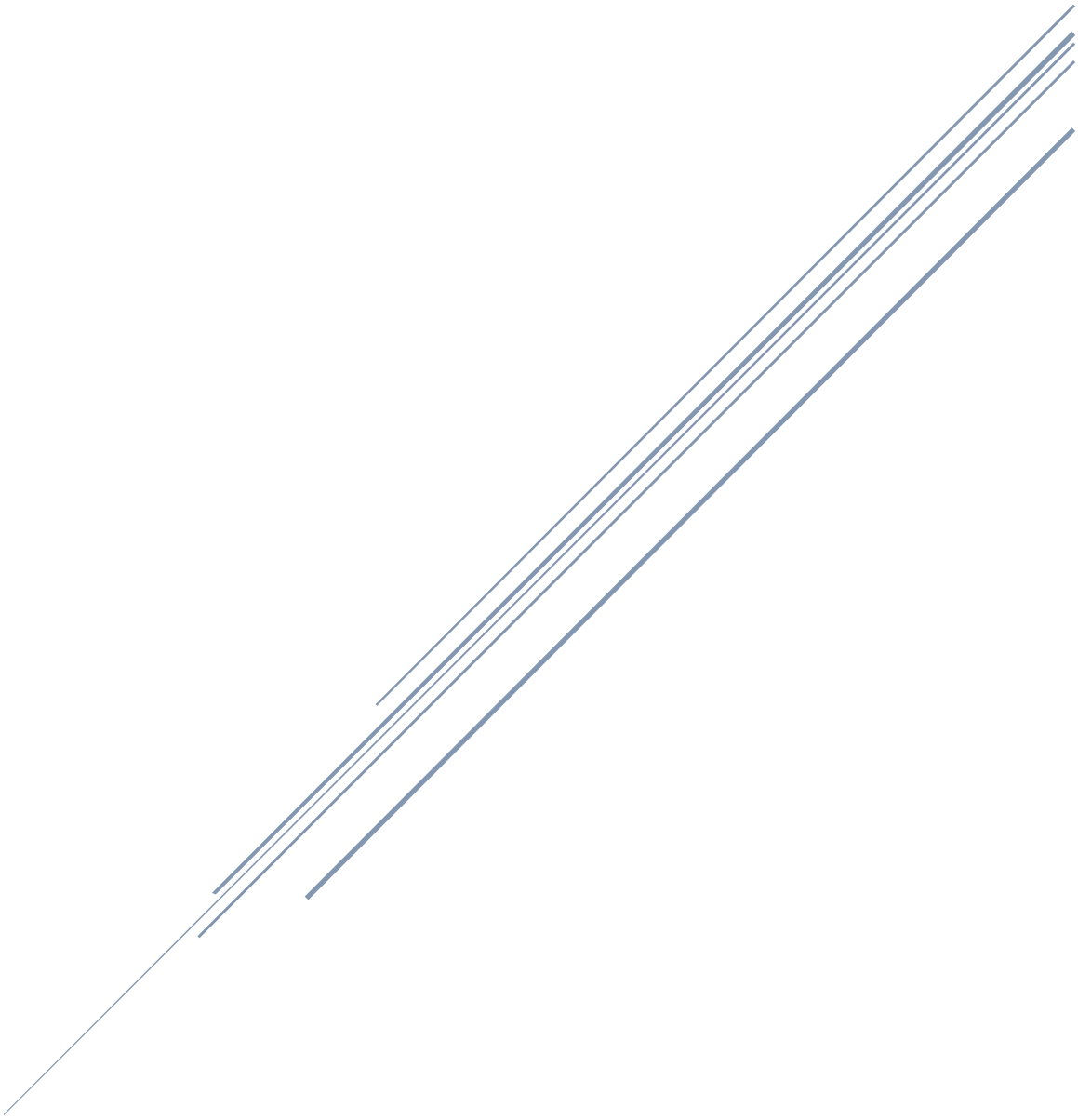
Chemical Hygiene Plan



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List of Acronyms

Acronym	Definition
ANSI	American National Standards Institute
ACGIH	Association Advancing Occupational & Environmental Health
CFR	Code of Federal Regulations
DHS	Department of Homeland Security
DCHO	Departmental Chemical Hygiene Office
DCHP	Departmental Chemical Hygiene Plan
EHS	Environmental Health & Safety
EPA	Environmental Protection Agency
GHS	Globally Harmonized System
HF	Hydrofluoric acid
KSSP	Kent System for Sign Postage
KSU	Kent State University
NFPA	National Fire Protection Association
NIH	National Institute of Health
OSHA	Occupational Health & Safety Administration
PHSs	Particularly Hazardous Substances
PPE	Personal Protection Equipment
PI	Principal Investigator
SDS	Safety Data Sheets
SOP	Standard Operating Procedure
UCHP	University Chemical Hygiene Plan
UFM	University Facilities Management

1.0 Chemistry & Biochemistry Departmental Chemical Hygiene Plan

1.1 Purpose

This Chemistry & Biochemistry Department Chemical Hygiene Plan (DCHP) meets the requirements for compliance with OSHA's "Standard for Exposure to Hazardous Chemicals in Laboratories", 29 CFR 1910.1450 to minimize exposure of laboratory personnel to health and physical hazards presented by hazardous chemicals used in Chemistry and Biochemistry laboratories at Kent State University (KSU).

1.2 Scope

The Chemistry and Biochemistry Department Chemical Hygiene Plan applies to laboratories that use, store or handle potentially hazardous chemicals and all personnel and students who work in these facilities. The information presented in the DCHP represents best practices and provides an overview of the information necessary for the safe operation of laboratories that utilize potentially hazardous chemicals. *It is not meant to be all-inclusive*.

2.0 Rights and Responsibilities

2.1 KSU Environmental Health and Safety Committee

2.1.1 Provide oversight and assistance for managing the university's laboratory chemical safety program.

2.2 Departmental Environmental Health & Safety Committee

2.2.1 Provide oversight and assistance for managing the Chemistry and Biochemistry department chemical safety program. As a part of this oversight, the Departmental Environmental Health & Safety Committee reviews incidents that the Departmental Chemical Hygiene Officer (DCHO) deems necessary.

2.2.2 Members of the Departmental Environmental Health & Safety Committee are appointed by the DCHO on an annual basis. Appointments are made each fall and last a full calendar year.

2.3 Department Chairperson

2.3.1 Appoint a Chemical Health & Safety Coordinator.

2.3.2 Assist in the development of a Departmental Chemical Hygiene Plan (DCHP) to implement and ensure compliance with the University Chemical Hygiene Plan (UCHP).

2.3.3 Serve as an active member of the Departmental Safety Committee and be a pro-safety representative for the department.

2.4 Principal Investigators (PI) and Laboratory Supervisors.

2.4.1 Ensure laboratory functions in accordance with DCHP.

2.4.2 Ensure all students and employees working in their labs comply with the DCHP and the UCHP.

2.4.3 Make available Safe Operating Procedures (SOP) [alternatively, edit and approve SOP's written by post-docs, graduate students, or the DCHP] on unique equipment, procedures and hazards specific to the laboratory in which they will be working.

2.4.4 Ensure all people working in the laboratory have received training on equipment, procedures and hazards specific to the laboratory in which they will be working.

2.4.5 Enforce rules and requirements of the UCHP, DCHP and SOPs specific to the laboratory.

2.5 Employees: PIs, Graduate Assistants, Faculty, Students, Visiting Scientists, Volunteers, etc.

All employees in research or teaching laboratories that use, handle or store hazardous chemicals are responsible for:

2.5.1 Annual Review of the DCHP as well as review of the appropriate Safety Manuals and Policies.

2.5.2 Following all laboratory safety rules, regulations, and standard operating procedures required for the tasks assigned.

2.5.3 Developing good personal chemical hygiene habits, including but not limited to, keeping the work areas safe and uncluttered.

2.5.4 Planning, reviewing and understanding the hazards of materials and processes in their laboratory research or other work procedures prior to conducting work.

2.5.5 Utilizing appropriate measures to control identified hazards, including consistent and proper use of engineering controls, personal protection equipment (PPE), and administrative controls.

2.5.6 Understanding the capabilities and limitations of PPE issued to them.

2.5.7 Gaining prior approval from the PI/Laboratory Supervisor for the use of restricted chemicals (such as, radioactive chemicals and P-listed chemicals) and other materials.

2.5.8 Consulting with PI/Laboratory Supervisor before using particularly hazardous substances, explosives and other highly hazardous materials or conducting certain higher risk experimental procedures (i.e., experiments requiring a blast shield);

2.5.9 Immediately reporting all accidents and unsafe conditions to the PI/Laboratory Supervisor or Departmental Chemical Hygiene Officer.

2.5.10 Completing all required health, safety and environmental training and providing certification documentation to their supervisor.

2.5.11 When working autonomously or performing independent research or work, research personnel are responsible for:

2.5.11.1 Reviewing the plan or scope of work for their proposed research with the PI/Laboratory Supervisor.

2.5.11.2 Notifying and consulting with the PI/Laboratory Supervisor, in advance, if they intend to significantly deviate from previously reviewed procedures (i.e., a change in molarity).

2.5.11.3 Providing appropriate oversight, training and safety information to laboratory or other personnel they supervise or direct.

2.6 The Departmental Chemical Hygiene Officer (a.k.a. Chemical Health & Safety Coordinator)

2.6.1 Prepares and reviews (at least annually) the DCHP and other departmental specific documents.

2.6.2 Provides support to the University Safety Committee and chairs the Departmental Safety Committee.

2.6.3 Provides technical assistance to laboratory workers.

2.6.4 Facilitates the implementation of the DCHP and assisting in establishing a safe work environment by collaborating with the Office of Compliance and Risk Management, faculty, other researchers and lab personnel.

2.6.5 Coordinates or provides training on occupational health and safety requirements.

2.6.6 Attends and participates in the University Safety Committee meetings.

2.6.7 Encourages compliance with laboratory safety rules.

2.6.8 Prepares and files incident reports with the Environmental Health and Safety (EHS) Office.

2.6.9 Maintains an up to date chemical inventory system: oversees delivery of chemicals and packages to appropriate laboratories.

2.6.10 Collects and monitors chemical waste prior to disposal.

2.7 Facilities Planning and Operation, Environmental Health and Safety Office, Manager of Research and Laboratory Safety.

2.7.1 Manages the KSU laboratory safety, radiation safety, laser safety and biosafety programs. Determines Industrial Hygiene monitoring requirements.

2.7.2 Monitors and inspect laboratories to determine compliance with federal, state and local health and safety regulations.
2.7.3 Assists with the development of safety training and education programs for UCHP participants.
2.7.4 Annually review the UCHP implementation.
2.7.5 Develop and publishes Safety Bulletins as guidelines for compliance with regulations and generally accepted laboratory safety procedures.

3.0 Information to be Given to All Affected Employees

All personnel that utilize hazardous chemicals in the laboratory will receive this policy and be trained on its contents.

3.1 The following information shall be provided to laboratory personnel at the time of initial assignment to the laboratory.
3.1.1 "Occupational Exposure to Hazardous Chemicals in Laboratories" 29 CFR 1910.1450 4. Location of the University and/or Departmental Chemical Hygiene Plan.
3.1.2 The permissible exposure limits and recommended exposure limits for chemicals are found on the Safety Data Sheet for that chemical. Permissible Exposure Levels are also found in OSHA PEL, 29 CFR 1910.1000 available at the EHS Office. ACGIH recommended exposure levels are available at the EHS Office.
3.1.3 Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory are found in *Section 11: Toxicological information* of the Safety Data Sheet (SDS) for the chemical.
3.2 Additional safety reference material available on campus includes:
3.2.1 SDSs received from the chemical supplier. These are available online; see your PI or DCHO for instructions on how to access the system.

4.0 Initial Training for All Affected Employees

4.1 General Laboratory Safety Training is available online via the FlashTrain: Environmental Health & Safety Training Program, see **Appendix A** for FlashTrain login instructions.
4.2 Initial laboratory safety training will consist of:
4.2.1 The contents of the OSHA standard, which governs the use of potentially hazardous chemicals in laboratories [29 CFR 1910.1450].
4.2.2 The availability and details of the UCHP.
4.2.3 A general understanding of the signs and symptoms associated with overexposure to hazardous chemicals used in the laboratory as found on the SDS.
4.2.4 The location and availability of reference material concerning the hazards, safe handling, storage, and disposal of hazardous chemicals.
4.2.5 General training on how laboratory employees can protect themselves from the potential hazards of the chemicals they work with including work practices, personal protection equipment, and emergency procedures.
4.2.6 Following training, faculty, staff and students are REQUIRED to email their completion certificates to the DCHO.
4.3 Departmental Specific Training
4.3.1 The contents of the DCHP and rules and procedures decided specifically for the KSU Chemistry and Biochemistry Department.
4.4 Laboratory Specific Training
4.4.1 Laboratory specific training will be provided by the PI and will consist of:
4.4.1.1 Methods and observations that may be used to detect the presence or release of a unique hazardous chemical they may be using in that lab.
4.4.1.2 The physical and health hazards of unique hazardous chemicals in the work area.

4.4.1.3 Standard Operating Procedures: The SOP must outline process steps that identify the scope of the research, specific order of activities, materials, environment, approval, equipment, safety and health considerations, disposal and decontamination. Each laboratory is responsible for developing their own SOPs beyond what is described in the shared departmental SOPs, as necessary.

4.4.1.4 The measures that can be taken to protect yourself from these hazards, including specific procedures the Chemistry Department has implemented to protect persons from exposure to hazardous chemicals, such as engineering controls, appropriate safe work/lab practices, emergency procedures, and personal protection equipment to be used.

4.4.1.5 Location of Safety Data Sheet for the chemicals used in the laboratory.

4.4.1.6 **Appendix B** contains recommended documentation to use for recording training.

4.5 Academic Laboratory Safety Training

4.5.1 Academic Laboratory Safety Training is conducted by the teaching assistant of each laboratory course section; see **Appendix C** for the details of Academic Laboratory Safety Training.

5.0 Approvals

5.1 The Principle Investigator will institute a review mechanism and give approval for the following items:

5.1.1 For operations left unattended.

5.1.2 For new operations involving pressurized or very exothermic reactions.

5.1.3 Working after normal office hours [Normal office hours: 7:00 am to 6:00 pm].

5.1.4 Significant deviation, as defined by the Principle Investigator, from approved protocol.

5.2 Approval to continue or proceed will be obtained from the appropriate designee:

5.2.1 When there is a failure of equipment, especially safety control measures such as fume hoods, clamp apparatus or temperature control.

5.2.2 When the procedure produces unexpected potentially hazardous results.

6.0 General Lab Safety Rules

6.1 Locations & Reporting

6.1.1 Know the location of emergency showers, eyewash fountains, first aid kits, emergency kits, spill kits, and fire alarm pull stations. Know the location of the nearest telephone, and, in an emergency, call 911.

6.1.2 Know the location of Safety Data Sheets.

6.1.3 Report all injuries, fires, and accidents to your PI or Laboratory Supervisor, DCHO and EHS Office (Ext. 2-4347). All fires must be immediately reported by dialing 911 and the Fire Safety department must be notified (Ext. 2-1962).

6.1.4 Comply with all warning labels and signs.

6.1.5 If you have a question about a procedure or the hazards of a chemical, ask your PI or Laboratory Supervisor before performing the procedure.

6.1.6 Never work alone in a laboratory or chemical storage area unless appropriate means are available to summon assistance.

6.1.7 Perform only those experiments or procedures that you are authorized to do by the person in charge of the lab.

6.2 Housekeeping

6.2.1 Laboratories must be kept free of clutter. Working areas should be cleaned up at the end of each operation and at the end of each day.

6.2.2 Small spills of chemicals must be cleaned up **immediately**. Spills that require cleanup measures beyond general housekeeping by laboratory personnel must be reported to the DCHO.

6.2.3 Safety showers, eyewash fountains, and fire extinguishers must be free from obstructions that would prevent access and ease of use. Access to emergency exits must be kept clear at all times.

6.2.4 Circuit breaker panels must have an unobstructed clearance of 30 inches [Ohio Fire Code 605.3].

6.2.5 The floor must be kept clean and free of slip hazards by reasonable cleaning and immediate cleanup of spills.

6.2.6 Old containers, compromised containers, and full chemical waste containers must be disposed of properly by notifying the DCHO and not allowed to accumulate.

6.3 Inspections

6.3.1 Temperature control and over-temperature shutoff devices on heating equipment should be tested in accordance with manufacturer recommendations to ensure proper operation.

6.3.2 All automatic shutoff devices should be tested in accordance with manufacturer recommendations to ensure proper operation.

6.3.3 Fume hood performance will be checked annually. The Facilities Mechanical Systems Specialist conducts fume hood performance audits for Laboratories (Ext. 2-1990).

6.3.4 Explosion shields and isolation devices must be visually inspected by the user for cracks or other damage before use.

6.3.5 Safety showers and emergency eyewash fountains will be inspected monthly by University Facilities Management (UFM). Tags indicating date inspected and the inspectors name will be attached on or near the shower or eyewash.

6.4 Personal Protection Equipment:

6.4.1 Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory.

6.4.2 Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials

6.4.3 Long hair, neckties, or loose clothing must be tied back or otherwise secured.

6.4.4 Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the laboratory.

6.4.5 Avoid use of contact lenses in the laboratory unless necessary.

6.5 Chemical Handling and Storage:

6.5.1 Properly label and store all chemicals.

6.5.2 Use secondary containment <u>at all times</u> when transporting chemicals.

6.5.3 Containers must be closed when not in use.

6.5.4 Do not smell or taste chemicals. Avoid inhalation of chemicals. Do not “sniff” chemicals to determine their identity or for other reasons.

6.5.5 Never use mouth suction for pipetting or starting a siphon.

6.5.6 Always add acid to water.

6.5.7 Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the EHS Office’s Hazardous Waste Disposal Guide [see Section 12.1].

6.5.8 NEVER dispose of any hazardous chemicals through the sewer system.

6.5.9 Be prepared for an accident or spill and refer to the emergency response procedures for the specific material. Procedures must be readily available to all personnel.

6.5.10 For general guidance, the following situations should be addressed:

6.5.10.1 Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention.

6.5.10.2 Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention.

6.6 Equipment Storage and Handling:

6.6.1 Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments must implosion occur

6.6.2 Keep hood closed when you are not working in the hood.

6.6.3 Do not use damaged glassware or other equipment.

6.6.4 Avoid unnecessary storage of materials in hoods.

6.6.5 Do not allow the vents or airflow to be blocked.

6.7 Laboratory Operations:

6.7.1 Keep the work area clean and uncluttered.

6.7.2 Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.

6.7.3 If unattended operations are unavoidable, and have been approved by the PI/Laboratory Supervisor, place an appropriate sign on the door and provide containment for toxic substances in the event of failure of a utility service (such as cooling water) [see the *Unattended Operations* section 15.20].

6.7.4 Be alert to unsafe conditions and ensure that they are corrected when detected.

6.7.5 Do not engage in distracting behavior such as practical jokes in the laboratory. This type of conduct may confuse, startle, or distract another worker.

6.7.6 Wash areas of exposed skin well before leaving the laboratory.

6.8 Food/Drink:

6.8.1 Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities.

6.8.2 Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils that are used for laboratory operations.

7.0 Labels, Signs and Other Forms of Warning

7.1 Laboratories with special or unusual hazards must be posted with appropriate warning signs including: laser-warning signs, radioactivity warning signs, biological hazard signs, etc.

7.2 Labeling requirements for all hazardous substances are summarized as follows:

7.2.1 Labels on incoming containers of hazardous chemicals must not be removed or defaced until the container is completely empty.

7.2.2 All containers of hazardous materials must be labeled with the identity of the hazardous substance and all applicable hazard-warning statements.

7.2.3 All original containers will be labeled with a barcode generated by the inventory system that is applied by the DCHO upon receiving shipment. If you find a chemical without a barcode, please notify the DCHO.

7.2.4 Labels must be legible, in English, and clearly displayed.

7.2.5 Non-original containers (e.g., smaller or temporary containers into which a material is transferred for use) must be labeled with the identity of the substance, date, and initials of owner.

7.2.6 Use the symbols in the *Globally Harmonized System of Classification and Labeling of Chemicals* (https://www.osha.gov/Publications/OSHA3636.pdf).

7.2.7 Containers holding any chemicals must NEVER be unlabeled, see *Unlabeled Chemicals Screening* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/unlabeledchemicals.pdf) for assistance.

7.3 All hazardous materials waste containers must be labeled with the following:

7.3.1 Type of waste in container (e.g. Non-Halogenated, Halogenated, Acid, Base, etc.)

7.3.2 Identity of chemicals added on container.

7.3.3 Statement or statements that call attention to the particular hazardous properties of the material (e.g., flammable, corrosive, etc.).

7.3.4 Labeling is not required for portable containers of hazardous chemicals that are intended for the immediate use of the individual who performs the transfer.

7.4 Where hazardous materials are transported by piping systems, above ground pipes must be labeled by:

7.4.1 Preferably by stenciling the name or abbreviation of the chemical and an arrow, indicating direction of flow of the material, or,

7.4.2 Permanently marking or attaching tags of metal or other suitable material naming the material transported on or near valves.

7.5 Chemical Inventory System (CHIMERA)

7.5.1 All faculty and graduate students should have access to the CHIMERA Chemical Inventory System. If you are unable to login to CHIMERA, speak with the DCHO.

7.5.2 Chemical inventory access for laboratories that you work in is granted to you. No one is granted access to other laboratory's chemical inventories.

7.5.3 PI's may join ChemShare. The ChemShare search is an optional function that users must opt-into. Participants in Chemshare are able to search any ChemShare user's inventory for a product and CHIMERA will provide contact information for those who have it in their inventory. In order to participate in ChemShare, users have to opt-in while creating their account. If the user already has an account and would like to participate in ChemShare, they should contact the EHS Office (x2-1944).

7.5.4 CHIMERA may also be used to search for safety data sheets.

8.0 Safety Data Sheets (SDS)

8.1 Safety data sheets must be read before working with a chemical and accessible in the laboratory during use.

8.2 SDSs for chemicals unique to a specific laboratory will be kept in that laboratory.

8.3 SDSs for unique chemicals must accompany that chemical if it is transferred to another lab in or outside the University.

8.4 If a material synthesized at KSU is transferred out of the University, a SDS must accompany that material. If a SDS does not exist, one must be prepared prior to the transfer. The principal investigator is responsible for ensuring that a SDS is generated and goes with the shipment. SDS generation should be coordinated with the Research Safety Manager.

8.5 SDSs are available via *CHIMERA* (https://rms.unlv.edu/chimera/kent/) or *ChemWatch* (https://jr.chemwatch.net/chemwatch.web/account/login?ReturnUrl=%2fchemwatch.web%2fhome).

9.0 Identification and Classification of Hazardous Chemicals

9.1 Chemicals can be divided into several different hazard classes (see **Appendix D**). Hazard class will determine how these materials should be stored and handled and what special equipment and procedures are needed to use them safely.

9.2 Rooms containing hazardous chemicals MUST be labeled with a door placard at every entrance. Kent State University uses the *KSSP system* (http://solutions.kent.edu/KSSP) to automatically generate hazard-warning signs for individual labs. Primary contacts for each lab are responsible for reviewing, making necessary changes, and signing off on hazard warning signs annually. Included on the door placard:

9.2.1 The name of the PI, the building, the room number and emergency contact information;

9.2.2 Personal protection requirements;

9.2.3 Specific hazards and warnings (chemical, biological, radiological) utilizing the GHS (Globally Harmonized System) pictograms;

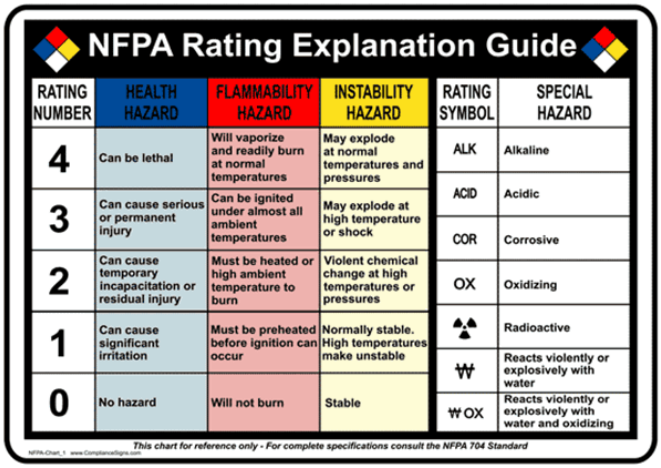
9.2.4 Special hazards;

9.2.5 Emergency response information and the NFPA label.

9.3 NFPA Labels

9.3.1 For NFPA labels, **1** indicates a low level of hazard and **4** indicates a high hazard level.

9.3.2 NFPA Labels:



NFPA Rating Explanation Guide

RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock
2	Can cause temporary incapacitation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable
0	No hazard	Will not burn	Stable

RATING SYMBOL	SPECIAL HAZARD
ALK	Alkaline
ACID	Acidic
COR	Corrosive
OX	Oxidizing
	Radioactive
W	Reacts violently or explosively with water
W OX	Reacts violently or explosively with water and oxidizing

This chart for reference only - For complete specifications consult the NFPA 704 Standard

9.4 GHS Labels:

9.5 All laboratory workers must understand the types of hazards, recognize the routes of exposure, and be familiar with the major hazard classes of chemicals. In many cases, the specific hazards associated with new compounds and mixtures will not be known, so it is recommended that all new chemical compounds and mixtures be treated as if they were potentially harmful and to use appropriate eye, inhalation and skin protection equipment.

9.6 Additional Resources:

9.6.1 *Reading Safety Data Sheets* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/2%20Reading%20Safety%20Data%20Sheets%20%28PDF%29.pdf)

10.0 Chemical Storage

10.1 Basics of Chemical Storage

10.1.1 Instructions on chemical storage for a specific chemical may be found in *Section 7* of the safety data sheet.

10.1.2 The specific SDS for any chemical must always be consulted when doubts arise concerning chemical properties and associated hazards.

10.1.3 Date all containers when opened.

10.1.4 Store incompatible chemicals separately, as opposed to alphabetically. Store all compatible chemicals in labeled storage areas or cabinets.

10.1.5 Each chemical in a laboratory should be stored in a specific location and returned there after each use.

10.1.6 Liquid chemicals must be placed below eye level, specifically 7 feet or below.

10.1.7 Flammable liquids should be stored in approved safety cabinets.

10.1.8 Chemicals must not be stored on the floor and must not protrude into traffic areas.

10.1.9 Chemicals must be stored at an appropriate temperature and humidity level and generally not stored in direct sunlight or near heat sources, such as laboratory ovens.

10.1.10 Chemicals must not be routinely stored on bench tops or stored on the floor. Additionally, bulk quantities of chemicals (i.e., larger than one kilogram) must be stored in a separate storage area.

10.1.11 Freezers must be defrosted periodically so that chemicals do not become trapped in ice formations.

10.1.12 Never store flammables in a refrigerator not specifically designed for storage of flammable liquids.

10.1.13 Food must not be stored or consumed in areas where toxic chemicals are used or stored.

10.1.14 Hallways and stairways must not be used as storage areas.

10.1.15 All containers must have caps and covers that are securely in place whenever the container is not in use.

10.1.16 Keep chemical inventory to a minimum and do not store excess quantities of any hazardous materials.

10.1.17 In shared areas, space, equipment and prepared solutions must be labeled with user, date, and lab name.

10.2 For specifics on chemical storage, see the *KSU Chemical Storage and Handling Policy* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/chemical-storage-and-handling-806chemstore.pdf).

10.3 Additional resources:

10.3.1 *Chemical Storage by Hazard Category & Incompatibility* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/Chemical%20Storage%20by%20Hazard%20Category.pdf)

10.3.2 *Incompatible Chemical List* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/Incompatible%20Chemical%20List.pdf)

10.3.3 *Toxic Gases Mixtures* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/Mixtures_Toxic_Gases.pdf)

10.4 Safe Chemical Storage Priorities

Keep in mind that most chemicals have multiple hazards and a decision must be made as to which storage area would be most appropriate for each specific chemical.

10.4.1 Flammability. When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.

10.4.2 Isolate. If the material will contribute significantly to a fire (e.g., oxidizers), it must be isolated from the flammables. If there were a fire in the laboratory and response to the fire with water would exaggerate the situation, isolate the water reactive material away from contact with water.

10.4.3 Corrosivity. Next look at the corrosivity of the material, and store accordingly.

10.4.4 Toxicity. Finally, consider the toxicity of the material, with particular attention paid to regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage area. For example, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage cabinet to protect it against accidental release.

10.4.5 There will always be some chemicals that do not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion.

11.0 Chemical Spill Response

11.1 For chemical spill response policies, see the *KSU Chemical Spill Response* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/chemical-spill-response-215chemical-spill-response.pdf).

11.2 Additional resources:

11.2.1 *Chemical Spill Kit Help* (https://www.kent.edu/sites/default/files/file/Chemical_Spill_Kit_Help.pdf).

12.0 Hazardous Waste

12.1 Hazardous waste must be disposed of according to EHS policy, see *KSU Hazardous Waste Disposal Policy* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/hazardous-waste-disposal-225-hazardous-waste-policy.pdf).

12.2 Additional Resources:

12.2.1 *Chemistry Department Sharps Disposal Procedures* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/Sharps_Disposal_Procedures_CHEM.pdf)

12.2.2 *Lab Waste Disposal Requirements* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/file/4%20Lab%20Waste%20Disposal%20Requirements.pdf)

12.2.3 *Ways to Reduce Hazardous Waste* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/ways-to-reduce-chemical-waste-sb-chem-waste-reduction.pdf)

12.2.4 *Biological Waste Disposal* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/treatment-and-disposal-of-biological-materials.pdf)

12.2.5 *Radioactive Waste Disposal* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/radioactive-waste-handling-and-disposal-ksu-radioactive-waste-handling.pdf)

12.2.6 *Acid Base Neutralization* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/acidbasenuetralization.pdf)

13.0 General Safety Controls and Emergency Response Equipment

13.1 Fire Safety

13.1.1 All laboratories working with combustible chemicals, flammable chemicals, or other potential ignition sources (e.g. lasers) must be outfitted with appropriate fire extinguishers. All extinguishers must be mounted on a wall in an area free of clutter or stored in a fire extinguisher cabinet.

13.1.2 Research personnel must be familiar with the location, use and classification of the extinguishers in their laboratory.

13.1.3 All researchers must complete in-person Fire Extinguisher Training that is coordinated by the DCHO semesterly.

13.2 Safety Showers and Eyewash Stations

13.2.1 All laboratories using hazardous chemicals must have immediate access (no more than 10 seconds to reach) to safety showers with eyewash stations (OSHA 29 CFR 1910.151(c)).

13.2.2 Safety showers must have a minimum clearance of 6 inches from the nearest obstruction at all times; this means that no objects may be stored or left within this distance of the safety shower.

13.2.3 Any units that do not have a testing date should be reported immediately to the DCHO. If an eyewash or safety shower needs repair, a work order must be submitted to UFM. Speak with the Business Manager or the DCHO about submitting work orders to UFM.

13.3 Other Safety Controls

13.3.1 Engineering Controls: Engineering controls include all "built in" safety systems. An example is the laboratory fume hood that is very effective at containing chemical hazards and protecting users from inhalation hazards. Other examples of engineering controls include general room ventilation, flammable material storage units, and secondary containment.

13.3.2 Administrative Controls

13.3.2.1 These controls consist of policies and procedures; they are not generally as reliable as engineering controls because the user has to carefully follow the appropriate procedures and must be fully trained and aware in order to do so.

13.3.2.2 Administrative Controls include general lab safety rules and regulations, standard operating procedures, and laboratory safety plans.

13.3.2.3 Additional Resources:

13.3.2.3.1 *Emergency Response Procedures* (https://www.kent.edu/compliance/emergency-procedures)

13.3.2.3.2 *Standard Operating Procedure Template* (https://www.kent.edu/sites/default/files/file/LabSOP.pdf)

13.3.3 Personal Protection Controls: PPE serves as a researcher's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals.

13.3.3.1 Maintenance of PPE:

13.3.3.1.1 PPE should be inspected prior to use to ensure it is in good condition.

13.3.3.1.2 PPE should fit properly and be worn properly.

13.3.3.1.3 In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the clothing/PPE must immediately be removed and placed in a closed container that prevents release of the chemical.

13.3.3.1.4 Heavily contaminated clothing/PPE resulting from an accidental spill must be disposed of as hazardous waste.

13.3.3.1.5 Lightly contaminated laboratory coats must be cleaned and properly laundered monthly. A washer and dryer are available for use in the Integrated Sciences Building Autoclave Room (room 059). The key card to room 059, laundry soap and bleach may be acquired in 120 Williams Hall (the 1st floor stockroom).

13.3.3.1.6 Laboratory personnel must never take contaminated items home for cleaning or laundering.

13.3.3.2 The primary goal of basic PPE is to mitigate, at a minimum, the hazard associated with exposure to hazardous substances. In some cases, additional, or more protective equipment must be used. If additional protective equipment is to be used, EH&S should be notified before beginning work to verify all necessary measures are being taken to protect life and property.

13.3.3.3 Eye and Face Protection

13.3.3.3.1 Eye protection (safety glasses with side shields, chemical-resistant goggles, or a face shield) must be worn at all times in laboratories when chemicals are being used.

13.3.3.3.2 All eye protection must meet American National Standards Institute (ANSI) 87.1Z– 2010.

13.3.3.3.3 Ordinary prescription glasses are not considered safety glasses. Safety glasses must be worn over prescription glasses.

13.3.3.3.4 Information regarding the use of contacts in a chemical environment is outlined in the National Institute of Occupational Safety and Health Publication Number 2005–139 (http://www.cdc.gov/niosh/docs/2005-139/pdfs/2005-139.pdf)

13.3.3.3.5 A face shield is required whenever there is a potential for severe chemical exposure from splashes, fumes, or explosions. Because a face shield alone does not adequately protect the eyes, it must be worn over safety goggles. In general, any operation that requires a face shield must be conducted inside a hood with the sash down as an additional barrier.

13.3.3.4 Skin Protection

13.3.3.4.1 When working with substances that are readily absorbed by the skin or with substances that are highly corrosive to the skin, appropriate protection must be provided to protect the laboratory worker from skin contact.

13.3.3.4.2 Skin protection may take the form of shields, isolation of the procedure, gloves, aprons, lab coats or other such protective equipment.

13.3.3.4.3 Gloves and lab coats should be selected according to the chemical resistance of the protective material to the chemical to be used. This information can be obtained by the supplier of the product and is usually presented in a chemical resistance chart in the supplier's catalog. The Research Safety Manager should be contacted to assist in selecting the proper personal protective equipment.

13.3.3.5 Respiratory Protection

13.3.3.5.1 Typically, respiratory protection is not needed in a laboratory. Under most circumstances, safe work practices, small-scale usage, and engineering controls (fume hoods, biosafety cabinets, and general ventilation) adequately protect laboratory workers from chemical and biological hazards.

13.3.3.5.2 Under certain circumstances, however, respiratory protection may be needed. Respirator use will be governed by the scientific work being done.

13.3.3.5.3 Before use of a respirator, the user must have a medical evaluation and be fitted by the EHS Office (x2-1944), the Occupational Health & Safety Coordinator. The user must also continue with regular medical monitoring.

14.0 Donated Chemical Policy

The Chemistry Department does not accept donated chemicals without prior approval from the DCHO. Very often the chemicals are near their expiration date or are in quantities that will not be used. In addition, the purity cannot be verified due to containers having been opened. The University ends up paying for the disposal of those chemicals that are deemed unacceptable. Disposal costs are expensive and the University spends much more than the original cost savings. The University is then the new generator of the waste and is responsible for it forever.

15.0 Universal Laboratory Procedures

15.1 Biological Safety

15.1.1 Biological agents include bacteria, viruses, fungi, other microorganisms and their associated toxins. Biological agents have the ability to adversely affect human health in a variety of ways, ranging from relatively mild, allergic reactions to serious medical conditions, even death.

15.1.2 Please refer to the Office of Research Safety Laboratory Safety Manual 307 Biosafety Practices (https://www.kent.edu/sites/default/files/biosafety-laboratory-practices-307biosafetypractices.pdf) and the Biosafety in Microbiological and Biomedical Laboratories 5th Edition (https://www.cdc.gov/biosafety/publications/bmbl5/BMBL.pdf) for basic biosafety practices.

15.1.3 Before use of biological agents, Biohazardous Request for Use forms, rDNA Request for Use forms or Exempt Biohazardous Agents Use Request forms must be completed so that experiments may be reviewed by the Institutional Biosafety Committee (IBC).

15.1.4 Additional Resources:

15.1.4.1 *Biohazardous Request for Use Form* (https://www.kent.edu/sites/default/files/file/Biohazardous%20Materials%20Use%20Request%20Form.docx)

15.1.4.2 *rDNA Request for Use Form* (https://www.kent.edu/compliance/biohazardous-material-form)

15.1.4.3 *Exempt Biohazardous Agents Use Request Form* (https://www.kent.edu/sites/default/files/file/BSC-3%20EXEMPT%20BIOAZARDOUS%20AGENTS%20REQUEST%202016%20Template%20pdf.pdf)

15.2 Bromine

15.2.1 *Chemistry Department Bromine SOP* (https://www.kent.edu/sites/default/files/file/Standard%20Operating%20Procedure_Bromine.docx)

15.3 Compressed Gases

15.3.1 Compressed gases must not be transferred from one container to another except by the manufacturer or distributer.

15.3.2 Containers must be legibly marked to identify the contents and give the appropriate precautionary information (e.g., flammable).

15.3.3 Containers must be stored upright and secured, with caps on when not being used. Combustible materials are not recommended to secure cylinders.

15.3.4 Cylinders of 1.3 gal (5 L) or less shall be permitted to be stored in a horizontal position.

15.3.5 Oxygen and oxidizing gases must be stored separately from flammable and highly combustible material. According to the NFPA 55 regulation, flammable gases and oxidizing gases must be stored a minimum of 20 feet apart. However, this distance can be reduced to 5 feet if one of the gases is enclosed in a gas cabinet or without limit where both gases are enclosed in gas cabinets. Note: Storage requirements differ from use requirements.

15.3.6 Pressure reducing regulators must be used when withdrawing contents from the cylinder.

15.3.7 Valve outlets and pressure relief valves must be directed away from personnel at all times.

15.3.8 Valves on cylinders being moved, cylinders that are not in use, or on empty cylinders must be closed and capped.

15.3.9 Only use regulators for the gases they are intended. Oils and lubricants should not be used on fittings for oxygen or other oxidizing gases.

15.3.10 Do not force connections that do not fit.

15.3.11 Use transport dollies to move cylinders. Dollies are provided by the Chemistry department in the basement of Williams Hall.

15.3.12 Do not store cylinders in a horizontal position.

15.3.13 Do not expose cylinders to excessive dampness, corrosive chemicals or fumes.

15.3.14 Never use a gas cylinder without a regulator!

15.3.15 Storage of lecture compressed gas bottles should be followed according to “Section 7: Handling and Storage” of the lecture bottle’s SDS.

15.3.16 Gas cylinder storage is provided for the Chemistry Department in the basement of Williams Hall. For access to this space, please contact the Business Manager.

15.3.17 Additional Resources:

15.3.17.1 *Compressed Gas Safety* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/compressedgas.pdf)

15.4 Corrosives

15.4.1 Corrosives must not be stored under sinks or in other areas where plumbing, equipment or shelving could be damaged by corrosive effects.

15.4.2 Concentrated acids (pH < 2) and concentrated bases (pH > 12) must be stored separately. Where amounts are small, separation may be achieved by storing either all the acids or all the bases being in separate containers such as bottle carriers, spill pans, or other secondary containment.

15.4.3 Corrosives will be stored in a cabinet designed for their storage.

15.4.4 Specific types of acids must be kept away from other acids; for instance, organic acids (e.g. formic acid) must not be stored with mineral acids or oxidizing acids (e.g. nitric acid).

15.5 Cryogenic Materials

15.5.1 The primary hazard of cryogenic materials is their extreme coldness. They and all surfaces they cool can cause severe burns if they are exposed to skin.

15.5.2 Cryogenic fluids must be stored or handled only in containers designed for such use.

15.5.3 Wearing of watches, rings, or other items that may trap the cryogenic material should be avoided.

15.5.4 When gloves are worn while handling cryogenic materials, they should be dry, impervious and loose enough to be easily tossed off the hands.

15.5.5 Lab coats must be worn while handling cryogenic materials. Open toe shoes and sandals must not be worn.

15.5.6 Cryogenic materials must be dispensed and used in areas with good ventilation. Laboratory workers should avoid lowering their head into dry ice chests or directly over cooling baths. When transporting dry ice or materials packaged in dry ice, the package should not be carried in the passenger compartment of the vehicle.

15.5.7 Cryogenic material may provide an oxygen rich atmosphere by condensing and fractionating air. This situation may increase fire and explosion hazard of flammable and combustible materials being cooled or materials located near the operation.

15.5.8 Dry ice must be added to cooling baths (or liquid added to dry ice) in small increments, allow foaming to stop before each addition.

15.5.9 Chemistry Department *Cryogenic Liquids SOP* (https://www.kent.edu/sites/default/files/file/Standard%20Operating%20Procedure_CryogenicLiquids.pdf)

15.6 Electrical Equipment

15.6.1 General

15.6.1.1 Extension cords may not be used as permanent wiring. Power strips that are equipped with an over current protection device (circuit breaker) may be used. A power strip cannot be plugged into another power strip (daisy chain).

15.6.1.2 Electrical receptacles must not rest on laboratory bench tops. An electrical receptacle is a socket that connects an electrical device to an electricity supply.

15.6.1.3 Power cords on appliances should be inspected for damage regularly. Frayed or otherwise damaged cords must be replaced before using.

15.6.1.4 To eliminate exposed wiring, outlet boxes or junction boxes must be provided with cover plates and receptacles must be provided with faceplates.

15.6.1.5 Ground-fault circuit interrupters must be used over sinks and in other wet areas.

15.6.1.6 Over current protection devices (circuit breakers) on panes must be individually labeled to indicate the equipment or location of equipment served by the device.

15.6.2 Laboratory Refrigerators and Freezers

15.6.2.1 Laboratory refrigerators or freezers used for storing or cooling flammable liquids must comply with NFPA 45 – Fire Protection for Laboratories Using Chemicals, section 9.2.2.2 and A.9.2.2.2.

15.6.2.2 All refrigerators and freezers must be appropriately labeled for the storage of chemicals, flammables or food.

15.6.3 Electrical Apparatus

15.6.3.1 All apparatuses used in the laboratory must be approved by a recognized approval agency (UP, ASTM, etc.) or meet accepted NFPA standards.

15.6.4 Exposed Live Current

15.6.4.1.1 Only experienced researchers who have been trained to work safely with test instruments and equipment on energized circuits may remove enclosures and guards to perform testing on energized electrical circuits.

15.7 Flammable and Combustible Liquids

15.7.1 A chemical's flash point is the temperature at which the chemical gives off sufficient vapor to ignite in air.

15.7.2 Flammable liquids have flash points below 100° F. Combustible liquids have a flash point between 100° F and 140° F.

15.7.3 All secondary containers of flammables greater than 4 L should be of the safety can type meeting NFPA standards.

15.7.4 Storage of more than 25 gallons of flammable liquids must be in flammable liquid storage cabinets meeting OSHA or NFPA 30 Flammable Liquids Codes.

15.7.5 Flammables must not be stored in the same cabinet as oxidizers or water reactive materials.

15.7.6 Always transfer flammable and combustible chemicals from glass containers to glassware or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers may lead to a fire hazard due to static electricity.

Hazard Classifications for Flammable Liquids			
Class	**Flash Point**	**Boiling Point**	**Examples**
I-A	Below 73° F (23° C)	Below 100° F (38° C)	Diethyl ether, Pentane, Petroleum ether
I-B	Below 73° F (23° C)	At or above 100° F (38° C)	Acetone, Benzene, Cyclohexane, Ethanol
I-C	73-100 F° (24-38° C)	N/A	p-Xylene
Hazard Classifications for Combustible Liquids			
II	101-140° F (39-60° C)	N/A	Diesel fuel, Motor oil, Kerosene
III-A	141-199° F (61-93° C)	N/A	Paints (oil base), mineral oil
III-B	200° F (93° C)	N/A	Paints (oil base)

15.8 Fume Hood Use

15.8.1 The Facilities Mechanical System Specialist from UFM will annually inspect laboratory hoods to determine proper function and adequate face velocity.

15.8.2 Any employee who has reason to believe that a local exhaust ventilation system is not functioning properly, must immediately report the suspected problem to their DCHO (Ext. 2-2112) or the Facilities Mechanical Systems Specialist (Ext. 2-1990).

15.8.3 The Research Safety Manager must be consulted for new hood installation.

15.8.4 Laboratory hoods must not be relied upon to provide explosion (blast) protection unless specifically designed to do so.

15.8.5 When perchloric acid is evaporated or heated above the flashpoint (113° C) in a laboratory hood, the hood must be specifically designed for perchloric acid.

15.8.6 For new installations or modifications of existing installations, fixed electrical services and their controls must be located external to the hood and within easy reach.

15.8.7 For new installations of modifications of existing installations, controls for other services (gas, air, water, etc.) must be located external to the hood and within easy reach.

15.8.8 The following general rules must be followed when using laboratory hoods:

15.8.8.1 Always keep hazardous chemicals >6 inches behind the plane of the sash

15.8.8.2 **NEVER** put your head inside a laboratory hood containing hazardous materials. The plane of the sash is the barrier between contaminated and uncontaminated air.

15.8.8.3 Work with the hood sash in the lowest practical position. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood.

15.8.8.4 Do not clutter your hood with unnecessary bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood.

15.8.8.5 Do not use large equipment in laboratory hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe.

15.8.8.6 Shut your sash! For energy efficiency, make sure to shut your sash when the hood is not in use.

15.8.8.7 Shut the sash if the fire alarm sounds, laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals.

15.8.9 Additional Resources:

15.8.9.1 *Use of Fume Hoods* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/use-of-fume-hoods-804-fume-hoods.pdf)

15.9 Glassware

15.9.1 Accidents involving glassware are a leading cause of laboratory injuries.

15.9.2 Careful handling and storage procedures should be used to avoid damaging glassware. Damaged items should be discarded or repaired.

15.9.3 Adequate hand protection should be used when inserting glass tubing into rubber stoppers or corks when placing rubber tubing on glass hose connections. Tubing should be fire polished or rounded and lubricated, and hands should be held close together to limit movement of glass should fracture occur. The use of plastic or metal connectors should be considered.

15.9.4 Glass blowing services are provided by the department of Chemistry; contact Junjie Xiang ext. 2-2977.

15.9.5 Vacuum-jacketed glass apparatuses must be handled with extreme care to prevent implosions. Equipment such as Dewar flasks must be taped or shielded. Only glassware for vacuum work should be used for that purpose.

15.9.6 Hand protection should be used when picking up broken glass. (Small pieces should be swept with a brush into a dustpan).

15.9.7 Proper instruction must be provided in the use of glass equipment designed for specialized tasks, which can represent unusual risks for the first time user (for example, separatory funnels containing volatile solvents can develop considerable pressure during use).

15.10 Hydrofluoric acid (HF)

15.10.1 HF should no longer be found in any of the Chemistry or Biochemistry laboratories. Contact the DCHO to dispose of HF that is no longer in use.

15.10.2 Before use of HF, researchers must take Lab Safety: Hydrofluoric Acid (50) training via FlashTrain as well as prepare an SOP including the use, emergency preparedness and disposal of HF.

15.10.3 Additional Resources:

15.10.3.1 *Safe Use of Hydrofluoric acid* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/sb011.pdf)

15.11 Laser Safety

15.11.1 Before use, laser operators are required to take Lab Safety: Laser Operator Safety Training (121) via FlashTrain. Employees that are not operators, but working in a laboratory with lasers are required to take Lab Safety: Laser Safety Training (120) via FlashTrain.

15.11.2 Please refer to the EH&S *General Laser Safety* (https://www.kent.edu/sites/default/files/sb002.pdf) and *Laser Safety Practices Manual* (https://www.kent.edu/sites/default/files/sb007.pdf) for practices and procedures involving Laser Safety.

15.12 Oxidizers

15.12.1 Oxidizers (see Chemistry Department Oxidizer Standard Operating Procedure for a list of common oxidizers) must be stored segregated from incompatible chemicals and materials and stored on compatible shelving.

15.12.1.1 *Chemistry Department Oxidizer SOP* (https://www.kent.edu/sites/default/files/file/Standard%20Operating%20Procedure_Oxidizers.docx)

15.13 Particularly Hazardous Substances (PHSs)

15.13.1 OSHA defines "particularly hazardous substances" as chemicals that pose significant threats to human health. Examples of “particularly hazardous substances” are available in **Appendix D** of this plan.

15.13.2 The OSHA Laboratory Standard requires that special provisions be established to prevent the harmful exposure of researchers to PHSs:

15.13.2.1 Establishment of a designated area (a designated area may be the entire laboratory, an area of the laboratory, or a fume hood or glove box);

15.13.2.2 Use of containment devices such as fume hoods or glove boxes;

15.13.2.3 Procedures for safe removal of contaminated waste; and

15.13.2.4 Decontamination procedures.

15.13.3 All PHSs must be handled to prevent skin contact, accidental ingestion, and inhalation.

15.13.4 A standard operating procedure must be developed before the use of any PHSs (see 15.14.5.1 for the Chemistry Department’s Particularly Hazardous Substance Standard Operating Procedure template).

15.13.5 Additional Resources:

15.13.5.1 Chemistry Department Particularly Hazardous Substances SOP (https://www.kent.edu/sites/default/files/file/Standard%20Operating%20Procedure_PHS.docx)

15.14 Perchloric acid

15.14.1 Use goggles for eye protection whenever the acid is handled.

15.14.2 In wet combustion with perchloric acid, treat the sample first with nitric acid to destroy easily oxidizable material.

15.14.3 Any procedure involving heating of the perchloric acid must be conducted in a ventilated hood equipped with water wash down.

15.14.4 Perchloric acid hoods must be constructed of materials that are acid resistant, non-reactive and impervious to perchloric acid, such as stainless steel.

15.14.5 Organic materials must not be stored in the perchloric hood.

15.14.6 Do not allow perchloric acid to come in contact with strong dehydrating agents (concentrated sulfuric acid, anhydrous phosphorus pentoxide, etc.).

15.14.7 Perchloric acid should be used only in standard analytical procedures from well-recognized analytical texts. Researchers should take the properties and hazards of perchloric acid into consideration before use.

15.14.8 If a laboratory hood or exhaust system has been exposed to perchloric acid heated above ambient temperature, tests must be conducted for explosive perchlorates before any inspection, cleaning, maintenance, or any other work is done on any part of the exhaust system or hood interior.

15.14.9 Additional Resources:

15.14.9.1 *Safe Use of Perchloric acid* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/sb008.pdf)

15.15 Peroxidizable Materials

15.15.1 Peroxide forming chemicals must be stored in airtight containers in a dark, cool, dry place and must be segregated from other classes of chemicals that could create a serious hazard.

15.15.2 Ensure that container are tightly sealed to avoid evaporation and that they are free of any exterior contamination or crystallization.

15.15.3 Peroxidizable materials should be purchased in amounts that are expected to be used within six months to one year. This practice ensures that others are used up before the manufacturer's expiration date.

15.15.4 Ethers must be disposed of without opening if there are visible crystals around the cap, or if the container is in a grossly corroded condition. Crystals visible in the container must be brought to the attention of the DCHO immediately.

15.15.5 Do not distill chemicals that have tested positive for peroxides. Always test for peroxides before distilling (even previously unopened ethers) and upon three months after opening List A and after one year of opening List B materials. Leave at least 20% bottoms when distilling peroxidizables. NEVER distill a peroxidizable material to dryness; this can result in a serious explosion! The flask can be rinsed with equal amounts of a solvent, such as ethanol, and considered waste.

15.15.6 Additional Resources:

15.15.6.1 *Safe Use of Peroxide Forming Chemicals* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/sb003.pdf)

15.16 Pyrophoric and Water Reactive Chemicals

15.16.1 Pyrophoric chemicals can spontaneously ignite when in contact with air and/or water. As such, pyrophoric chemicals must be stored in such a way that they are protected from air and moisture.

15.16.2 Suitable storage locations may include inert gas-filled desiccators or glove boxes.

15.16.3 Never return excess reactive chemical to its original storage container, since small amounts of impurities may cause a fire or explosion.

15.16.4 Additional Resources:

15.16.4.1 *Safe Use of Pyrophoric Chemicals* (https://du1ux2871uqvu.cloudfront.net/sites/default/files/sb004.pdf)

15.16.4.2 *Chemistry Department Pyrophoric SOP* (https://www.kent.edu/sites/default/files/file/Standard%20Operating%20Procedure_Pyrophorics.pdf)

15.17 Radiation Safety

15.17.1 Please refer to the *Research Safety & Compliance's Radiation Safety* website (https://www.kent.edu/compliance/radiation-safety) for radiation safety materials.

15.17.2 Before working with any radioactive materials, researchers must complete Radiation Safety Training. Radiation Safety Training consists of two parts: online education and examination and in-person education and examination. To begin the online training, please notify the EHS Office (x2-1944) and she will grant you access via FlashTrain. For the in-person training, the EHS Office will contact you to set up a meeting time.

15.18 Working Alone

15.18.1 A worker is considered as "working alone" if the individual is working by his/herself such that assistance is not readily available should some injury, illness or emergency arise. Alone includes working in physical isolation, e.g. as the sole occupant of a laboratory where no other person is in the vicinity. It can occur during normal working hours as well as in the evening, at night or during weekends.

15.18.2 For the purpose of this document, "after hours" is defined as any time between the hours of 6pm – 7am Monday to Friday, all day Saturday and Sunday, statutory holidays, and University holidays.

15.18.3 Working with hazardous chemicals alone, especially after regular hours in a laboratory, poses an additional risk to life and property. If an unanticipated event occurs and the researcher is incapacitated, available safety equipment such as emergency showers, fire extinguishers, or antidotes become worthless to provide emergency assistance to injured individuals or to mitigate the losses

incurred. With this in mind, working alone, especially after hours, should be avoided whenever possible.

15.18.4 All work to be performed by someone working alone must be approved in advance by the Principal Investigator.

15.18.5 When approving working alone, Principal Investigators must consider the level of risk associated with the activities being performed. Examples of different risk activities are below. Activities involving extreme risk must not be approved.

15.18.5.1 Low Risk: e.g., working in an office environment, using a computer laboratory, reading or observing low risk experiments, assembly or modification of laboratory apparatus when no chemical, electrical or physical hazards are present, etc.

15.18.5.2 Moderate to High Risk: e.g., experiments involving toxic or otherwise hazardous chemicals, experiments involving high-pressure equipment, etc.

15.18.6 Following the guidelines below will aid in protecting the health and safety of laboratory personnel, while minimizing risks associated with working alone in laboratories.

15.18.6.1 Principal investigators and responsible faculty should establish specific guidelines and develop notification procedures when working in laboratories during times of limited occupancy.

15.18.6.2 Laboratory procedures must be discussed, and hazardous operations must be identified prior to permitting lab personnel to work alone.

15.18.6.3 Laboratory personnel and supervising faculty must establish and maintain a weekly work schedule and minimize the opportunities when laboratory personnel are alone in the lab.

15.18.6.4 A telephone must be immediately available to the individual working alone. Contact University Police at 911 in the event of an emergency.

15.18.6.5 Another individual capable of providing on-site assistance in the event of an emergency should be accessible, a.k.a. the buddy system.

15.18.6.6 A check-in system for updating an individual's status while working alone.

15.19 Unattended Operations

15.19.1 Arrangements must be made, where possible, to periodically check unattended operations for abnormal conditions.

15.19.2 For operations left running after normal hours and leave the "Unattended Experiment Notice" on the door indicating that an unattended procedure is in progress.

15.19.3 Additional Resources:

15.19.3.1 *Unattended Experiment Notice* (https://www.kent.edu/sites/default/files/file/UnattendedExperimentNotice.pdf)

16.0 Laboratory Safety Audits

16.1 The purpose of the laboratory safety audits is to educate faculty and staff on the university's current safety program as well as the standards and compliance requirements. To meet the university's ongoing commitment to safety and comply with state and federal regulations, the Compliance and Risk Management Department conducts annual audits.

16.2 The Audit Process

16.2.1 The audit process begins with a notification to the department chair or director, followed by a scheduled meeting with each principal investigator (PI) or responsible party.

16.2.2 During the audit, an inspection checklist, which is provided to you prior to the inspection, will be used to review documentation, chemical storage, chemical waste, housekeeping, personal protective equipment, chemical and biological hoods, gas cylinder storage, emergency safety equipment, signs and labels, biosafety, electrical and equipment safety and ventilation.

16.2.3 Following inspections, a detailed report will be sent to principal investigators and the appropriate administrator. The report is sent via email and will include a summary of the recommendations for improved safety. Once the report has been received, the PI will need to add comments to the items that need correction and return the report to the Office of Compliance and Risk Management to be reviewed.

16.2.4 After the inspection, the reviewer will return to verify that recommendations have been implemented.

16.2.5 If conditions are found that pose immediate danger to life or health or are in serious violation of any regulatory requirements, these are deemed "critical actions." The responsible party will promptly be asked to address the issues and Compliance and Risk Management will seek or oversee the corrective actions.

16.2.6 Items designated "opportunities for improvement" include things that may not be an immediate safety concern, but warrant further examination by the PI.

16.2.7 It is important to note that the audit inspection checklist was developed using the following: Occupational Health and Safety Administration (OSHA), Environmental Protection Agency (EPA), National Fire Protection Association (NFPA), Ohio Fire Code, the Kent State University Chemical Hygiene Plan, Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (2011), Department of Homeland Security (DHS), American National Standards Institute (ANSI), National Institute of Health (NIH) and the American Industrial Hygiene Association.

17.0 Medical Consultation and Examinations

17.1 All employees who believe they have a health condition that compromises their ability to work in the lab should notify their supervisor immediately. Following notification, a determination will be made if there are chemicals being used in the individual's work area that may present a potential hazard. If such materials are being used, the employee may need to be transferred to another assignment.

17.2 The University must provide all persons involved in the laboratory use of chemicals an opportunity to receive medical attention, including any follow-up examinations the examining physician determines to be necessary, under the following circumstances:

17.2.1 Whenever a laboratory employee develops signs or symptoms associated with a hazardous chemical to which the employee or student may have been exposed in the laboratory;

17.2.2 Where industrial hygiene monitoring in a laboratory reveals an exposure level routinely above the action level (or in the absence of an action level, the Permissible Exposure Limit) to a substance listed by OSHA requiring medical examinations; or

17.2.3 Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

17.3 Any employee showing signs or symptoms they believe are due to exposure while working in the laboratory must immediately report to the DCHO who will send the employee to the DeWeese Health Center for medical examination with documentation.

17.4 All medical examinations in accordance with this document must be performed by or under the direct supervision of a licensed physician and must be provided at no cost to the exposed laboratory employee.

17.5 The University is required to provide the following to the physician:

17.5.1 The identity of the hazardous chemical(s) to which the laboratory employee or laboratory student may have been exposed and a copy of the SDS, if available;

17.5.2 A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

17.5.3 A description of the signs and symptoms of the exposure that the laboratory employee or laboratory student is experiencing, if any.

17.5.4

18.0 Records

18.1 Records documenting training will be kept for length of employment plus 30 years.

18.2 Records of audits or inspections will be kept for 5 years by the department conducting the audit.

Works Cited

Indiana University. *Recommendations for Storage of Laboratory Chemicals*. (n.d.) In *Storage of Laboratory Chemicals*. Retrieved from https://www.ehs.iupui.edu/lab/guidance/storage/index.html.

Office of Health & Safety. (2013). *University Chemical Hygiene Plan*. Retrieved from https://www.kent.edu/sites/default/files/chemical-hygiene-plan-ksu-chp2013-dropbox.pdf.

UC Irvine Environmental Health & Safety. (2014). *Chemical Hygiene Plan*. Retrieved from https://www.chem.uci.edu/~nizkorod/intranet/files/UCI_CHP.pdf.

UC Los Angeles Environmental Health & Safety. (2017). *UCLA Chemical Hygiene Plan*. Retrieved from https://www.chemistry.ucla.edu/sites/default/files/safety/chemical_hygiene_plan_2017.pdf.

UC Riverside Environmental Health & Safety. (2017, May 12). *Chemical Hygiene Plan*. Retrieved from https://www.mse.ucr.edu/facilities_pdfs/MSE CHP 2017 05 12.pdf.

Vadnais, D. (2012). *Hazardous Materials Disposal Guide*. Nipissing University. Retrieved from https://www.nipissingu.ca/departments/human-resources/health-and-safety/Lab-Safety/Documents/Hazardous Materials Disposal Guide.pdf.

Appendix A

FlashTrain Login Instructions for the Chemistry Department

The **Laboratory Safety Training** that is required for all laboratory workers is now located online in *Flashtrain* (https://flashtrain.kent.edu/Public/Login.aspx).

The Chemistry Department and all other departments (this includes Liquid Crystal, Geology, Anthropology, Biochemistry, Psychology, Physics and all other disciplines) must complete the training Module called **Lab Safety: Chemical Safety Introduction (98)**. To access this course you will need to log in with your FlashLine ID and password (detailed instructions are on the following pages).

Once an individual is enrolled in the **Chemical Safety Introduction** module, they will automatically be enrolled in four additional required courses that are:

1. Fume Hood Training

2. GHS-SDS Training

3. Hazardous Waste Training

4. Flammable & Combustible Material Training

These additional courses will need to be completed and the certificates printed to be given to the Principal Investigator as a part of you training record. PDF's of certificates are also to be emailed to the DCHO at kminton4@kent.edu.

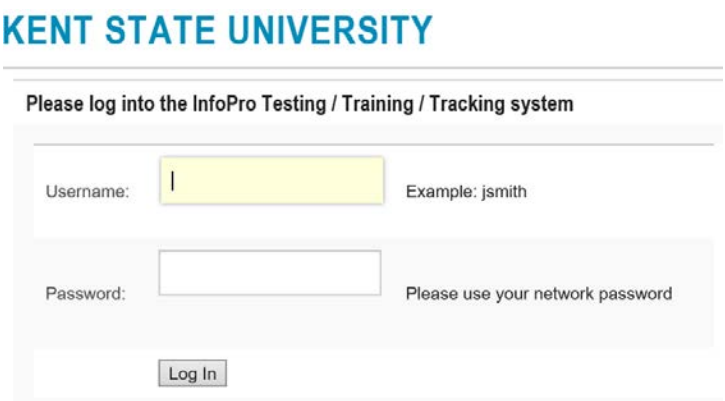
If you have any problems logging into FlashTrain please contact Elaine Ramoff at 330-672-1949 or email at eramhoff@kent.edu.

Steps for Laboratory Training

Step 1

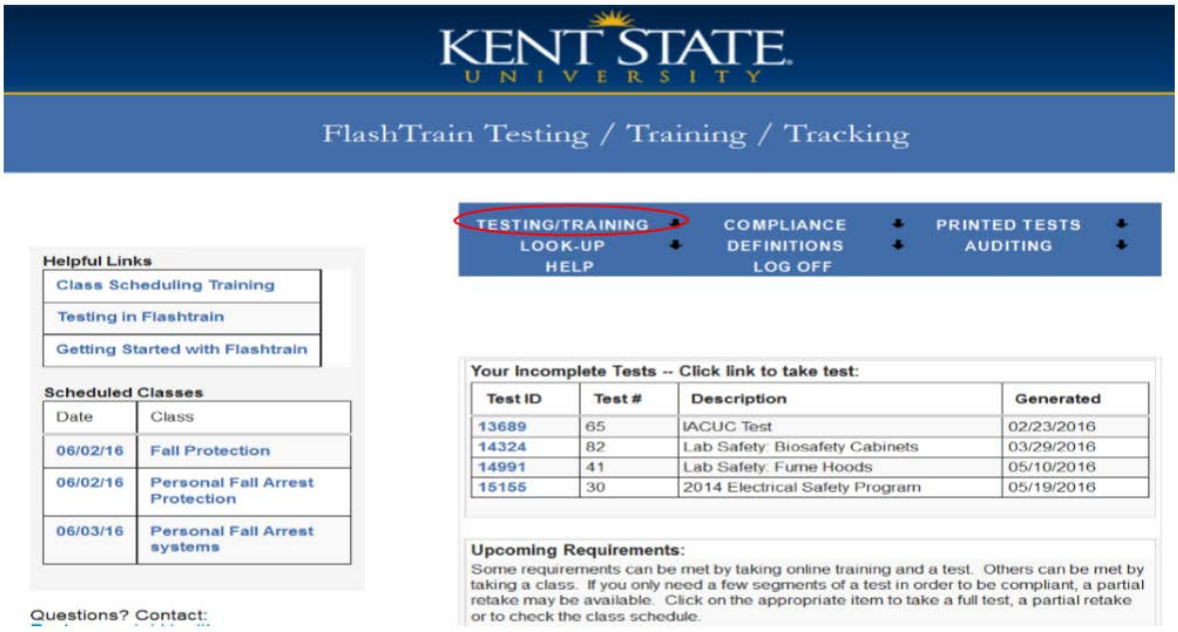
Log in to FlashTrain with FlashLine ID and Password using the link:

https://flashtrain.kent.edu/Public/Login.aspx.



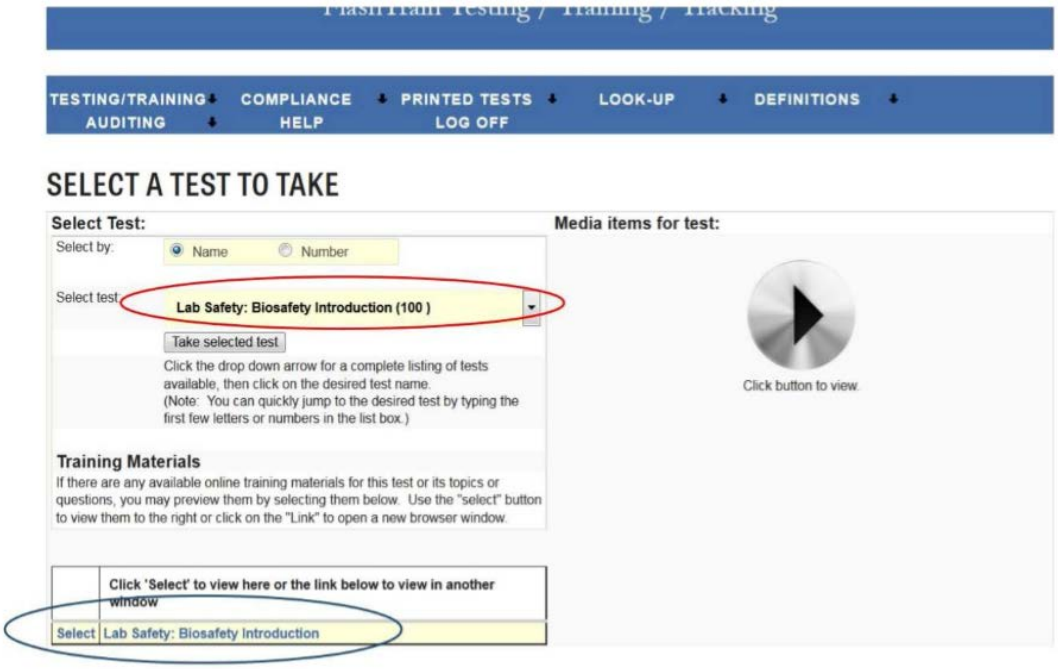
Step 2

Select the Test/Training Menu. From the Test / Training drop down menu, choose "SELECT TEST".



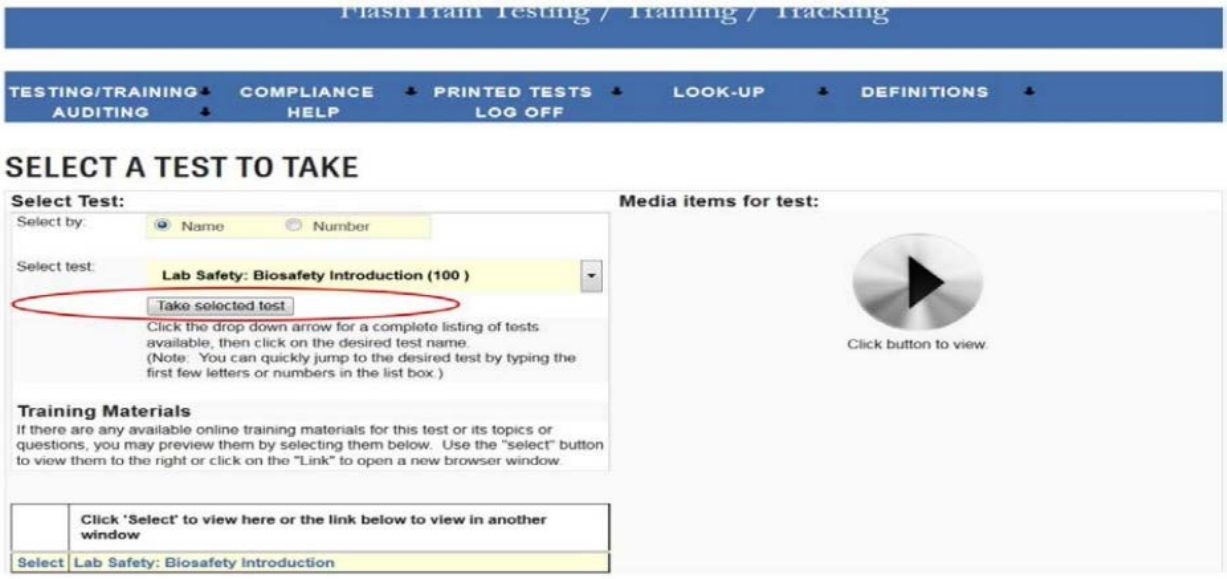
Step 3

Then select the course from the drop down menu (circled in RED). Once the course has been selected use the link (circled in BLUE) below to view information or presentation in another window.



Step 4

Once the course is completed, go back and take selected test.



Step 5

Once the test is completed, go to "Testing /Training" on the home page and select "Past Results" to print certificates for courses passed with an acceptable score.

Appendix B

Recommended Documentation for Training Records

Spring 2017					
	FlashLine ID	Laboratory Rooms:	Keys issued (Y/N)	OSHA training completed (Y/N)	Lab-specific training completed? (Y/N)
Faculty Investigator:					
Graduate Student Investigators:					
Undergraduate Investigators: *(indicate course # or grant)					
Other Laboratory workers/visitors:					

Appendix C

Academic Laboratory Safety in the Kent State University Chemistry department is a collective effort to effectively teach, enforce, and cultivate appropriate laboratory safety habits.

Responsibilities

A. Stockroom Responsibilities:
   a. Provide appropriate chemical amounts to each academic laboratory.
   b. Label all chemical containers clearly and completely with the name, concentration of the chemical, and GHS symbols.
   c. Use dispensing bottles for chemical solutions where possible to minimizing the risk of contamination of entire bottles.
   d. Use several small bottles rather than one large bottle for solutions for ease of handling and pouring and minimization of the risk of spillage of large quantities.
   e. Provide bottles with droppers to prevent cross contamination.
   f. In addition to chemicals, provide appropriate hazardous waste bottles with each lab experiment.
   g. Provide academic labs with appropriate cleaning supplies including paper towels and benchtop cleaner.

B. DCHO Responsibilities:
   a. Verify that safety equipment is available in all laboratories: chemical showers, plumbed in eyewash stations, fire extinguishers, fire blankets, first aid kits, spill kits (universal and neutralizing absorbents), all sizes of gloves, and broken glass boxes are provided in all academic laboratories.
   b. Verify that eyewash stations, safety showers, fire extinguishers, fume hoods and first aid kits are appropriately inspected and safety supplies are within expiration date.
   c. Submit incident reports that occur in the academic laboratories to EH&S within two business days.

C. Course Coordinator Responsibilities:
   a. Be present in the building during laboratory hours, unless the course coordinator is able to find suitable coverage from a fellow faculty member.
   b. Visit lab in the beginning to verify that the TA is present and students are properly attired for lab.
   c. Serve as a replacement for any emergencies that occur with TA's.
   d. Encourage TA's commitment to enforcing safety in the academic labs.

D. Teaching Assistant Responsibilities:
   a. Take required online safety training before the start of the semester, including: Lab Chemical Safety Introduction, Fume Hood Safety, GHS SDS Safety, Hazardous Waste Safety, Flammable and Combustible Liquid Safety, and Fire Extinguisher Use Training.
   b. Train academic laboratory students using safety PowerPoint presentations provided by the course coordinator.
   c. Reiterate the hazards associated with each laboratory experiment at the beginning of lab during pre-lab lecture.
   d. Fully explain and demonstrate any new procedures or techniques that will be introduced in the experiment.
   e. Model and enforce appropriate behavior in the laboratory including the usage of personal protection equipment and the importance of laboratory safety.

E. Academic Laboratory Student:
   a. Read and understand the safety PowerPoint outlined on Blackboard and presented in the first laboratory class session of the semester.
   b. Prepare for each experiment by reading the instructions before class. If in doubt about a procedure, the student should ask for help. Thoroughly read the experimental procedure before class to anticipate any potential hazards and prepare for them.

c. Pay attention to use of new equipment, changes in procedure, specific chemical safety guidelines, and disposal of used chemicals.
d. Report any accidents that occur during the laboratory session, regardless of how insignificant they may seem.
e. Not work in the laboratory alone or begin laboratory work until the teaching assistant is present. Only do the experiment assigned.
f. Not eat, drink, use tobacco, apply make-up, or chew gum during laboratory. Not taste or directly sniff any chemicals.
g. Read all labels before using reagents.
h. Report any safety deficiencies seen in the lab to the teaching assistant.
i. Keep the lab as clean as possible and clean up bench space after use.
j. Know not to dispose of hazardous materials, including boiling stones or waste, down any sink or into the trash can. Know where the used chemical receptacles are stored and understand how to use the containers correctly.

Dress Code Requirements

1) Lab safety goggles MUST be worn at ALL times in the lab when chemicals are being used or when a lab procedure is in progress (i.e., when chemicals, glassware, or equipment is being used), whether you personally are working with any of these items or not.
2) Lab safety goggles MUST be the state-mandated safety goggles.
3) Lab coats are mandated for this course. Lab coats MUST be worn at ALL times in the lab when chemicals are being used or when a lab procedure is in progress (i.e., when chemicals, glassware, or equipment is being used), whether you personally are working with any of these items or not.
4) The lab coat MUST be the course-mandated lab coat. The lab coat has cuffed sleeves. Sleeves of other clothing may not protrude beyond these cuffs.
5) Footwear (i.e., the sock/shoe combination) must be of sturdy construction and must cover the whole foot and ankle. No open-toed shoes or sandals, backless or sling-back shoes, or shoes that leave skin exposed, may be worn in the lab. Slippers, including moccasin-type slippers may not be worn.
6) If your shoes have laces or fastenings, these must be tied/fastened securely.
7) Shoes that have slippery soles are extremely dangerous. Make sure that your shoes have sufficient grip.
8) Shorts, capris, cargo shorts, and short skirts or dresses are not permitted.
9) Trousers must cover the entire leg down to the ankle.
10) Tights and yoga pants are not considered trousers and are not permitted.
11) Trousers or skirts that trail on the ground are extremely dangerous and are not permitted.
12) Jeans or trousers with slashes or holes, designer or otherwise, are not permitted.
13) Long hair must be tied back and secured.

Academic Laboratory Safety Training

The teaching assistant conducts academic laboratory safety training during the first day of the laboratory course. Students MUST attend the first lab class for the semester in order to receive this training or make up safety training one-on-one with the DCHO; otherwise, the student will be disenrolled from the course.

Topics covered during the academic laboratory safety training include:

- General Lab Safety Rules: Dress Code, Food & Drink in the Laboratory, Glassware Inspections, etc.
- Safety Equipment: SDS Forms, Chemical Showers, Eye Washes, Fire Blankets, Fire Extinguishers, etc.
- Housekeeping: Appropriate Glassware Cleaning, Bench Space Cleaning, etc.
- Incident Reporting

- Waste Disposal
- Emergency Procedures

Following lab safety training, students are required to take a lab safety test and must pass with an 80% or better.

Response to Violations of Academic Laboratory Safety Guidelines

Undergraduate Students

- Any student not following safety guidelines will be suspended from laboratory work immediately and not allowed to return until the next lab, therefore receiving a zero for the laboratory.
- Consecutive dismissals from lab will result in a failure for the laboratory course.

Teaching Assistants

- Continual non-compliance of any teaching assistants and safety guidelines will be reported to the graduate coordinator.

Appendix D

Hazard Classes

Flammability Hazards

A number of highly flammable substances are commonplace in campus laboratories. Flammable liquids include those chemicals that have a flashpoint of less than 100 degrees Fahrenheit (37.78 degrees Celsius). No more than 10 gallons in aggregate of flammable liquids may be stored outside of an approved and labeled storage cabinet. No more than 60 gallons of flammable liquids may be stored inside of an approved flammable liquid storage cabinet.

Even though the use of these materials is fairly common in the laboratory setting, attention should be given to preventing static electricity and sparks when handling flammable liquids by using electrical grounding and bonding techniques whenever possible.

Reactivity Hazards

Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release large volumes of gases and heat. Some materials, such as peroxide formers, may not be explosive, but may form explosive substances over time.

These substances pose an immediate potential hazard and procedures that use them must be carefully reviewed. These materials must also be stored in a separate storage cabinet or, in a separate laboratory grade refrigerator or freezer that is designed for flammable/reactive chemicals.

Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory-specific training.

Health Hazards

OSHA uses the following definition for health hazards: The term 'health hazard' includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Major classes of "hazardous" and "particularly hazardous substances" and their related health and safety risks are detailed below:

Corrosive Substances

As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by chemical action at the site of contact.

Major classes of corrosive substances include:

- Strong acids – e.g., sulfuric, nitric, hydrochloric acids
- Strong bases – e.g., sodium hydroxide, potassium hydroxide and ammonium hydroxide
- Dehydrating agents – e.g., sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide
- Oxidizing agents – e.g., hydrogen peroxide, chlorine and bromine.

Inhalation exposure symptoms include a burning sensation, coughing, wheezing, laryngitis, shortness of breath, nausea, and vomiting.

Eye exposure symptoms include pain, blood shot eyes, tearing, and blurring of vision.

Dermal exposure symptoms may include reddening, pain, inflammation, bleeding, blistering and burns.

As a physical hazard, corrosive substances may corrode materials they come in contact with and may be highly reactive with other substances. It is important to review information regarding the materials they may corrode, and their reactivity with other substances, as well as information on health effects. In most cases, these materials must be segregated from other chemicals and require secondary containment when in storage.

Irritants

Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. Wide varieties of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. The most common example of an irritant may be ordinary smoke that can irritate the nasal passages and respiratory system.

Consequently, eye and skin contact with all laboratory chemicals should always be avoided. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems.

Sensitizers

A sensitizer (allergen) is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance.

Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives.

Sensitizer exposure can lead to all of the symptoms associated with allergic reactions, or can increase an individual's existing allergies.

Hazardous Substances with Toxic Effects on Specific Organs

People working with these materials must review the SDS for the specific material being used.

Substances included in this category include:

- Hepatotoxins – i.e., substances that produce liver damage, such as nitrosamines and carbon tetrachloride
- Nephrotoxins – i.e., agents causing damage to the kidneys, such as certain halogenated hydrocarbons
- Neurotoxins – i.e., substances which produce their primary toxic effects on the nervous system, such as mercury, acrylamide and carbon disulfide
- Agents which act on the hematopoietic system – e.g., carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen
- Agents that damage lung tissue – e.g., asbestos and silica. Symptoms of exposure to these materials vary.

Particularly Hazardous Substances

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. To differentiate this different risk characteristic, OSHA identifies two categories of hazardous chemicals:

1. hazardous chemicals; and
2. particularly hazardous substances.

Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard require that special provisions be established to prevent the harmful exposure of researchers to PHSs:

1. Establishment of a designated area;

2. Use of containment devices such as fume hoods or glove boxes;
3. Procedures for safe removal of contaminated waste; and
4. Decontamination procedures.

Particularly hazardous substances are divided into three primary types:

1. Acute Toxins (also known as p-listed chemicals);

Acute Toxins are interpreted by OSHA as being substances that "may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration." These chemicals, associated chemical waste, and storage containers must be handled with care to prevent cross contamination of work areas and unexpected contact. These chemicals must be labeled as "Toxic."

To be classified as having a high degree of acute toxicity, the chemical must fall within any of the following categories:

- A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally in test populations.
- A chemical with an LD50 of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 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.

Examples of Acute Toxins (This list is NOT all-inclusive; therefore, it is necessary to also reference the chemical SDS plus other hazardous chemical databases if the chemical you are looking for is not listed.):

- Acrolein
- Arsine
- Chlorine
- Diazomethane
- Diborane (gas)
- Hydrogen cyanide
- Hydrogen fluoride
- Methyl fluorosulfonate
- Nickel carbonyl
- Nitrogen dioxide
- Osmium tetroxide
- Ozone
- Phosgene
- Sodium azide
- Sodium cyanide

2. Reproductive Toxins; and

Reproductive toxins include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline. Pregnant women and women intending to become pregnant should consult with their PI and EHS before working with substances that are suspected to be reproductive toxins.

Examples of Reproductive Toxins (This list is NOT all-inclusive; therefore, it is necessary to also reference the chemical SDS plus other hazardous chemical databases if the chemical you are looking for is not listed.):

- Dibromochloropropane (DBCP)
- Lead
- Ionizing radiation
- Ethylene Oxide

3. Carcinogens.

Carcinogens are chemical or physical agents that cause cancer. Generally, they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects.

Examples of Carcinogens (This list is NOT all-inclusive; therefore, it is necessary to also reference the chemical SDS plus other hazardous chemical databases if the chemical you are looking for is not listed.):

- 4-Nitrobiphenyl
- Asbestos
- α-Naphthylamine
- Methyl chloromethyl ether
- 3,3-Dichlorobenzidine (and it's salts)
- bis-Chloromethyl ether
- beta-Naphthylamine
- Benzidine
- 4-Aminodiphenyl
- Ethyleneimine
- beta-Propiolactone
- 2-Acetylaminofluorene
- 4-Dimethylaminoazobenzene
- N-Nitrosodimethylamine
- Vinyl chloride
- Inorganic arsenic
- Cadmium
- Benzene
- Coke oven emissions
- 1,2-dibromo-3-chloropropane
- Acrylonitrile
- Ethylene oxide
- Formaldehyde
- Methylenedianiline
- 1,3-Butadiene
- Methylene chloride
- Any substance listed under the category, "known to be carcinogens" in the annual Report on Carcinogens (RoC) published by the National Toxicology Program (NTP) (https://ntp.niehs.nih.gov/pubhealth/roc/index-1.html).
- Any substance listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (https://monographs.iarc.fr/agents-classified-by-the-iarc/).

Appendix E

Specific Laboratory Safety Information

Nature of Research

Description of Research.

Responsible Personnel

Name	Title	Room	Extension
	Principal Investigator		
	Laboratory Supervisor		
Kara Barnett	Safety Officer	ISB 130	x22112
Soumitra Basu	Department Chair	WMH 214	x22032
LaKetta Wilson	Research Safety & Compliance Manager	HAR 310	x21977
Dennis Baden	Environmental Health & Safety Director	HAR 310	x21950
Police Service	Department of Public Safety	SSB	911 (emergency) x23070 (business)

Lab Equipment

List all laboratory equipment. All individuals must be trained and authorized before using the equipment. Repair and maintenance of the equipment will be made by the Responsible Individual, Principal Investigator or Manufacturer.

Lab Equipment

Laboratory Safety Acknowledgement Statement

I acknowledge that I have reviewed the university and departmental chemical hygiene plan. I have also been trained on laboratory specific procedures and understand that as assignment changes occur, the responsible individual will review any new hazards and protective measures. My signature indicates that I have had the opportunity to discuss the health and safety aspects of my work with the responsible individual and that I agree to abide by the University, Department, and Laboratory procedures and guidelines.

Name	Signature