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Kennesaw State University (KSU) is committed to providing and maintaining a safe teaching, learning, living, and working environment for all members of its community. Laboratories (including teaching labs, shops, and studios) are unique work environments that entail a variety of operations and activities, involving working with hazardous materials and potentially dangerous equipment. Laboratory personnel, therefore, are at risk of exposure to various types of hazards, including chemical, biological, physical, and radiological. However, with prudent laboratory practices, appropriate equipment, proper facilities, and awareness, reasonable laboratory operations can be handled safely without undue risk to KSU's employees, students, properties, or the environment.

The responsibility of ensuring a safe laboratory environment at KSU is a shared responsibility between laboratory personnel, administrators, students, and Environmental Health & Safety (EHS) personnel. Nevertheless, laboratory supervisors, principal investigators (PIs), and managers have the primary responsibility for safety in laboratories under their supervision and for ensuring compliance with the applicable regulations and policies with their labs.

This Chemical Hygiene and Safety Program (CHSP or the Program) is intended to serve as the primary resource to KSU's laboratory personnel and students by providing information on policies, procedures, and tools relating to laboratory safety at KSU. The Program is written to reflect the requirements and guidelines of federal and state regulations, and industry standards and best practices. The PIs and laboratory supervisors and managers should supplement this information with laboratory safety training, instruction and guidance regarding specific practices, and procedures unique to the work being done in their individual laboratories. This Program will be reviewed and revised as necessary, and at least annually.

The document has been approved by:

Official	Signature	Date
Dr. Ivan Pulinkala Provost (Interim)	DocuSigned by: Ivan Pulinkala	October 5, 2022
Tricia Chastain Chief Administrative Officer Office of the VP of Administration	DocuSigned by: Tricia Chastain	October 5, 2022
Dr. Phaedra Corso Vice President for Research/Professor of Health Policy for the Office of Research	DocuSigned by: Phaedra Corso	September 28, 2022
Stephen Ndiritu Director, Environmental Health & Safety	DocuSigned by: Stephen Ndiritu	September 27, 2022
Rodrick Esaw Sr. Research Safety and Biosafety Officer Environmental Health & Safety	DocuSigned by: Rodrick Esaw	September 27, 2022
Dr. Ian Ferguson University Safety Council Chair	DocuSigned by: Ian Ferguson	September 27, 2022

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Contact Information

Environmental Health and Safety (EHS) Department	Phone: 470-578-3321 After Hours: 678-449-7693 Email: ehs@kennesaw.edu Web: ehs.kennesaw.edu
Laboratory spills or accidents involving chemicals and/or biological materials; Chemical Hygiene Plan; regulatory permits (e.g., USDA, APHIS, controlled substances, radioactive materials, etc.); biological agents; chemical fume hoods; biological safety cabinet certifications; inspections of academic and research laboratories; and chemical and biological materials prior approval.	Rodrick Esaw, MPH, CSP Sr. Research Safety and Biosafety Officer Phone: 470-578-4803 Mobile: 404-326-3707 Email: resaw@kennesaw.edu
Hazardous waste disposal (e.g., chemical, toxic, radiological, biological); DOT and IATA shipping requirements for chemical, biological, and radiological material being shipped off campus	Vanessa Biggers Sr. Environmental Programs Manager Phone: 470-578-2415 Email: vbigger1@kennesaw.edu
Recombinant DNA guidelines and biological material use	Institutional Biosafety Committee (IBC) ibc@kennesaw.edu Rodrick Esaw, MPH, CSP Sr. Research Safety and Biosafety Officer
Radioactive materials	Dr. Eduardo Farfan, Chair, Radiation Safety Committee Phone: 470-578-5155 Email: efarfan1@kennesaw.edu Rodrick Esaw, MPH, CSP Sr. Research Safety and Biosafety Officer
Research animal use	Institutional Animal Care and Use Committee (IACUC) Phone: 470-578-3678 iacuc@kennesaw.edu Rodrick Esaw, MPH, CSP Sr. Research Safety and Biosafety Officer
Public Safety, Security, and Emergency Management (Police)	Public Safety Department Emergency: 470-578-6666 Non-Emergency: 470-578-6206
Ventilation (HVAC) problems; chemical fume hood operation; laboratory facilities design; laboratory furniture; plumbing and fixtures	Facilities Maintenance Phone: 470-578-6224 Web: web.kennesaw.edu/plantops/
Laboratory Managers/Coordinators	Dale A. Zaborowski Director of Laboratory Safety & Operations College of Science and Mathematics Phone: 470-578-6165 Benjamin Huck Laboratory Manager Department of Chemistry and Biochemistry Phone: 470-578-6404 Chris Dziejowski Studio Coordinator and Facility Operations School of Art and Design Phone: 470-578-6867 Rachel Kidd-Chancey Building Operations Manager College of Architecture and Construction Management Phone: 470-578-5537 Michael Rogers Engineering Laboratory Manager Southern Polytechnic College of Engineering & Engineering Technology Phone: 470-578-7248

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1. Purpose

The purpose of the Chemical Hygiene and Safety Program (CHSP) is to minimize the potential for KSU employees to be exposed to hazardous chemicals through the provision of basic health and safety information regarding the safe handling, use, and storage of hazardous chemicals in laboratories, in compliance with the requirements of OSHA's standard for Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450).

2. Scope

The program applies to all laboratories owned, leased, or operated by KSU. The Program covers all faculty, staff, students, contractors, and other personnel at KSU, or those under the management or control of KSU.

The workspaces covered under this CHSP include, but are not limited to, research labs, teaching labs, chemical stock rooms, chemical storage areas, art studios, engineering and wood working shops, and all other areas where chemicals are used on a non-production or non-manufacturing scale. In addition, these separate workspaces can encompass an entire room or portions of rooms that are shared with other groups.

3. Definitions

a. **Chematix** – The web-based chemical management and inventory system used by KSU and other University System of Georgia (USG) universities.
b. **Combustible liquid** – A liquid which can be ignited, but whose flashpoint is 100°F or greater.
c. **Controlled substances** – Substances that are regulated by the Controlled Substance Act and are separated into five schedules based on their currently accepted medical use in treatment in the US, relative abuse potential, and the likelihood of causing dependence when abused. The five schedules [as defined by the Drug Enforcement Administration (DEA)] are as follows:
    i. **Schedule I** – Have no currently accepted medical use in the US, a lack of accepted safety for use under medical supervision, and a high potential for abuse.
    ii. **Schedule II/IIN** – Have a high potential for abuse which may lead to severe psychological or physical dependence.
    iii. **Schedule III/IIIN** – Have a potential for abuse less than substances in Schedules I or II and abuse may lead to moderate or low physical dependence or high psychological dependence.
    iv. **Schedule IV** – Have a low potential for abuse relative to substances in Schedule III.
    v. **Schedule V** – Have a low potential for abuse relative to substances listed in Schedule IV and consist primarily of preparations containing limited quantities of certain narcotics.
d. **Dual-use research/materials** – Research or materials that could be used or have intent to improve public health, animal health, or agriculture, but in the wrong hands, can be used to impair public health, animal health, or agriculture.
e. **Explosive materials** – (OSHA) Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion (i.e., with instantaneous release of gas

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and heat), unless such compound, mixture, or device is otherwise specifically classified by the US Department of Transportation (DOT).

f. **Flammable liquid** – A liquid which can be ignited but whose flashpoint does not exceed 100°F.
g. **Hazardous chemicals** – Chemicals that have an inherent property to potentially do harm. These chemicals include, but are not limited to, carcinogens, corrosives, toxic or highly toxic, irritants, sensitizers, or target organ effectors.
h. **Highly reactive materials** – Materials that react violently with air, water, or otherwise non-reactive materials. Examples include, but are not limited to, pyrophoric materials, water reactive materials, and strong oxidizing agents
i. **Highly toxic materials** – Materials that are lethal in small doses, as defined in 29 CFR 1910.1200, Appendix A, section A.1 under Category 1 and Category 2. For example, a highly toxic material (Category 1) which has an LD_{50} (oral) of ≤ 5 mg/kg, and an LD_{50} (inhalation) of ≤100 parts per million (ppm).
j. **Laboratory** – Separate workspaces that are under the purview of a PI, professor, laboratory coordinator, or supervisor, where hazardous materials are used and/or stored. Separate workspaces include, but are not limited to, research labs, teaching labs, chemical stock rooms, chemical storage areas, art studios, engineering and wood working shops, and all other areas where chemicals are used on a non-production or non-manufacturing scale.
k. **Oxidizing agent** – A material that gains electrons during a chemical reaction. These agents give off oxygen when reacting with other materials which increases the potential for a fire or explosion.
l. **Particularly hazardous substances (PHS)** – Substances that are suspected or known to have a high degree of hazard, and include three primary categories: carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity.
m. **Peroxide forming materials** – Materials that react with oxygen to form peroxides, which can explode due to applied force, heat, or friction.
n. **Pressure/shock sensitive materials** – Materials that have the potential to explode due to applied force, vigorous shaking or vibration, or other forms of agitation.
o. **Pyrophoric materials** – Materials that can spontaneously ignite or react violently upon contact with air, oxygen, or moisture.
p. **Thermally unstable materials** – Materials that decompose or degrade within a given time when stored at ambient temperature.

4. Responsibilities

A. Deans

Deans have the following responsibilities under the CHSP:

- Create vision, enforce policy, set performance expectations, and ensure timely availability of resources that support laboratory safety at KSU.
- Provide leadership to ensure effective implementation of the CHSP and ensure the college's compliance with governing laws, regulations, and policies. To this end, Deans may designate a safety officer(s) within the college.
- Review laboratory and safety-related assessment reports to assess and direct actions necessary to continually improve laboratory safety performance in the college.

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B. Department Chairpersons

Department chairpersons have the following responsibilities under the CHSP:

- Set performance expectations, manage laboratory safety risks, and ensure the department's compliance with this Program and other environmental and occupational safety (EOS) laws, regulations, and policies.
- Effectively implement and ensure compliance with KSU's CHSP and its requirements within their respective units and laboratories.
- Incorporate CHSP requirements and responsibilities into employee job descriptions and address performance related to the same.
- Ensure that individuals under their supervision, including but not limited to supervisors, regular and temporary employees, contractors, and other affected personnel, obtain required laboratory safety training.
- Ensure that departmental processes are developed and followed to maintain incident and illness prevention and environmental protection.
- Ensure prompt reporting and appropriate investigations of incidents.
- Ensure development and implementation of a process for conducting hazard and risk assessments within their respective unit or laboratory, inclusive of periodic safety inspections of work areas and facilities and ensuring non-compliance items are corrected with follow-up and closure.
- Ensure assessment of the EOS impact of new laboratory chemicals, processes, and equipment and incorporate appropriate controls.

C. Principal Investigators, Supervisors, and Coordinators

PIs and instructors have the primary responsibility for safety in labs and process areas under their jurisdiction, including the following:

- Inform laboratory personnel, contractors, and visitors about KSU chemical hygiene and safety policies and procedures, ensure they comply with the requirements outlined in the CHSP, instruct them on potential hazards associated with the use of hazardous chemicals in the labs, and ensure that they have the proper personal protective equipment (PPE).
- Attend and ensure that laboratory personnel attend all required laboratory safety training.
- Provide area specific training on hazards and safety precautions related to each employee's assigned work.
- Ensure equipment and chemical containers are adequately labelled and, where necessary, work areas are posted with caution placards that depict the hazards in the area.
- Ensure laboratory employees have access to safety data sheets (SDSs).
- Select and employ engineering controls and laboratory practices to reduce the potential for exposure to the lowest practical level.
- Develop and maintain an accurate and up-to-date chemical inventory for each laboratory area under their direction using the KSU Enterprise Chemical Inventory System, Chematix.

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- Conduct a job hazard assessment (JHA) for tasks under their direction to identify the hazard(s) and associated risks and to determine the appropriate controls and PPE needed.
- Limit the amount of hazardous material procured, used, and stored to the minimum required and where practical, substitute high hazard materials with low hazard materials.
- Promptly report and investigate incidents in the laboratory and ensure that corrective actions identified from accident investigations and inspections/audits are implemented.
- Ensure monthly required safety inspections are conducted and properly documented.
- Ensure that proper decommissioning is performed on equipment to be serviced or laboratory areas prior to vacating.
- Ensure hazardous waste is collected at the point of generation and handled in accordance with the University's procedures for hazardous waste management.

D. Laboratory Personnel, Assistants, and Students

Laboratory personnel, teaching and research assistants, and students have the following responsibilities under the CHSP:

- Plan and conduct laboratory procedures safely by complying with the requirements of the CHSP and other safety standards, guidelines, and procedures and by using prudent practices based on training and expertise.
- Promptly report unsafe working conditions or practices to the supervisor.
- Promptly report any work-related injuries or illness to the supervisor.
- Attend laboratory safety training sessions as may be scheduled by EHS or the laboratory supervisor.
- Cultivate and practice good work and personal hygiene habits.

E. Environmental Health and Safety Department

For this CHSP, the Sr. Research Safety and Biosafety Officer within the EHS Department will serve as the University's Chemical Hygiene Officer (CHO). The responsibility of the CHO includes broad oversight in the implementation of the CHSP with the following responsibilities:

- Work with scientists/PIs, faculty, laboratory coordinators, safety committees, laboratory managers, and laboratory supervisors to develop and implement good chemical hygiene policies, procedures, and practices.
- Provide guidance for establishing engineering and administrative controls, good work practices, and selection of PPE.
- Perform and document exposure monitoring to determine employee exposures to hazardous materials and to evaluate the adequacy of controls.
- Review and approve procurement and use of chemicals and equipment, and assist PIs, instructors, and laboratory supervisors to develop and implement control procedures for handling, storing, and disposing of the chemicals.
- Provide general laboratory safety training to employees and document such training.
- Assist departments and laboratories with development and delivery of job-specific training, including identifying and providing additional training materials to assist in the training efforts.

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- As liaison with safety committees, assist PIs, instructors, laboratory coordinators, and laboratory supervisors in performing and documenting hazard assessments for existing and planned operations, including laboratory moves and decommissioning.
- In collaboration with the colleges and departments, oversee the laboratory chemical inventory process and provide guidance to Laboratory Managers (LMs) and PIs for maintaining laboratory specific chemical inventories.
- Perform periodic safety inspections and audits of laboratories to ensure compliance with the CHSP.
- Responding to hazardous materials spills (e.g., chemical, biological, radiological, etc.) when necessary.
- Collaborating with Office of Emergency Management (OEM) to update the Emergency Operations Plan (EOP) for emergency response to incidents involving hazardous materials.
- Review the CHSP at least annually and update as necessary.

F. Facilities Planning, Design, and Maintenance Departments

The Maintenance Department has direct control over operations of laboratories' general and local ventilation systems and utility systems. Maintenance personnel must be informed of the hazards that are present in the laboratory before beginning any work in a laboratory, sanitary waste lines, or the heating, ventilation, and air conditioning (HVAC) system. The Maintenance Department has the following responsibilities under the CHSP:

- Inform laboratory personnel in advance of scheduled utility or maintenance shutdowns (gas, water, chemical fume hoods, etc.).
- Maintain a proactive preventative maintenance program to ensure the laboratory's controls and emergency equipment (e.g., ventilation systems, detectors, shut-off devices, emergency eyewash, and safety shower) are in proper operating condition to maintain safe laboratory working conditions.
- Inform EHS when a major change of the HVAC is contemplated, completed, and coordinate planned maintenance with the end user.
- Coordinate laboratory demolition, construction, and renovation activities with EHS to ensure that proper design review is performed and that work areas and equipment meet current requirements, specifications, standards, and codes.
- Coordinate with current space occupants to ensure that all chemicals, radiological material, and wastes are removed and that all visible residues are cleaned before demolition, construction, or renovation activities are initiated.

5. Availability

The CHSP will be available on the KSU EHS website (https://ehs.kennesaw.edu/).

6. General Laboratory Safety Rules and Policies

All KSU students, faculty, staff, and visitors must adhere to the following basic laboratory rules and guidance to maintain a safe laboratory environment:

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- Ensure you understand the hazards of the materials and equipment you will be working with by reviewing the material's SDS and other available safety information and by carefully reading the labels and instructions before use. Make others in the laboratory aware of any special hazards associated with your work.
- Working alone in the laboratory is strongly discouraged, especially when working with hazardous materials or performing hazardous procedures. Having at least one other person present will ensure that assistance is available in case of emergencies.
- Do not perform experiments that have not been approved by your PI or supervisor.
- Always follow the appropriate standard operating procedures (SOP) and plan appropriate emergency procedures before beginning any operation.
- Do not use hazardous chemicals other than for their intended purposes.
- Do not use laboratory equipment other than for its intended purposes unless modifications have undergone a thorough hazard assessment and have been proven to be safe.
- Prior to using equipment, inspect for breaks, leaks, tears, and other damage.
- Horseplay is strictly prohibited in laboratories or laboratory areas. Never distract or startle other workers when they are handling hazardous chemicals or are working with hazardous equipment.
- When working with hazardous chemicals that are known to produce harmful fumes or vapors, use the appropriate ventilation and containment devices, such as chemical fume hoods.
- Adhere to all safety warning signs and labels in the laboratory, including in areas with unique hazards.
- Familiarize yourself with the locations and proper use of the safety equipment for your laboratory (i.e., eyewash unit, safety shower, fire extinguisher, first aid kit, fire blanket, emergency telephone, and fire alarms) and know the appropriate emergency response procedures.
- Always be aware of the potential hazards from ongoing experiments in the laboratory.
- Report any unsafe conditions, including inadequate safety equipment or chemical handling procedures in the laboratory to your supervisor and EHS.
- Report all injuries, incidents, and near misses to the supervisor, PI, or instructor and EHS per the University Incident Management Procedure.
- Notify your supervisor of any chemicals or materials to which you may be sensitive or allergic.
- Exclude visitors, especially children, from laboratory areas without prior authorization. Authorized visitors must not be allowed in laboratory areas unless they have been given a brief safety orientation and have been given all required PPE. If minors are expected in a laboratory (e.g., as part of an educational or classroom activity), they must be directly supervised by a PI, professor, or laboratory manager.
- Prohibit animals kept as pets (i.e., not meant for research or experimental purposes) from the laboratory. Emotional support animals are prohibited in the laboratory. Service animals are generally prohibited in the laboratory. If a service animal is needed, the owner must be referred to Student Disability Services to explore alternative accommodations.
- Dispose of all chemical waste in accordance with KSU's Hazardous Waste Management Procedures. Do not pour chemicals down the drain or discard them in regular waste containers.

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- Wash hands thoroughly with soap and water after handling chemicals and removing gloves.
- Do not eat, drink, smoke, chew gum, insert or remove contact lenses, or apply cosmetics while in the laboratories or laboratory areas.
- Never taste or sniff chemicals; do not pipette or siphon chemicals by mouth.
- Confine long hair and loose clothing, jewelry, etc., to avoid contacting chemicals or being entangled in machines and equipment.

A. Appropriate Laboratory Attire

Wearing the appropriate laboratory attire and PPE is required upon entrance into the laboratories.

Eye protection is required for all faculty, staff, students, and visitors in all areas where laboratory chemicals are stored or used, whether one is performing a chemical operation or not.

When handling hazardous materials, gloves that are appropriate for the hazard must be worn. Inspect all gloves for holes, tears, and other defects before using.

Wear an appropriate laboratory coat or apron while working in the laboratory. Replace soiled or dirty laboratory coats and aprons with clean ones.

Shorts, short skirts and dresses are prohibited in the laboratory. Wear clothing that covers the upper body and legs (to the ankles).

Always wear footwear that completely covers the foot. Sandals, open toe, and high-heeled shoes are prohibited.

Do not wear laboratory coats, gloves, or other PPE outside of the laboratory. Remove all PPE prior to leaving the laboratory to prevent contamination of door handles, elevators, other laboratories, and public areas.

Carefully inspect all protective equipment before using. Do not use defective protective equipment. For additional guidance on the use of PPE, see section D on page 22.

B. Working Alone in the Laboratory

It is not prudent for anyone to work alone when the work involves hazardous materials or equipment, or in areas where hazardous procedures are taking place. When working alone, the ability to respond to an accident could be severely impaired, resulting in serious personal injury, death, or catastrophic property damage.

If working alone cannot be avoided, anyone who will be doing so must read and follow KSU's *Procedure for Working Alone*. For additional guidance on this procedure, refer to the *Guidelines for Working Alone* document. **This procedure states the minimum best practices for situations where working alone may not be avoidable. Colleges, safety committees, individual PIs, or supervisors may choose to implement procedures that are more restrictive. In this event, the more restrictive procedure shall take precedence**.

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7. Chemical Procurement, Transportation, and Inventory

A. Procurement

1. Purchasing Chemicals

All laboratory chemicals must be purchased through the University Procurement System. Chemicals may be purchased using a University issued P-Card, ePro, or OwlPay. However, prior approval must be obtained through EHS. When purchasing chemicals, the requestor must provide the appropriate information for the purchase, including the vendor or supplier, catalog number, quantity, volume, etc.

2. Pre-Purchase Hazard Assessments

Some chemicals and equipment have inherent safety hazards that require special safety controls and authorizations. It is important that these controls are in place before the material is purchased and used on site. EHS will conduct a hazard assessment before approving the procurement of these materials or equipment while ensuring that the necessary controls and authorizations are in place.

Chemicals or laboratory equipment that may require a pre-purchase hazard assessment include but are not limited to the following:

- Chemicals
  - Explosive materials
  - Highly reactive materials
  - Particularly hazardous substances
    - Carcinogens
    - Reproductive and developmental toxins
    - Highly toxic chemicals
  - Controlled substances (see *DEA List of Controlled Substances*)
  - Radioactive sources (sealed or open source)
  - Biological materials
- Equipment
  - Ethylene oxide sterilizers
  - Class 3B or Class 4 lasers
  - Magnets or magnet systems capable of creating a magnetic field ≥0.5 millitesla (mT) at a distance of one (1) foot or at the operator's position, whichever distance is less
  - Equipment generating sub-radiofrequency (30 kHz and below) magnetic fields which at any time where the magnetic flux density may be ≥60 mT/frequency (in Hz)
  - Equipment which may generate noise at any time more than 82 decibels (dBA).
  - Equipment that contains sealed radiation sources (e.g., irradiators and liquid scintillation counters)
  - Equipment that produces radiation, such as x-ray machines
  - 3-D printers
  - Laser cutters
  - Equipment that produces combustible powders and/or dusts

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- Equipment that has specific ventilation requirements

Once EHS has completed the required hazard assessment(s), ensured all necessary safety controls are in place, and ensured that current SDSs are available, the request will be marked as approved.

B. Receiving Chemicals

Chemicals must be delivered to an area that is equipped to receive chemicals, such as a receiving area or a laboratory. Such areas are equipped to receive chemicals, including having chains for temporarily holding compressed gas cylinders and carts designed to safely move various types of chemical containers. Emergency showers and eye wash equipment must also be available in these areas. Shelves, tables, or caged areas must be designated for packages to avoid damage.

The following precautions must be taken when receiving chemicals:

- Chemicals must not be received or stored in offices, reception areas, or other areas that are not designed to handle chemicals.
- Receiving personnel are required to receive training on hazard recognition, safety precautions, security, and incident and spill response.
- Incoming packages must not be accepted from the courier if the outer package is compromised. This includes visibly leaking containers or severely damaged boxes.
- Incoming packages must be promptly opened and inspected to ensure that inner containers are sealed, in good condition, and confirm what was ordered was received.
- Unpacked chemicals must be stored safely.
- Reactive chemicals shipped in metal containers (e.g., lithium aluminum hydride, sodium peroxide, phosphorus)—which are often sealed—must be promptly unpacked and stored to prevent degradation and corrosion and to be available for periodic inspection.

Do not open and inspect packages of radioactive materials. If a package of radioactive materials arrives, contact EHS immediately at 470-578-3321.

C. Transportation

1. Transportation Within the Facility

While transporting chemicals within KSU facilities, care must be taken to prevent inadvertent spills and other accidents from occurring.

Single boxes of chemicals in their original packaging can be carried to their destination if they are light enough to manage easily. Groups of packages or heavy packages must be transported on a cart that is stable, has straps or side rails to contain packages securely, and has wheels large enough to negotiate uneven surfaces easily.

Suitable secondary containment must be used when transporting individual containers of liquids and solids in glass containers.

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Compressed gas cylinders must always be secured and transported on carts designed to transport compressed gas cylinders and must never be dragged or rolled. The cylinder cap must always be securely in place during transportation and storage.

Chemicals and compressed gas cylinders must be moved on freight elevators that are not used by the public. For best practices, delivery personnel should avoid riding in the elevators with compressed gas cylinders. If it is necessary to use a passenger elevator, passengers, other than the person transporting the chemicals, must be prohibited from riding in the same elevator during transportation.

If outside delivery personnel are found not to be handling materials according to the KSU's receiving standards, immediate correction should be sought, or other carriers or suppliers should be used.

2. Transportation Offsite

Hazardous materials, including compressed gas cylinders, must not be transported outside of KSU's laboratory buildings into the street or public sidewalks, in a personal vehicle, or on any form of public transportation, including KSU's shuttle service (BOB).

Consult with EHS before transporting chemicals. Chemicals can be transported in a University vehicle only when the reason for transporting is University related.

Shipment of any hazardous material must comply with the package and label requirements for hazardous materials transportation in accordance with the Department of Transportation (DOT) Title 49 regulations for ground transport or with the International Air Transport Association (IATA) Dangerous Goods Regulations for air transport. Compliance with these standards will minimize risk to employees and the public and ensure that the DOT and IATA regulations for packaging, manifesting, and placarding are met.

Only KSU employees who have received the appropriate DOT/IATA training are authorized to ship hazardous material or dangerous goods. EHS currently offers DOT training online via OwlTrain. However, to be certified to ship hazardous materials or dangerous goods, a complete DOT/IATA training from a qualified vendor must be completed.

EHS has developed shipping forms that will be used if EHS is requested to ship a package for someone who needs to ship chemicals and has not taken the training. All shipments must include an SDS. If one is not commercially available, such as newly synthesized chemicals, the PI must write one.

D. Chemical Inventory

Each laboratory must maintain an accurate and up-to-date inventory of all chemicals being used or stored in the laboratory through Chematix. The purpose of the chemical inventory is to provide accurate and up to date chemical hazard information to the owners of the chemicals, EHS staff, and emergency responders. Responders need to know the maximum quantity of hazardous materials on-hand at any given time to respond to incidents with appropriate knowledge, training, and equipment. An accurate chemical inventory must also be maintained

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for compliance with BOR (Board of Regents) reporting requirements. A well-maintained chemical inventory can also aid in management of business and research needs of the laboratory.

It is the responsibility of PIs, laboratory supervisors, laboratory coordinators, and laboratory managers to ensure that laboratories under their purview develop and maintain accurate and up-to-date chemical inventories. Chemical inventories must be reconciled at least semiannually (July and December).

8. Chemical Hazards and Hazard Assessments

A. Hazardous Chemicals

A hazardous chemical is any element, chemical compound, or mixture of elements and/or compounds which is a physical or a health hazard (OSHA, 29 CFR 1910.1200).

1. Physical Hazards

A chemical is a physical hazard if it possesses flammable, combustible, explosive, oxidizing, self-heating, corrosive to metal, pyrophoric, or self-reactive properties, if it is an organic peroxide or compressed gas, or if it emits flammable gas when in contact with water (OSHA, 29 CFR 1910.1200).

2. Health Hazards

A chemical is a health hazard if it produces acute toxicity (any route of exposure), skin corrosion or irritation, serious eye damage or eye irritation, respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity (single or repeated exposure), or aspiration hazard in exposed individuals (OSHA, 29 CFR 1910.1200). Review the following breakdown of health hazard classes.

Class	Description	Examples
Irritants	Noncorrosive chemicals that cause reversible inflammatory effects (swelling and redness) on living tissue	Acetone; iodine; benzoyl chloride
Corrosives	Agents that cause destruction of living tissue by chemical action at the site of contact	Acids (nitric, sulfuric, hydrofluoric acids); bases (metal hydroxides, ammonia)
Allergens and Sensitizers	Agents that cause adverse reactions to the immune system. Allergic reactions can be immediate or delayed.	Phenol derivatives; various isocyanates; metals
Asphyxiants	Substances that interfere with the transport of an adequate supply of oxygen to vital organs of the body	Carbon monoxide; hydrogen cyanide
Neurotoxins	Chemicals that cause adverse effects on the nervous system	Mercury; organophosphate; carbon disulfide; xylene; trichloroethylene; *n*-hexane.
Reproductive and developmental toxins	Substances that cause chromosomal damage (mutagens) and substances with lethal or teratogenic (malformation) effects on fetuses	Organic solvents; lead; certain ethylene glycol ethers; bromine; carbon disulfide (CA Proposition 65)
Toxins affecting other target organs	Substances that produce one or more effects in target organs - liver, kidney, lung, or blood toxins	Chlorinated hydrocarbons; benzene; aromatic hydrocarbons; some metals, carbon monoxide; cyanides
Carcinogens	Substances capable of causing cancer	Formaldehyde; chloromethyl methyl ether; benzene; asbestos; beryllium

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		and beryllium compounds; chromium (VI) compounds; 1,3-Butadiene

B. Particularly Hazardous Substances

Particularly hazardous substances include select carcinogens, reproductive and developmental toxins, and substances with a high degree of acute toxicity. Additional precautions are required when handling particularly hazardous substances. Any work activity involving a PHS must be evaluated by EHS to ensure that proper controls are in place and that appropriate area specific training is provided. For more information on working with PHSs please consult the University's *Procedure for Working with Particularly Hazardous Substances* (EOSMS-204).

1. Carcinogens

Carcinogens are agents that cause tumors (neoplasms) in humans and/or animals. OSHA identifies certain classes of chemicals which have been strongly implicated as a cause of cancer in humans as select carcinogens. Select carcinogens include, as defined by the National Research Council (NRC), 2011:

- Any substance regulated by OSHA as a carcinogen.
- Any substance listed under the category "Known to be a Carcinogen," or "Reasonably Anticipated to be Carcinogens," in the latest edition of *Annual Report on Carcinogens* published by the National Toxicology Program (NTP).
- Any substance listed in Group 1 Carcinogenic to Humans, Group 2A Probably Carcinogenic to Humans, or Group 2B Possibly Carcinogenic to Humans by the International Agency for Research on Cancer (IARC) monograph.
- Any substance listed under the category "Reasonably Anticipated to be Carcinogens" by the NTP and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
  - After inhalation exposure of 6-7 hours per day, 5 days per week, for significant portion of a lifetime to dosages of less than 10 mg/m^3.
  - After repeated skin applications of less than 300 mg/kg of body weight per week.
  - After oral doses of less than 50 mg/kg or body weight per day.

2. Reproductive and Developmental Toxins

The NRC (2011) defines reproductive toxins as chemical substances that can cause chromosomal damage (i.e., mutagens) or substances with lethal or malformation (i.e., teratogenic) effects on fetuses. The substances have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive capabilities, and can affect both men and women. Male reproductive toxins can in some cases lead to sterility.

Developmental toxins are substances that act during pregnancy to cause adverse effects on the developing embryo or fetus.

3. Substances with a High Degree of Acute Toxicity

The NRC (2011) states highly acutely toxic substances include materials that may be fatal or cause damage to target organs because of a single exposure or exposures of short duration

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or that can cause intense irritation resulting in fluid and swelling in the lungs (e.g., pulmonary edema), chemical asphyxia, and systemic (body-wide) poisoning.

C. Hazard and Risk Assessments

Hazard and risk assessments must be conducted to identify potential hazards and evaluate the risks associated with the use of chemicals and with processes in the laboratory. Risk can be defined as a combination of three elements:

1. Hazard – The known or inherent properties of materials or processes to cause harm (to people, property, or environment).
2. Severity – Defines or quantifies severity of the hazard.
3. Probability – The likelihood that adverse effects or undesired events will occur.

Before quantifying the hazard and severity or defining the likelihood of occurrence of adverse effects and events, the hazard(s) must first be identified. Hazards can be identified in laboratories using several methods, including but not limited to Chemical Hazard Assessments (CHAs), Job Hazard Analyses (JHAs), and "What If" Hazard Analyses.

1. Chemical Hazard Assessments

CHAs are techniques that can be used in laboratories to identify potential hazards associated with the use of chemicals and with certain processes. In a CHA, each experiment/operation must be evaluated individually because assessment of the level of risk depends on how substances will be used in a particular operation. CHAs also help to determine the necessary control measures to minimize chemical exposures and to minimize or prevent the occurrence of undesired events.

2. Job Hazard Analyses

JHAs or Job Safety Analyses (JSAs) are techniques used to identify hazards that are associated with specific tasks. JHAs focus on the relationship between the worker, the task(s), the materials, and the work environment. In a JHA, one would break down each process into steps and identify the hazards for each step. Once all hazards have been identified, methods to reduce or eliminate the hazard can be explored and implemented, including engineering controls and PPE.

3. "What If" Hazard Analyses

The "What If" Hazard Analysis combines a structured checklist with the creative thinking of a group of selected specialists from various disciplines (e.g., EHS, research, and facilities management). This team would then use the checklist to examine a process from start to finish, asking "what-if" questions based on the hazards and safety implications of the procedure or operation. After thorough discussion, answers would be provided for each question. The group would then work towards a consensus as well as recommendations for each question and answer for an official hazard analysis report.

The assessments must ensure appropriate protective measures have been put in place and that the proper level of work authorization has been obtained.

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PIs, instructors, laboratory supervisors, and laboratory coordinators must be aware of and approve the work performed under their purview and must ensure that appropriate hazard assessments are conducted in their work areas.

EHS may be consulted to provide assistance and guidance for performing the hazard assessments.

Once all the hazards have been identified, risk should be evaluated based on the perceived severity of the hazard and the likelihood of occurrence of adverse effects or events. Actions must be taken to eliminate hazard or control risk associated with hazards that cannot be controlled to mitigate potential injuries and illnesses, damage to University properties, or environmental impacts.

Risk can be assessed using several tools, including the JHA, the "What if" Analysis, and the Laboratory Risk Assessment Tool (LabRAT). These tools are available via the EHS website.

9. Hazard Prevention and Controls

Protecting workers from hazards in the workplace should follow a specific approach known as the Hierarchy of Controls. This Hierarchy includes five primary methods. The first is elimination, which is to completely remove the hazard from the work environment. Unfortunately, this is not always feasible, and therefore, other methods must be considered to minimize the hazards. These include chemical substitution, engineering controls, administrative controls, and the proper use of PPE.

A. Chemical Substitution

Before a chemical or product is selected for use in an experiment or process, the PI, instructor, laboratory supervisor, or laboratory coordinator must take the following steps:

- Determine if the chemical requires prior approval and ensure that prior approval is obtained in accordance with the procurement process.
- Determine if a safer chemical alternative is available.
- Review the hazards associated with the material and assess the conditions under which it will be used. This information can be obtained from the SDS for the material or by consultation with EHS.
- Keep working quantities of all hazardous materials to a minimum; procure, use, and store the minimum amount of material required.

B. Engineering Controls

Except for substitution, engineering controls provide the most effective means of hazard control because they enclose the hazard or separate it from employees. Engineering controls include chemical fume hood (CFH), shield, and auxiliary local exhaust ventilation system (snorkel).

1. Local Exhaust Ventilation

Local exhaust ventilation is used to remove airborne contaminants from an employee's breathing zone. The selection, procurement, installation, and balancing of all ventilation systems must be done through EHS and Facilities Services to ensure proper functionality. Local exhaust ventilation systems such as CFHs and glove boxes must be used during the following situations:

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- Using volatile toxic substances
- Using PHSs
- Generating particulates, such as dust, or liquid aerosols of even moderately toxic chemicals
- Using odiferous compounds
- Creating chemical reactions or syntheses that produce harmful vapors
  ***Caution: Operations involving heating or evaporating perchloric acid is not allowed at KSU without special controls, such as the use of a perchloric acid CFH, which is not currently available on the Kennesaw or Marietta campuses.**
- Diluting concentrated acids and bases
- Discharging hazardous gases and vapors from vacuum pumps and distillation columns

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If local exhaust ventilation is not available or conducting such procedures under local exhaust ventilation is not feasible, a hazard assessment will be conducted to determine if point source ventilation (i.e. - snorkel exhaust) is needed. Generally, all substances with a permissible exposure limit (PEL)/threshold limit value (TLV) of 50 ppm or less and all particularly hazardous substances (carcinogens, highly toxic and reproductive and developmental toxins) must be handled under local exhaust ventilation (National Research Council, 2011).

Laboratory HVAC systems must provide 100% outside air as make-up air to laboratory spaces. In other words, no recirculation of air is allowed.

All laboratory spaces must maintain negative directional airflow relative to the adjacent offices, hallways, and service corridors. This ensures no air contaminants migrate from laboratory spaces to non-laboratory spaces.

2. Glove Boxes and Gas Cabinets

Glove boxes purged with an inert gas are required for operations involving alkali metals and other air-sensitive materials that should not be exposed to air.

3. Safety Shields

Safety shields must be used for protection against explosions. Laboratory equipment used in experiments where there is potential for explosion must be shielded on all sides to ensure there is no line-of-sight exposure to personnel.

C. Administrative Controls

Administrative controls include written procedures, employee training, establishing designated or restricted areas, chemical procurement procedures, and preventive maintenance.

PIs, instructors, laboratory coordinators, and laboratory supervisors must develop written procedures for laboratory operations and procedures under their jurisdiction involving handling of:

- PHSs

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- Air or water reactive materials
- Radioactive materials
- Explosives
- Elevated temperature and pressure operations (e.g., high pressure hydrogenations)

Training is discussed in the Training and Hazard Communication section of this plan. The establishment and use of designated areas are discussed in the *Procedure for Working with Particularly Hazardous Substances (PHS)* (EOSMS-204).

Work practice controls include preplanning work, good housekeeping, personal hygiene practices, and using common sense to minimize exposure to hazardous materials. Work practice controls must be used regardless of the type of hazardous material handled.

D. Personal Protective Equipment

PPE is to be used as a supplement, not a substitute, for engineering controls. PPE is considered the last layer of defense and protection between the worker and the hazard. PPE may only be used as a sole means of control if the use of other controls is not feasible.

The University will provide appropriate PPE at no expense to the employee. PPE includes chemically resistant gloves, eye protection (non-prescription only), footwear, hardhats, coveralls, and respiratory protection, among others. To be effective, employees must understand the uses and limitations of PPE and use them appropriately.

1. Minimum Personal Protective Equipment Requirements

Laboratory employees must wear at a minimum appropriate laboratory attire:

- Laboratory coats
- Safety glasses with side shields (refer to General Procedures for Working with Hazardous Substances, Avoiding Eye Injury, regarding when chemical splash goggles must be worn)
- Appropriate footwear while handling or using chemicals; open-toe shoes are not permitted.
- Gloves

Appropriate gloves must be worn when handling hazardous substances, materials at temperature extremes, or materials with sharp or rough surfaces. No single glove material provides universal protection against all chemical agents. Gloves must be selected based on their chemical resistance to the material(s) being handled, their suitability for the procedures being conducted, and their resistance to wear and extreme temperatures. A variety of sizes of gloves must be made available to employees to ensure the appropriate fit, and materials that are alternatives to latex must be made available for individuals who have latex allergies.

In addition to wearing the minimum PPE, employees must also wear laboratory appropriate attire (i.e., avoid wearing shorts, short skirts, short dresses, or capri pants).

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2. Use of Respirators

Respirators must be used in accordance with KSU's *Respiratory Protection Program* (EOSMS-208). All employees required to use respirators must be deemed medically fit by a physician, trained in respiratory protection, and fit tested to wear respiratory protection equipment. Any questions regarding the need for or use of respirators should be directed to the EHS department.

Any employee who voluntarily wears a respirator must be provided information about wearing respiratory protection in accordance with the KSU *Respiratory Protection Program*.

10. General Procedures for Working with Hazardous Substances

A. Planning

Everyone should seek information and advice about hazards before starting work with hazardous substances. Plan appropriate protective procedures and positioning of equipment before beginning new operations.

Pre-plan work: stage tools, equipment, and materials prior to beginning the activity. Keep drip pans, secondary containment, and clean-up materials readily available. Be familiar with the location, use, and limitations of emergency equipment such as emergency eyewashes, safety showers, fire alarms, fire extinguishers, and exits.

Limit the amount of hazardous materials procured, used, and stored to the minimum needed for an operation.

B. Personal Behavior

A professional standard of personal behavior is required in the laboratory and other areas where hazardous materials are used:

- Never engage in practical jokes or other behavior that might confuse, startle, or distract another worker.
- Use laboratory equipment only for its designated purpose.
- Do not allow visitors, including children and pets, in laboratories where hazardous substances are stored or in use or hazardous activities are in progress.
- If children are permitted in laboratories as part of an educational activity, ensure they are under direct supervision of trained, qualified adults.

C. Minimizing Exposure to Chemicals

Precautions should be taken to avoid exposure to hazardous chemicals through any of the principal routes of exposure:

- Dermal – skin and eye contact
- Inhalation
- Injection
- Ingestion

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1. Avoiding Inhalation of Hazardous Chemicals

Chemicals or compounds of unknown hazards must never be inhaled. Procedures involving volatile or toxic substances (solid or liquid) and operations that may result in the aerosolization of these substances must be conducted under local exhaust ventilation such as CFHs or glove boxes. Dusts must be recognized as potentially contaminated and hazardous.

Respiratory protection must be used when engineering controls fail to reduce airborne contaminants to safe levels. You must be qualified through the Respiratory Protection Program to use a respirator. Consult EHS if you believe you need a respirator or have related questions.

Working with Chemical Fume Hoods

CFHs can be found in most laboratories where chemicals are used and should be used to protect against inhalation hazards. CFHs provide protection to the user only. Biological samples have the potential to become cross-contaminated when manipulated inside of CFH; therefore, avoid working with these materials inside a CFH. CFHs must satisfy the following requirements:

- Be evaluated and certified for adequate containment when working with hazardous substances.
- Be inspected annually by a qualified vendor, and the inspection certification label must be in a visible location.
- Maintain face velocity between 80-120 linear feet per minute (lfm) for standard, continuous volume hoods, and as low as 60 lfm for high performance hoods. If the face velocity is outside of these parameters, contact EHS to have the functionality of the CFH evaluated.
- Not be used for storage of chemicals, waste, or other materials, as overloading the interior could affect the flow rate.
- Have regularly cleaned grill along the bottom slot or baffle in the back of the hood so the air flow is not impeded with paper, debris, or dirt.
- Contain only materials actively in use. Following this rule will provide optimal containment and reduce the risk of extraneous chemicals being involved in any fire or explosion.
- Have hazardous chemicals and chemical reactions at least 6 inches behind the plane of the hood sash.
- Have any equipment that needs to remain in hoods on risers or feet to provide airflow under the equipment.

Never put your head inside an operating CFH while chemicals are in use; the plane of the sash is the barrier between contaminated and uncontaminated air. On hoods where sashes open vertically, work with the hood sash in the lowest position commensurate with the task so that the hood sash may act as a barrier between the user and experiment. On hoods where sashes open horizontally, position one of the doors to act as a shield in the event of an accident in the hood. When the hood is not in use, keep the sash closed; the sash must not be broken or cracked.

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Report suspected hood malfunctions promptly to EHS. If it is evident that the CFH is not functioning property (i.e., chemical vapors can be detected, does not adequately exhaust smoke, fails the "chem wipe test"), contact EHS immediately to have the functionality of the hood evaluated.

Special Purpose Chemical Fume Hoods

Working with some chemicals in the laboratory requires specially designed CFHs to protect against particular hazards. These CFHs operate in the same manner as standard CFHs by pulling air around the employee and exhausting air to the outside of the building. However, they have alternative designs and additional features to ensure adequate protection of the employee and the equipment. Two examples of special purpose CFHs are perchloric acid hoods and acid digestion hoods.

Perchloric acid is a highly corrosive chemical whose vapors can form crystalline perchlorates and attach to the interior walls of the CHF's ductwork upon drying. These perchlorates are shock sensitive and present an explosion hazard. Perchloric acid must be used in hoods that are designed as follows:

- The materials that construct the interior and ductwork must be non-reactive, acid resistant, and relatively impervious (e.g., PVC, porcelain, etc.).
- Interior surfaces of the hood and ductwork shall be smooth, seamless, and easy to clean.
- The ductwork should be a standalone exhaust system (i.e., not connected to other hoods or ductwork) and should go from the hood directly to the ceiling.
- The ducts must be equipped with a "wash down" system. This wash down system must be used at least weekly to minimize the formation of dry, explosive perchlorates.

Perchloric acid must not be used in standard fume hoods.

Some acids have highly corrosive properties that can cause multiple hazardous effects. For example, hydrofluoric acid (HF) is a highly corrosive material that can cause devastating effects to human health (e.g., pulmonary edema, deep tissue burns, gangrene, and heart failure) and major damage to incompatible materials. The fumes from HF are corrosive enough to digest glass over time. Materials like HF should be used in hoods that are designed as follows:

- The materials that construct the interior and ductwork must be non-reactive, acid resistant, and relatively impervious (e.g., PVC, polypropylene lined, and porcelain).
- The sash must not be made of glass, but of transparent, durable, acid resistant material (e.g., polypropylene and plastic).
- The ductwork should be a standalone exhaust system (i.e., not connected to other hoods or ductwork) and should go from the hood directly to the ceiling.

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Working with Biosafety Cabinets

Biological safety cabinets (BSCs) can be found in some research laboratories and should be used to work with biological materials only. They function by pulling air from around the working employee but unlike CFHs, they provide various types of protection, such as employee protection, product or sample protection, and environmental protection.

BSCs can provide all three forms of protection or a combination of one or more of these. This is accomplished by either exhausting or recirculating the air inside the BSC through a series of high efficiency particulate air (HEPA) filters. Generally, BSCs must not be used as protection against hazardous chemicals because not all BSCs exhaust contaminants and vapors to the outside of the building. Certain designs of BSCs recirculate 70 percent of the air intake and 30 percent of the air is exhausted to the room where the unit is located, while other designs recirculate 30 percent and exhaust 70 percent to the air. Some BSCs exhaust all air to the outside of the building and are hard ducted, while others are thimble connected. For more information on BSCs, refer to the KSU Biosafety Manual (EOSMS-203).

2. Avoiding Skin Contact

Avoid skin contact with chemicals and hazardous substances by using gloves, clothing, and approved apparel.

Wear gloves whenever handling hazardous chemicals, sharp-edged objects, very hot or very cold materials, toxic chemicals, and substances of unknown toxicity. The following general guidelines apply to the selection and use of protective gloves:

- No single glove protects against all hazardous materials.
- Wear gloves that are appropriate to the task being performed. Wearing the wrong type of gloves can be more hazardous than wearing no gloves at all, because if a chemical seeps or permeates through, the glove can hold it in prolonged contact with your hands.
- Inspect gloves for small holes or tears before use.
- Remove gloves before handling objects such as doorknobs, telephones, pens, and computer keyboards to prevent the unintentional spread of hazardous substances.
- Replace gloves periodically, depending on the frequency of use and their permeation and degradation characteristics relative to the substances handled.
- When working with materials of extreme temperatures (e.g., liquid nitrogen, autoclaved materials, etc.), thermal gloves must be used to protect hands.
- When working with sharp-edged objects, wearing cut-resistant gloves can prevent inadvertent incisions or lacerations to hands.

Confine long hair, loose clothing, and jewelry when working in the laboratory. Unrestrained long hair, loose or torn clothing, and jewelry can dip into chemicals or become entangled in equipment and moving machinery. Clothing and hair can catch fire if exposed to open flames.

Sandals and open-toe shoes must never be worn in a laboratory and other process areas where hazardous chemicals are in use due to the exposure potential to the feet and toes.

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Always wear a laboratory coat, apron, or coveralls when working with hazardous chemicals. This is particularly important if personal clothing leaves any skin exposed. For work with corrosive materials, liquid barrier laboratory coats or wearing aprons, in addition to a standard laboratory coat, is recommended. Because many synthetic fabrics are flammable and can adhere to the skin when ignited/on fire, increasing the severity of a burn, cotton is the preferred fabric for standard laboratory coats and coveralls.

Apparel giving additional protection may be required for work with certain hazardous substances. For example, flame resistant/retardant laboratory coats are required when working with extremely flammable or pyrophoric materials.

3. Avoiding Eye Injury

Safety glasses must be made available at the entrances to all laboratories. PIs/instructors and supervisors/coordinators shall assess the risks associated with each task to ensure the level of eye protection provided is appropriate for the anticipated hazards.

Eye protection is required for all personnel and visitors in all locations where chemicals are stored or used, whether a chemical operation is being performed or not.

Safety glasses with side shields are the minimum protection acceptable for regular use. Safety glasses must meet the American National Standards Institute (ANSI) Z87.1 standard. Ordinary prescription glasses do not provide adequate protection against injury, therefore individuals who wear prescription glasses have two options:

- Wear safety glasses that are designed to fit over prescription lenses (OTG)
- Wear prescription safety glasses. These can be obtained at the user's expense or paid for if arrangements have been made with the employee's department regarding a prescription safety glasses program.

Contact lenses offer no protection against eye injury and cannot be substituted for safety glasses and goggles. Hazard-appropriate safety eyewear (e.g., safety glasses or goggles) must be worn regardless of contact lens use.

Chemical splash goggles must be worn when carrying out operations in which there is potential for splashing chemicals or flying particles. Goggles protect against projectile hazards, as well as when working with glassware under reduced or elevated pressures (e.g., sealed tube reactions), when handling potentially explosive compounds (particularly during distillations), and when employing glassware in high-temperature operations.

Because goggles offer little protection to the face and neck, full-face shields should be worn in addition to chemical splash goggles when conducting particularly hazardous laboratory operations, such as working with concentrated acids and bases. These instances should be determined by a hazard assessment.

Operations such as glassblowing and the use of laser or ultraviolet (UV) light sources require special glasses or goggles. It is the responsibility of the supervisor to ensure

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availability of the special eye protection and that the eye protection is designed with the necessary protective filters for the anticipated hazard(s).

4. Avoiding Ingestion of Hazardous Chemicals

Eating, drinking, smoking, chewing gum, applying cosmetics, and taking medicine in places where hazardous chemicals are used is strictly prohibited. Food, beverages, cups, and other drinking and eating utensils must not be stored in areas where hazardous chemicals are handled or stored. Glassware used for laboratory operations must never be used to prepare or consume food or beverages.

Laboratory refrigerators, freezers, ice chests, cold rooms, ovens, or other types of laboratory equipment must not be used for food storage or preparation.

Laboratory water sources and deionized laboratory water must not be used for drinking water.

Laboratory chemicals must never be tasted, and edible materials intended for laboratory use (e.g., milk, vinegar, and sugar) must not be consumed.

Pipetting must never be done by mouth; mechanical pipetting devices must be used.

After handling chemicals, wash hands with soap and water before leaving the laboratory or work area and prior to breaks and consumption of food and beverages, even if gloves have been worn.

D. Housekeeping

Keep work areas clean and walking surfaces free of obstructions. Clean the work area at the completion of an operation or at the end of the day. Maintain access to exits, emergency equipment, and other control equipment free of any obstruction. Do not use stairways, hallways, mechanical spaces, and pipe chases as storage areas. Store equipment and chemicals properly to avoid clutter.

Wipe drips and residues from containers of hazardous materials. Skin contact with residues may cause dermal absorption, chemical burns, skin irritation, and possible accidental ingestion because of hand to mouth transfer.

Clean surfaces (counter tops, bench tops, chemical fume hoods, and floors) of all drips and residues.

Clean small chemical spills immediately and dispose of all waste materials in the appropriate waste stream (i.e., chemical waste materials must be discarded as chemical waste; biohazard waste materials must be discarded as biohazard waste; no mixing of waste materials). Call EHS for large chemical spills (i.e., volume greater than 1 liter) or if the spill volume is outside of one's comfort level.

For chemical spills involving PHSs (e.g., HF, methylene chloride, and mercury) contact EHS immediately for assistance.

Dispose of chemical waste in accordance with the University's *Hazardous Waste Management Plan*.

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E. Use of Glassware

Use adequate hand protection when inserting glass tubing into rubber stoppers or corks or 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. Plastic or metal connectors should be used whenever possible.

Do not attempt glassblowing operations unless proper annealing facilities are available.

Handle vacuum-jacketed glass apparatus with extreme care to prevent implosions. Equipment such as Dewar flasks should be taped or shielded. Only glassware designed for vacuum work should be used for that purpose.

Avoid picking up broken glass with your hands. Wear eye protection and use a broom and dustpan to clean up broken glass.

Dispose of broken glass in marked containers designated for the disposal of broken glass. Containers for disposal for broken glass should be made of sturdy materials (e.g., corrugated cardboard) and should be lined with a thick plastic liner. Glassware should not contain liquids (e.g., water, chemicals, etc.) prior to disposal in a broken glass container.

11. Chemical Storage Guidelines

Storing chemicals in stockrooms and laboratories requires consideration of several health and safety factors. For instance, proper storage is needed to minimize the hazards associated with accidentally mixing incompatible chemicals including the risk of fire or explosion.

A. General Storage Requirements

Observe the following general guidelines for storing chemicals. Specific guidelines are presented later in this section.

- Avoid chemical stockpiling. Procure hazardous materials as needed. Conduct periodic cleanouts to minimize accumulation of chemicals.
- Maintain a clearance of at least 18 inches from the fire sprinkler heads to allow proper spray coverage under the horizontal plane of the fire sprinkler system.
- Do not store chemicals or equipment on top of high cabinets where they will be hard to see or reach.
- Avoid storing heavy materials up high.
- Chemicals must be sorted by compatibility groups (e.g., acids stored separately from bases and flammables stored separately from oxidizers).
- Do not sort and store chemicals alphabetically unless they have first been separated into compatibility groups.
- Avoid storing chemicals on bench tops or in chemical fume hoods, except for those chemicals that are currently being used.
- Ensure that caps and lids on all chemical containers (including chemical waste) are tightly closed to prevent evaporation of contents.
- Use corrosion-resistant secondary containers (e.g., polypropylene bins) to retain materials if the primary container breaks or leaks.

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- All containers to which hazardous materials are transferred should be labeled with the identity of the substance (full chemical name; no abbreviations or chemical formulas) and the associated hazard(s) (e.g., corrosive, flammable, health hazard).
- Inspect containers of peroxide-forming chemicals periodically for crystal formation, deterioration, and container integrity. If crystals can be seen with these chemicals, contact EHS immediately.
- Do not store chemicals in hot areas or in direct sunlight; this may lead to the deterioration of storage containers as well as the degradation of the chemicals.
- Use approved corrosive storage cabinets for storing acids and bases in which acids are stored separately from bases.
- Store flammable liquids in flammable storage cabinets.
- Refrigerators and freezers for storing flammable liquids must be designed, constructed, and approved for that purpose. Domestic refrigerators and freezers as well as units that have been modified to remove spark sources are not acceptable alternatives.
- Refrigerators used for storing chemicals, samples, or media must be labeled: "Caution – Do Not Store Food or Beverages in This Refrigerator," or similar verbiage that conveys the same message.
- Do not store equipment and materials under tables or benches or in a way that will obstruct exits and passageways.
- Consider the security needs for the materials. Certain materials such as consumable alcohol, explosives, dual-use materials, and controlled substances may be subject to specific requirements by state and federal regulations.

B. Storage According to Hazard Classes

Consult the SDS for individual substances for additional information on storage of the substance. SDSs are available online in the Velocity EHS Chemical Management Online SDS binder. EHS can also be consulted if additional assistance is needed. The following guidelines are provided for the safe storage of hazardous materials in accordance with their hazard classes.

Hazard Class	Guidelines
Flammable & Combustible Liquids	• Fire and life safety codes must be visible on the container. • Limit the quantity of flammable and combustible liquids in laboratories. The quantity allowed depends on various factors, including: the type of laboratory, floor level of the lab, fire protection systems, and use of flammable-liquid storage cabinets or safety cans. • Consult EHS for guidance on storage. • Store in approved safety cabinets. • Segregate from strong oxidizing agents. • Keep away from any source of ignition: heat, sparks, or open flames.
Reactive Chemicals	• Bring into the laboratory only the quantities of material that are commensurate with the task. • Label, date, and inventory materials as soon as received. Make sure the label states "DANGER! HIGHLY REACTIVE MATERIAL!" • Do not open a container that is past its expiration date. • Do not open a liquid organic peroxide or peroxide former if crystals or precipitates are present.

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	• Dispose of (or recycle) prior to expiration date. • Call EHS for assistance in disposing of the material. • Store in trays large enough to hold the contents of the bottles. • Store peroxide-forming materials away from heat and light. • Store liquid organic peroxides at the lowest possible temperature consistent with the solubility or freezing point. Liquid peroxides are particularly sensitive during phase changes. • Inspect peroxide-forming chemicals periodically for crystal formation, deterioration, and container integrity. • Store water-reactive materials away from possible contact with water. • Store thermally unstable materials in approved refrigerator. • Store shock or pressure sensitive materials or larger amounts of explosive materials in explosion relief boxes. • Restrict access to the areas where highly reactive materials are stored.
Toxic Chemicals	• Store chemicals known to be highly toxic (including carcinogens) in ventilated storage in unbreakable, chemically resistant secondary containers. • Keep working chemical quantities at the lowest amount possible. • Label storage areas with appropriate warning signs, such as, "CAUTION!," or "CANCER-SUSPECT AGENT STORAGE." • Limit access to storage areas.

C. Avoid Storage of Incompatible Chemicals

Certain hazardous chemicals should not be mixed or stored with other chemicals. Mixing of incompatible chemicals can result in several adverse reactions, including but not limited to formation of crystals, production of toxic gas, fire, and explosion.

To reduce the risk of mixing in event of accidental breakage, fire, earthquake, or response to a laboratory emergency, containers of incompatible chemicals should be stored separately.

See the chemical incompatibility matrix below for examples of incompatible chemicals. Consult the SDS of the material for information on its incompatibilities. Incompatible hazardous waste should not be mixed. Several serious laboratory accidents have occurred when people have poured incompatible waste materials into hazardous waste containers. Use separate waste containers for each type of waste. Consult with the EHS department for guidance when you are not sure about proper waste disposal.

	Acids, inorganic	Acids, oxidizing	Acids, organic	Alkalis (bases)	Oxidizers	Poisons, inorganic	Poisons, organic	Water-reactive	Organic solvents
Acids, inorganic			X	X		X	X	X	X
Acids, oxidizing			X	X		X	X	X	X
Acids, organic	X	X		X	X	X	X	X	
Alkalis (bases)	X	X	X				X	X	X
Oxidizers			X				X	X	X
Poisons, inorganic	X	X	X				X	X	X
Poisons, organic	X	X	X	X	X	X			

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Water-reactive	X	X	X	X	X	X			
Organic solvents	X	X		X	X	X			
Note: "X" indicates incompatibility between two chemical product groups in the row and column. Incompatible products should not be stored in close proximity.									

12. Other Laboratory Hazards

Working with other hazardous materials, equipment, or employing certain processes in the laboratory can be the sources of other potential laboratory hazards. Proper training, SOPs, and protective measures must be implemented to minimize the hazards associated with the following hazards, equipment, or processes.

A. Biohazards

Some research and academic laboratory work involve handling and manipulating biological materials. While not all biological materials are considered hazardous, others are considered pathogenic or infectious and can cause illness in healthy human adults or animals. These materials are classified into risk groups (RGs) based on their transmissibility, invasiveness, virulence or disease-causing capability, lethality of the specific pathogen, and the availability of vaccines or therapeutic interventions.

Pathogenic microorganisms include bacteria, viruses, fungi, parasites, and other potentially infectious agents. RGs for these materials ascend in order of increasing hazard from RG1 agents, which do not cause disease in healthy human adults, to RG4 agents, which cause lethal disease in healthy human adults and for which preventative or therapeutic measures are not available. For additional information on RGs, review the Center for Disease Control's (CDC's) *Biosafety in Microbiological and Biomedical Laboratories (BMBL) 6th Edition*.

1. Biosafety Levels

Biosafety levels (BSLs) must be assigned to laboratories where biohazards are used and must be implemented properly to minimize illness and injury associated with working with biohazards. For additional information on BSLs, review the CDC's *BMBL 6th Edition*. Current laboratory work with biohazards at KSU does not exceed BSL2 requirements. For additional guidance for working with biohazards at KSU, review the KSU *Biosafety Manual* (EOSMS-203).

2. Institutional Biosafety Committee

Some research experiments using biohazards require additional committee oversight. The KSU Institutional Biosafety Committee (IBC) was established through the Office of Research to comply with the *National Institutes of Health (NIH) Guidelines for Research Involving Recombinant DNA Molecules* and to provide oversight for research involving work with certain biohazards. For more information on the IBC and its role in providing oversight for research with biohazards, refer to the IBC website.

B. Radioactive Materials

Ionizing radiation, as defined by the US Nuclear Regulatory Commission (NRC), is "a form of radiation, which includes alpha particles, beta particles, gamma rays, x-rays, neutrons, high-

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speed electrons, high-speed protons, and other particles capable of producing ions." It contains enough energy to displace (remove) electrons from atoms or molecules, which may lead to changes in living tissue. Due to these properties, ionizing radiation has benefits when used properly (e.g., radiation therapy, nuclear medicine) but can also be harmful if misused. Therefore, the possession, use, storage, and disposal of radioactive materials is strictly regulated by the NRC and the State of Georgia. Both entities require provisions to be made to ensure that all doses of ionizing radiation are maintained "as low as reasonably achievable (ALARA)," which means protective measures must be put in place to protect KSU employees and students from excess exposure to ionizing radiation. This will be accomplished by employing the ALARA principle through the implementation of administrative and engineering controls, the use of safe work practices, and the use of PPE. For additional guidance on the safe use of radioactive materials, refer to the *Radiation Safety Program* (EOSMS-206) document.

1. Radiation Safety Committee

The KSU Radiation Safety Committee (RSC) was established through the Office of Research to provide oversight for the use of ionizing radiation in accordance with Georgia Department of Natural Resources' *Rules and Regulations for Radioactive Materials, Chapter 391-3-17*. In addition to ionizing radiation, the RSC will also provide oversight for forms on non-ionizing radiation, including lasers, radiofrequency waves, and machine produced radiation.

C. Laser Devices and Systems

Laser devices and laser systems produce non-ionizing radiant energy by stimulated emission and are used for multiple applications in research. Lasers are separated into four main classes: Class 1, Class 2, Class 3, and Class 4. Lasers that fall into Class 1 and Class 2 are safe overall and do not require safety measures to prevent accidents or injury. However, lasers that are classified as Class 3(B) or Class 4 can cause a range of adverse outcomes, including, but not limited to, eye and skin injuries, damage to property, and fires. Therefore, control measures must be implemented to minimize the possibility of adverse outcomes related to the use of Class 3B and Class 4 lasers.

KSU's *Laser Safety Program* (EOSMS-205) was developed in accordance with the ANSI Z136.1, *American National Standard for the Safe Use of Lasers* and aims to minimize all potential eye and skin injuries and other laser related incidents that could result from the use of Class 3B and Class 4 lasers. Meeting this Standard will be accomplished through conducting hazard assessments; ensuring all end users have been trained in laser safety; the use of administrative controls, engineering controls, and safe work practices; and by ensuring that the proper PPE is worn. For more guidance on the safe use of lasers, review the KSU *Laser Safety Program* document.

D. Autoclaves and Sterilizers

Autoclaves and sterilizers use steam, extreme heat (i.e., 250°F or greater), and pressure as a means of decontaminating and sterilizing materials, including, but not limited to, metal instruments, liquids, and waste materials. Consider the following when operating autoclaves and sterilizers:

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- Anyone who will be authorized to use an autoclave must first be trained in its operation.
- Prior to using an autoclave, remaining items should be removed.
- Autoclaves should never be overloaded.
- Follow the appropriate SOP for operating the autoclave.
- Wear appropriate PPE when removing materials from the autoclave (e.g., long thermal gloves, laboratory coat, eye protection, closed toe shoes), as not doing so will result in severe burns.
- When handling sharp instruments that have been autoclaved, use cut resistant gloves to prevent inadvertent incisions or lacerations.
- Never attempt to open an autoclave while it is in operation; autoclaves are pressurized vessels and doing so could result in the release of steam, the ejection of the components or contents of the autoclave, and the sudden release of the autoclave door, all which could result in the severe injury or death of an individual.
- Preventative maintenance must be performed on autoclave units periodically to prevent mechanical failure.
- Maintenance must be conducted according to the manufacturer's specifications and by an individual trained in recognizing critical defects that could result in a mechanical failure.
- A maintenance history should be kept, recording all inspections, failures, and repairs.

E. Centrifuges

Centrifuges are commonly used in laboratories as a means of separating materials according to size and density. They operate at high speeds to accomplish this task, and if used inappropriately, can cause injury or exposure to hazardous materials. Centrifuges present two main types of hazards: generation of aerosols and mechanical failure. Consider the following regarding aerosol generation:

- Follow the appropriate SOPs for centrifuge use.
- Ensure that all tubes for use in the centrifuge are compatible.
- When loading samples, use centrifuge safety caps or sealed rotors to prevent spills.
- Do not attempt to operate the centrifuge while the door or lid is open.
- Before removing samples (particularly those that are infectious or potentially infectious), wait 10 minutes before opening the centrifuge to allow any aerosols produced to settle.
- Always wear appropriate PPE when loading and removing samples from the centrifuge.
- Decontaminate all spills immediately using an appropriate disinfectant.

Mechanical failure can also occur if centrifuges are not properly maintained, specifically the rotors. Rotors of high-speed and ultracentrifuges are subject to high levels of mechanical stress which can cause the rotors to fail. In addition, rotors can break and separate from the housing while spinning at high levels of speed. In some instances, this has caused centrifuges to explode and project metal shards throughout laboratory areas or the entire centrifuge to be tossed about the laboratory and crash into other objects. These instances have the potential to cause varying degrees of accidents, including, but not limited to, personnel injury or death, damage to the laboratory and other equipment, and chemical spills. Consider the following with regards to centrifuge maintenance:

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- Follow all instructions for use outlined in the manufacturer's instruction manual.
- Ensure that the rotor is properly seated on the drive shaft inside the unit.
- Ensure that sample tubes or buckets are properly balanced in the rotor.
- Check O-rings on the rotor; anyone completing this task must be properly trained.
- Apply vacuum grease in accord with the manufacturer's guidelines.
- Do not exceed the rotor's maximum run speed.
- Store the rotor upside down in a dry place, with lids or plugs removed, to prevent condensation.
- Remove adapters after use and inspect for corrosion.
- Inspect the rotor regularly. Remove rotors from use that show any sign of defect and report it to a manufacturer's representative for inspection.
- Keep a logbook for high-speed and ultracentrifuge rotors, recording the length of time and speed for each use.
- Track and discard rotors according to the manufacturer's recommended schedule.

F. Rotary Evaporators

Rotary evaporators (rotovaps) are used in some laboratories (e.g., organic chemistry laboratories) as a means of removing solvents from reaction mixtures through evaporation. These devices consist of a condenser and a round collection flask (both made of glass), heated water bath, a motor that rotates the flask in the water bath, and a pump that serves as the vacuum system. Follow the appropriate SOPs for rotovap use. The following should be considered when using rotovaps:

- The rotovap has a rotating motor that can operate at up to 220 revolutions per minute (rpm).
  - Avoid moving parts when possible.
  - Avoid wearing long hair down and wearing loose clothing and jewelry such as necklaces. These can become entangled and cause the user to be pulled into the apparatus, which could result in the breakage of glassware, burns, and chemical exposure.
- Avoid using air and water sensitive materials, for which introduction of air or water inside the flask can produce unwanted reactions, including explosions.
- Glassware with imperfections or cracks can shatter when under a vacuum.
  - Check glassware prior to operation.
  - A polycarbonate shield should be placed in front of rotovaps while in operation.

G. Cryogenic Materials and Dry Ice

Cryogenic materials are liquefied gases that have a boiling point of less than -130°F at an absolute pressure of 14.7 pounds per square inch (psi) (NFPA 55). Cryogens are extremely cold, and direct exposure to the liquids or vapors causes frostbite to skin or can cause materials to become weakened and/or brittle. There are several other hazards associated with cryogens, which include but are not limited to:

- Asphyxiation – Caused by rapid expansion of liquid to gas inside enclosed areas to create an oxygen deficient environment.
- Pressure build-up – Caused by rapid expansion of liquid to gas inside of a vessel.

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- Fire or explosion – Caused when cryogenic materials such as oxygen and hydrogen combined in air with flammable gases. An ignition source such as a spark or flame could ignite the mixture.

When using cryogenic liquids, remember the following:

- Containers must be able to withstand extreme cold temperatures without becoming brittle or weakened.
- Cylinders containing cryogens must be equipped with pressure release valves or burst discs.
- Store cylinders and use liquids in a well-ventilated area.
- When handling, wear PPE that protects against splashing and extreme cold temperatures (e.g., thermal gloves, splash goggles, long sleeves, laboratory coats).
- When transferring from one container to another, always pour slowly to prevent splashing or boiling.
- Never overfill vessels or containers with cryogenic liquids to avoid rupturing (rapid expansion of gas).

H. Compressed Gases

Compressed gases have a wide range of hazard potential; the gases can be inert, oxidizing, corrosive, flammable, or toxic. The chemical hazards can result in several effects, including, but not limited to, fire, explosion, chemical burns, and asphyxiation. Regardless of what chemicals are contained, compressed gas cylinders are all under extreme pressure, which adds a physical hazard to all compressed gases. If not handled safely, compressed gas cylinders become potential gas propelled missiles that are capable of penetrating concrete walls. Therefore, it is imperative that all compressed gas cylinders are used, handled, and stored appropriately. When using compressed gas cylinders, consider the following precautions:

- Gas cylinders should be secured to a wall, stationary bench, or other fixed or stationary support using a chain or strap – racks and brackets are also an option.
- The chain or strap should be positioned at 1/3 the length of the cylinder (from the top).
- Ideally, cylinders should be strapped individually (one chain or strap per cylinder); however, two cylinders per chain/strap is acceptable in some instances.
- Store upright cylinders, not horizontally.
- Do not store near heat sources or in temperatures above 125°F.
- Do not store where they can become part of an electric current.
- Cylinders should be stored by compatibility (e.g., oxidizing gases and flammable gases should not be stored together).
- All cylinders should be labeled as to their contents and if not in use, should be labeled as “empty” or “full.”
- The gas cylinder’s cap should be left in place until the cylinder is in use and replaced when not in use.
- Empty cylinders should always be returned to the distributor; although empty, they could be still pressurized.
- Do not drop, drag, or slide compressed gas cylinders. Full cylinders can weigh more than 100 pounds and present a potential crushing hazard.

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- If a gas cylinder must be moved, always use an appropriate hand truck equipped with a chain or strap for securing the cylinder, even if moving only a short distance.
- Do not allow compressed gas cylinders to strike against each other or against other hard surfaces violently.
- Never use cylinders as rollers for moving other equipment.
- Do not tamper with pressure relief valves or other pressure relief devices connected to the cylinder.

I. Electrical Hazards

Laboratories contain equipment that requires the use of electricity to operate. With the use of electrical equipment comes potential electrical hazards, including electrical shock, fire, explosion, electrocution, and ultimately, death. Consider the following control measures when working with or around electrical hazards:

- Use electrical equipment only for the task for which it was designed; be sure to follow all the manufacturer's instructions and any written SOPs for working with the equipment.
- Inspect electrical cords regularly for frays, cuts, and tearing. If electrical cords are found to be in poor condition, tag out and discontinue use of the equipment or device until either the unit or the cord is replaced. See Lockout and Tagout, Section Q, below.
- For permanent equipment, extension cords must not be used.
- Do not overload electrical circuits.
- Never plug or unplug energized equipment (or let anyone plug or unplug energized equipment) with wet hands.
- Ensure that electrical devices that are within six inches of a water source are well grounded and that the outlet they will be plugged into is equipped with a ground fault circuit interrupter (GFCI).
- Do not attempt to work on or repair energized electrical equipment. Submit a work order for facilities management or contact the service vendor for repairs.
- Adjusting instrumentation or analytical equipment must be done by individuals who are trained.

J. Fire Hazards

Fires are some of the most serious hazards that can occur in a laboratory, and unfortunately, they are quite common. Fires can be caused by several sources in the laboratory environment, including, but not limited to, ignition of flammable materials, violent chemical reactions, explosions, spontaneous combustion of pyrophoric materials, and faulty electrical equipment. To prevent laboratory fires, consider the following:

- Avoid storing or using flammable materials around ignition sources such as open flames, sparks, hot plates, etc.
- Do not heat flammable materials using hot plates.
- Do not store flammable materials near oxidizing agents, as they accelerate the rate of fire development.
- Conduct procedures using flammable materials inside CFHs; if a fire or explosion occurs, it will be contained inside the hood.

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- Minimize the quantity of flammable materials used in the laboratory when feasible.
- Employ proper housekeeping in laboratory areas by reducing clutter and storing materials in their appropriate areas.
- Avoid storing flammable liquids in standard refrigerators. Flammable liquids produce flammable vapors, which can be ignited by a spark from within a malfunctioning refrigerator. Standard refrigerators are not designed to contain explosions.
- Bunsen burners must not be used inside BSCs. Some BSCs recirculate a percentage of their air intake. If a Bunsen burner goes out, the gas would get recirculated with the intake air, producing an ignitable air/gas combination that could potentially be ignited by a spark from the fan motor (i.e., fire, explosion).
- Ensure that fire extinguishers are both visible and free of obstructions.
- Ensure that storage is at least 18 inches below the ceiling (otherwise, the fire sprinkler system will not work properly).

If a fire occurs, safety measures must be in place to preserve life and reduce damage to property. The following control measures and emergency procedures must be considered in preparation for a fire:

- Everyone in the work area must be alerted that there is a fire.
- Know where the fire extinguisher(s) is located.
- Know how to get out; be familiar with the evacuation routes.
- Have a plan – remember the "RACE" method (OSHA):
  - Rescue/remove all occupants
  - Activate the alarm system
  - Confine the fire by closing doors
  - Evacuate/extinguish

If the fire is manageable, you have been properly trained to use a fire extinguisher, and you feel comfortable extinguishing the fire, remember the PASS method (OSHA):

- Pull the pin.
- Aim the extinguisher nozzle at the base of the fire.
- Squeeze the trigger while holding the extinguisher upright.
- Sweep from side to side and cover the fire with the spray.

Be prepared to assist others if needed.

If someone is on fire, the individual should go immediately to the nearest emergency shower, pull the lever, and stay under the deluge until the flames are extinguished. If an emergency shower is not immediately available, roll yourself or other victim on the floor (stop, drop, and roll) or use a fire blanket to smother the flames. Once the flames are extinguished, go to the nearest emergency shower, activate, and drench the victim under the shower.

K. Lockout and Tagout

Lockout and tagout (LOTO) applies primarily to employees who perform service or maintenance on equipment with hazardous levels of energy (e.g., replacement of the high voltage electrodes in autoclave). While performing these duties, they have the potential to be unexpectedly exposed to hazardous levels of energy that could result in electrical shock,

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electrocution, and ultimately death. LOTO involves shutting down equipment and isolating their energy sources to prevent this unexpected exposure. Isolation of energy sources is done by locking it in place in the "off" position with a physical lock and attaching a visible tag that reads "Do Not Operate, Equipment Locked Out," "This Equipment Has Been Locked Out," or other similar verbiage. To prevent accidents involving hazardous energy, consider the following:

- Recognize when equipment has been locked and tagged out; adhere to all hazard warning signs.
- Do not attempt to operate equipment that has been locked and tagged out.
- Do not remove the visible tag from the energy source.
- Do not attempt to remove the lock from the energy source.

L. Slips, Trips, and Falls

Slip, trip, and fall injuries usually occur due to a person walking across a surface that is wet or slippery, or from tripping over an uneven surface or something in the floor. To prevent slips, trips, and falls in the laboratory environment, the following measures must be taken:

- Clean up all spills immediately; if possible, position a "Wet Floor" sign over wet areas after cleaning.
- Do not leave boxes and other obstructions in walking areas.
- Do not stretch wires, extension cords, ethernet cords, etc. across walking areas; if this cannot be avoided, use duct tape to secure them to the floor.
- Be aware of uneven walking surfaces and eliminate them when possible.
- If using stairs, hold on to handrails. Ideally, a person should always have three points of contact when using stairs.

13. Emergency Procedures and Equipment

In the event of an emergency such as fire, explosion, spill, or medical accidents in laboratory, the following basic emergency procedures are recommended:

- Call, or have someone call, the KSU Police emergency number at 470-578-6666 (or extension 6666 from a KSU phone) and clearly state the nature of the incident and where it has occurred.
- Assess the safety of the situation and do not enter or re-enter the area if it is unsafe. KSU Public Safety and Cobb Fire will provide information when reentering the facility is permitted.
- Warn personnel in adjacent areas of any potential risks to their safety.
- Render assistance to the people involved and remove them from exposure to further injury, if it is safe to do so.
- Render immediate first aid. Appropriate measures include washing under a safety shower, activating emergency eyewash stations, or washing the affected area(s) in a sink. Cardiopulmonary resuscitation (CPR) and special first aid measures can only be administered by trained personnel.
- Extinguish small fires by using a portable extinguisher, but only if you have been trained in the use of fire extinguishers and are comfortable doing so. Turn off nearby equipment and

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remove combustible materials from the area. For larger fires, call the KSU emergency number or 911 immediately.
- Provide emergency personnel with as much information as possible about the nature of the hazard.

In case of medical emergency, remain calm and do only what is necessary to protect life.

- Summon medical help immediately by calling KSU Police by dialing 470-578-6666 (or extension 6666 from a KSU phone).
- Do not move an injured person unless the individual is in danger of further harm.
- If clothing is on fire and a safety shower is immediately available, douse the person with water. If a safety shower is not immediately available, move the person to the floor and roll them around or use a fire blanket to smother the flames. Once the flames are extinguished, escort the victim to the nearest emergency shower, activate, and drench with water.
- If harmful chemicals have been spilled on the body, flood the exposed area with sufficient running water from the safety shower and immediately remove any contaminated clothing.
- If a chemical has splashed into the eye, immediately wash the eyeball and the inner surface of the eyelid with plenty of water for 15 minutes. All eye exposures require a medical evaluation.
- If possible, determine the identity of the chemical involved and inform the emergency response team/medical personnel attending the injured person. It may be helpful to provide the SDS, if it is accessible.
- Remain in the area in a safe place until help arrives. You may need to answer additional questions about the incident.

M. Spill Response Procedures

Laboratory personnel may clean up small spills (1 liter or less) of hazardous materials if all the following conditions are met:

- The hazards of the material(s) are known, and appropriate precautions can be taken to prevent personal exposure or exposure to others.
- The spill does not involve highly toxic, highly reactive chemicals, or elemental mercury. Special cleanup is required for such substances; contact EHS for assistance.
- There is no potential of release to the environment.
- There are no personal injuries because of the spill.
- The clean-up procedures are known and the proper equipment (e.g., PPE and spill clean-up materials) is available.
- The spill can be cleaned up safely.

If all these conditions are not met, EHS must be contacted by calling 470-578-3321 or by dialing the University emergency number at 470-578-6666 (or extension 6666 from a KSU phone) for spill response. Inform your supervisor of all spills and clean-ups and enter the incident into the KSU incident reporting system (Reliance).

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1. Spill Kit

Laboratories and areas where hazardous materials are handled must have an adequate number of spill kits for the hazardous materials handled. The spill kits should meet the following requirements:

- The absorbents and other materials used for spill cleanup must be adequate and compatible with the spilled material.
- Special chemical hazards (e.g., for hydrofluoric acid) must have a separate spill kit with compatible spill absorbent materials.
- There should be an inventory list of the materials inside the spill kit.
- Spill absorbents should be labeled with the volume they can absorb.
- Combustible materials are generally inappropriate substitutes for the materials contained in spill kits.

2. Personal Protective Equipment

Chemical splash goggles, gloves, laboratory coats (or appropriate coveralls), and closed toed shoes must be worn during spill clean ups.

N. Emergency Equipment

1. Emergency Eyewash Stations and Emergency Showers

Emergency eyewash stations and emergency showers must be provided in areas where splash hazards to corrosives, eye irritants, or chemicals that are toxic via skin and/or eye contact exist. Plumbed eyewash stations and emergency showers should be provided.

The location of each emergency eyewash station and emergency shower should be posted with a highly visible sign.

Selection and Installation

The selection, installation, and use of eyewash stations and safety showers must comply with ANSI Z358.1.

Access to these facilities must remain open and reachable within 10 seconds from the source of the hazard. Paths to these units must be maintained free of obstructions.

Showers must be located at least 25 inches from any wall and must not be located next to unprotected electrical panels, switches, outlets, or equipment.

Inspection

Emergency eyewash stations located at the sink must be flushed every week by the laboratory personnel. Inspection tags must be filled out to document this activity.

Combination emergency shower/eyewash station units must be flushed monthly by EHS personnel.

Alternatives to Emergency Eyewash Stations and Emergency Showers

Self-contained pressurized portable eye wash/safety shower units may be permissible for remote locations where the installation of a plumbed unit is not feasible; consult EHS before

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installing a portable eyewash station. These must be maintained in accordance with manufacturers' requirements and are the responsibility of the line manager of the owning department.

If plumbed or self-contained pressurized portable eyewash stations are not feasible, supplemental eyewash bottles must be provided. Supplemental eyewash bottles contain buffered saline solution but are not considered replacements for plumbed eyewash stations. They are merely a temporary measure to be employed until a plumbed eyewash station can be accessed. Each bottle of buffered saline solution should be checked at least monthly to ensure it is within the expiration date.

2. Fire Extinguishers

Laboratories and areas using hazardous chemicals must have an ABC-rated, dry-chemical fire extinguisher within 50 feet of any exit for use on ordinary combustibles, flammable liquids, and electrical fires.

Special purpose portable fire extinguishers may be required in certain laboratories depending on the nature of materials being used. Class D extinguishers will be required in laboratories using combustible metals such as magnesium, titanium, and sodium.

If additional extinguishers are needed for an area or if special extinguishers and extinguishing media are needed for materials such as alkali metals, contact EHS for information concerning recommendations and requirements.

3. Automated External Defibrillators

Automated external defibrillators (AEDs) have been installed throughout buildings on campus to treat individuals experiencing life-threatening cardiac events, such as ventricular tachycardia (V-Tach) and ventricular fibrillation (V-Fib). Furthermore, a tourniquet is located in each ground and first floor AED box in the event of uncontrolled bleeding.

AEDs should not be used by individuals who have not been trained. For additional information on AEDs, contact the Office of Emergency Management at 470-578-6985.

14. Incident and Emergency Investigation

Incidents and emergencies in laboratories must be promptly reported to the laboratory supervisor or manager and to the EHS Department. Prompt and thorough investigations of many of these incidents is crucial to identifying their causes so that appropriate actions can be taken to prevent similar occurrences.

All laboratory safety-related incidents must be reported in accordance with the University process for *Incident Reporting and Investigations* (EOSMS-108) through the Reliance system, the University's electronic system for safety incidents reporting and investigation.

Any of the following that occurs in the laboratory, on campus, at a University-controlled workplace, or while engaged in any University sanctioned activity must be reported:

- Incidents resulting in injury or illness.
- Incidents or near misses with no injuries.

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- Incidents resulting in environmental damage (e.g., chemical released into storm drain, contamination of soil)
- Incidents resulting in property damage.
- Each situation or condition observed on the job which has the potential for injuring or endangering the health of people or causing damage to property or the environment.

Serious incidents or incidents requiring immediate medical attention should be reported immediately by calling the campus emergency number: 470-578-6666 (extension 6666 from a KSU phone). Serious incidents are those which result in:

- A fatality
- The hospitalization or medical treatment (beyond first aid) to KSU or non-KSU personnel
- Fires
- Property damage exceeding $1,000.00

All other incidents must be reported in writing to the laboratory safety manager and EHS Biosafety Officer within 24 hours of becoming aware of the incident, injury, or illness.

15. Exposure Monitoring and Medical Consultation

A. Exposure Assessment

Exposure assessments will be conducted by the EHS Department to identify the potential for employees' exposure to hazardous materials and to ensure proper control measures are in place. Priority will be given to operations involving the use of particularly hazardous substances, chemicals regulated by OSHA's substance specific standards and other chemicals, and operations deemed appropriate by EHS. Operations and materials may also be assessed in response to concerns expressed by an employee or supervisor. Monitoring may involve, but is not limited to, the following sampling methods:

- Air sampling – Air is sampled and analyzed to determine the presence and concentration of airborne contaminants.
- Wipe sampling – Surfaces, such as bench tops, are tested to determine the presence and amounts of residual contaminants.
- Bulk sampling – Materials are collected and analyzed to determine the presence and amounts of contaminants such as lead and asbestos.
- Biological monitoring (where deemed necessary).

Air sampling results will be compared to occupational exposure limits to determine if the potential for hazardous exposure exists. The following occupational exposure limits will be used:

- OSHA's PELs
- American Conference of Governmental Hygienists TLVs
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs)

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B. Employee Notification of Monitoring

The employee and their supervisor will be notified in writing within 15 days after receipt of the monitoring results from the laboratory performing the analysis.

C. Medical Consultations and Examinations

Employees will be afforded the opportunity to receive medical attention for any work-related illness, injury, or exposure under the following circumstances:

- When an employee develops signs or symptoms associated with exposure to a hazardous material.
- Where exposure monitoring reveals exposure at or above the OSHA's Action Level (AL) or PEL for OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
- When an uncontrolled event such as a spill, leak, or an explosion occurs, resulting in likelihood of employee exposure to hazardous chemicals.

Exams and consultations will be performed by a licensed physician, or under the direct supervision of a licensed physician, and will be at no cost to the employee. Also, the time allotted for such exams and consultations will not result in a loss in pay for the employee.

If a consultation is requested, the exposed individual will need to provide specific information:

- Identity of the hazardous material to which the exposure occurred (i.e., What was it?)
- The conditions under which the exposure occurred (i.e., What happened?)
- A description of the signs and symptoms being experienced (i.e., What are your symptoms?)

As a result of the exam or consultation, the employer will receive the following in writing from the examining physician:

- Recommendations for additional follow-up.
- Examination results and any other related exams.
- Medical conditions revealed during the exam which may place the exposed employee at increased risk because of exposure to a hazardous workplace.
- A written statement confirming that the exposed individual has been informed of the results of the exam or consultation and any medical condition that may require further examination or treatment.

The written statement will not reveal findings or diagnoses not related to workplace exposure.

16. Training and Hazard Communication

A. Training

Laboratory personnel must receive the required training in accordance with the University's EOS training requirements. Both the EHS department and the employee's supervisor are responsible for providing the required training to laboratory personnel. This training involves three levels:

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1. New employee safety orientation
2. Specialized and compliance training
3. Operation- and procedure-specific training

All new laboratory personnel must receive all levels of training before commencing work with hazardous substances.

1. New Employee Safety Orientation

This training is to be provided by both the EHS and the employee's supervisor. New hires must receive general safety orientation offered by EHS and includes the mandatory Right to Know (Hazard Communication) training. In addition, each new laboratory personnel must receive job-specific orientation provided by the individual's direct supervisor that covers EOS matters specific to their job and to their working environment (individual laboratory). Completion of the job-specific orientation must be documented by the supervisor.

2. Specialized and Compliance Training

In addition to the New Employee Safety Orientation, the EHS Staff will provide general and compliance training to laboratory personnel to ensure that they are informed of the hazards of the chemicals they may encounter or work within their work environment. The general training covers EOS topics such as incident investigation, roles and responsibilities, and hazard control, while the compliance training covers in greater depth operational risks. These include reviewing the requirements of the CHP, including physical and health hazards related to chemicals, recognition of signs and symptoms of over exposure and exposure controls, methods that may be used to detect the presence or release of hazardous chemicals (e.g., odors, visual appearance, monitoring devices, etc.), and control measures (e.g., work practices, emergency procedures, PPE).

3. Operation- and Procedure-Specific Training

This is to be provided by the PIs, instructors, or supervisors. It is their responsibility to review the hazards associated with the employee's assigned work, the uses and limitations of controls, the warning signs of exposure to hazardous materials used in the operations (e.g., odors, irritation), and the emergency procedures for abnormal events. Heads of Units are responsible for ensuring employees are trained in the hazards and controls associated with new materials introduced into the work area.

It is the responsibility of the PI, instructor, or supervisor to ensure employees under their authority attend the scheduled training session(s). EHS can provide reference and videotape materials to assist in providing the required site-specific training for chemicals or procedures that may introduce risk to the employees.

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4. Frequency of Training

All laboratory employees are required to complete training on laboratory safety upon initial appointment, prior to the introduction of new hazards, and periodically thereafter. This training is offered by EHS online through OwlTrain and/or in a classroom setting.

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5. Documentation of Training

EHS will maintain records of general laboratory safety training while the PI, instructors, and supervisors are responsible for maintaining records for operation and procedure-specific training and continuing education training for employees under their supervision.

B. Hazard Communication

Information regarding the hazards of chemicals is conveyed in three primary ways: SDSs, signs, and labels.

1. Safety Data Sheets

An SDS provides safety and health related information such as known hazards of the material, its physical and chemical properties, exposure limits, precautionary measures, and emergency and first aid procedures.

SDSs must be readily available for all chemicals used in laboratories. SDSs of chemicals purchased from the manufacturers and distributors can be accessed from the University's SDS online portal, VelocityEHS Chemical Management. A master file of all SDSs onsite is available in the library.

When a chemical substance is synthesized at a KSU lab and is to be used in the laboratory, the PI is responsible for ensuring that a hazard assessment is conducted to identify the hazards and necessary controls. EHS should be notified of internally synthesized chemicals. If synthesized chemicals are to be shipped offsite, SDS and warning labels must be generated. Please consult EHS before shipping such material offsite.

2. Signs

Signs of the following types are to be displayed:

- Location signs for safety showers, eyewash stations, other safety and first aid equipment, and emergency exits.
- Warning signs in areas or on equipment where special or unusual hazards exist indicating the hazard types in the work area, such as corrosives and carcinogens, and emergency contact information.
- Cabinets where flammable liquids are stored must be labeled "Flammable Liquid Storage".
- A "Hazardous Waste Satellite Accumulation Area" label or sign posted where hazardous waste is stored within the laboratory.
- Laboratories using radiological isotopes will have the appropriate signage, as required by EHS.
- Refrigerators in the laboratory must be labeled "No Food or Drinks."

PIs, instructors, and supervisors are responsible for ensuring that chemical substances, work areas, and entrances are appropriately labeled and posted.

3. Labels

Labels showing the content of the container and the associated hazards are required for all primary and secondary containers of hazardous materials. Primary containers are the

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original containers received from the manufacturer, while secondary containers are cans, squeeze bottles, and other vessels to which hazardous materials are transferred by an employee or student.

Labels on primary containers must convey the following:

- The name of the material or hazard identification (must be the same name as listed on the SDS)
- Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Pictograms
- GHS Signal Word
- GHS Hazard statement(s)
- Precautionary statement(s)
- List the name, address, and telephone number of the manufacturer

Note: The label must be legible, in English, and prominently displayed.

Secondary containers must be marked or labeled minimally with the full chemical name of the chemical(s) (in English), hazard warnings (e.g., 70% ethanol; flammable), and the date the chemical was poured into the container.

Peroxide forming chemicals and other unstable or reactive compounds need to be marked with the date received and date opened.

17. Inspections and Audits

Periodic inspections and audits must be conducted in accordance with the University's requirements for *Environmental and Occupational Safety Inspections and Audits* to keep laboratory facilities and equipment in a safe operating condition. The goals of an inspection and audit program are as follows:

- Ensure laboratory facilities and equipment are maintained in a safe operating condition.
- Provide a comfortable and safe working environment for all employees, students, contractors, and visitors.
- Ensure that all laboratory procedures and experiments are conducted in a safe and prudent manner.

A. Annual Laboratory Self-Inspections

PIs, instructors, and supervisors of each laboratory must conduct semi-annual inspections of their laboratory and equipment using the *Laboratory Self Inspection Form* and follow-up to ensure problems identified are promptly resolved.

B. Compliance Inspections and Audits

Each laboratory will be subject to routine compliance inspections and audits conducted by EHS in accordance with the University's *EOS Inspections and Audits* (EOSMS-107) Program. The audits will be scheduled by the EHS Department.

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Findings of all audits and inspections must be entered in Reliance.

18. Recordkeeping

PIs, supervisors, and coordinators must maintain records of job-specific training, self-inspection reports, observations, and action items.

EHS will maintain records of compliance training and inspections and audits conducted by EHS or by a third party. EHS must also maintain a record for each employee of any exposure monitoring, medical consultation, and examination, including tests and written opinions. Such records will be kept, transferred, and made available in accordance with BOR records management policies.

19. Laboratory Facilities Design and Decommissioning

A. Design

All new laboratories must be designed and constructed in accordance with the USG Design Criteria for Laboratories. No room shall be converted into a laboratory for use of chemical materials until it has been reviewed and approved by the EHS Department.

B. Decommissioning

Laboratory decommissioning involves the formal deactivation of a laboratory while ensuring the safety of the space to safeguard the health and safety of facilities, transportation, and contract personnel who may be involved in cleaning, demolition, renovation, and construction activities. It is the responsibility of PIs, instructors, and supervisors of laboratory spaces to ensure chemical, physical, and radiological hazards have been removed prior to releasing the space to facility department or to new occupants.

When a laboratory is vacated:

- All chemical and radioactive materials (if applicable) must be removed and disposed of properly.
- All non-fixed laboratory equipment and supplies must be cleaned and put into safe condition. This includes removing visible residues, standing liquids, loose particulate materials, hazards on floors, bench tops, shelves, inside drawers, cabinets, refrigerators, surfaces of local exhaust enclosures, and any other potentially contaminated surfaces.
- Equipment, supplies, products, and materials such as apparatuses, thermometers, gas cylinders, sharps containers, trash, absorbent material, and other miscellaneous lab materials must be removed prior to vacating the space.
- Chemicals and products, including cleaning compounds, surplus chemicals, stock solutions, experimental products, and hazardous waste, must be removed.

C. Evaluation and Release of Laboratory Spaces

Following the decontamination of work surfaces and the removal of chemical, physical, and radiological hazards, the EHS Department will perform a final inspection prior to the release of the space. EHS will evaluate the space for evidence of debris, residual chemicals, and any other potential hazards.

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Appendix A – Forms

Laboratory Risk Assessment Tool (LabRAT)

KENNESAW STATE UNIVERSITY Environmental Health & Safety Department	Risk Assessment for Laboratory Procedures
EOSMS- 201-3	Effective Date: 11/8/2021	Last Updated: 11/8/2021	Page 1 of 2

Procedure Title			
Date Performed		**WORK TYPE**	
Lab Location		( )	DEVELOPMENTAL
PI		( )	ROUTINE

Sequence of Steps and Actions	Hazards Associated w/ Step	Recommended Control/Procedure	JOB CONTROLS Check items which apply to job. All checked items must be addresed in procedure.	
			( )	SDS
			( )	Lab Chem Hood
			( )	Shielding
			( )	Spill Containment
			( )	Fire Suppression Equipment
			( )	Grounding/Bonding
			( )	Hand Protection Required
			( )	Eye Protection Required
			( )	Respiratory Protection
			( )	SCBA
			( )	APR/PAPR
			( )	Lab Coat
			( )	Gloves
			( )	Hot/Cold Protection
			( )	Special PPE
			( )	Radiant Energy Protection
			( )	Electrical Hazards

LIST OF PERSONNEL INVOLVED	JOB HAZARDS			EMERGENCY RESPONSE	
	( )	Exposure to Public		Alarm Method	
	( )	Fire Hazards		Assembly Area	
	( )	Toxic Chemical Hazards		Local EMS	
		( )	Health Hazards	Local Fire	
		( )	Pressure Hazards	Local Police	
CONDITIONS		( )	Pressure Relief	Sewer Authority	
Press Range		( )	Reactivity Hazards	Air Quality	
Press Range		( )	Static Electricity Hazards	Env. Services	
Temp Range	( )	Other (List)		**ENVIRONMENTAL ISSUES**	
Monitoring equipment needed:				( )	Releases to air
				( )	Releases to land
				( )	Releases to water
				( )	Haz waste generated

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KENNESAW STATE UNIVERSITY
Environmental Health & Safety Department

Risk Assessment for Laboratory Procedures

Instructions

Complete the Risk Assessment as part of the procedure review. Scoring is based on a 0-5 scale, with 0 being "NOT APPLICABLE" and 5 being "EXTREME." You may assign any score to a specific box, even if the score value is not shown on the RAT. After scoring, interpret the score using the guidelines in the RECOMMENDED ACTIONS. The assessor/PI can increase or decrease the assessment based on the situation.

Chem Volume(s)	Micro <0.5L 1	0.5 L 2	Normal 1 L 3	2L 4	Large >2L 5	
Hazard Recognition (Highest Score Only) Flammable Corrosive Toxic Cryogenic	None 0	1	Routine 2	3	Extreme 4	5
Process Conditions	Sub-ambient P < 1 atm T < 10 C 0	1	Ambient P=1 atm 10 <T<40 2	3	Extreme T > 1 atm T > 40 4	5
Explosive Hazard	No 0					Yes 5
Radiation Hazard	No 0	Minimal 1	2	Normal 3	4	High 5
Other Hazards	None 0	Minimal 1	2	Normal 3	4	High 5
Special Hazards	Inhalation Tox 0		Reactive 5	0		5
Procedure	Detailed & Written 0	1	2	Routine 3	4	Under Develop 5
Personnel Preparedness & Training	Fully Trained & Qualified 0	1	2	Routine 3	4	Untrained 5
Ventilation	Hood used 0		General Lab Ventilation 3			None 5
Shielding Needed	Used 0					Not Used 5
Equip Maintenance	Regularly Performed 0	1	2	3	4	Never Performed 5

SCORE:

RECOMMENDED ACTIONS BASED ON SCORE		
LOW	<15	Procedures can be performed with routine precautions.
MODERATE	15-25	Procedures can be performed with attention given to specific hazards. Supervision is recommended.
HIGH	26-30	Procedure may be performed if ncessary. High level attenion must be given to all hazards. High level, continuous supervison is manadatory.
EXTREME	>30	Procedure must be revised to reduce risk.

CHEMICALS USED	
Chemical	Volume or Weight

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Job Hazard Analysis

KENNESAW STATE UNIVERSITY Department of Environmental Health & Safety	Job Hazard Analysis Form
EOSMS- 105-1 *Effective Date: 10/21/2021* *Last Updated: 11/9/2021*	*Page 1 of 2*

Instructions				
A Job hazard Analysis (JHA) is to be conducted as a proactive measure of identifying and eliminating or minimizing job related hazards before the job is performed. The analysis can also be conducted as part of hazard awareness and employee training and as an accident investigation tool. The completed form should be maintained for record purposes and a copy forwarded to the Environmental Health and Safety (EHS) Department via email at ehs@kennesaw.edu.				
Department		Date		☐ New ☒ Revised
Job/Task Evaluated		Job Performed By		
Work Supervisor		Conducted By		

Ref. No.	Task (Step) Description	Potential Hazards	Recommended Corrective Action or Procedures
	Itemize each step of the job/task to the completion of the task.	*In consultation with the employee involved, identify possible hazards associated with each step.*	*For each step/task, indicate what corrective actions are necessary to control the hazards.*

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"What If" Hazard Analysis

Instructions				
A What If Analysis is to be conducted as a proactive measure of identifying and eliminating or minimizing job related hazards before the job is performed. The Analysis can also be conducted as part of hazard awareness and employee training and as an accident investigation tool. *The* completed form should be maintained for record purposes and a copy should be forwarded to EHS via email at ehs@kennesaw.edu.				
Department		Date		☐ New ☒ Revised
Job/Task Evaluated		Job Performed By		
Work Supervisor		Conducted By		

What If?	Answer	Likelihood	Consequences	Recommended Corrective Actions

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Appendix B – Revision History

Version #	Implemented By	Revision Date	Approved By	Approval Date	Revision Summary
2.0	Rodrick Esaw	06/15/2016	EHS		NA
2.1	Rodrick Esaw	07/07/2017	EHS		N/A
2.2	Rodrick Esaw	05/23/2018	EHS		N/A
2.3	Rodrick Esaw	06/03/2019	EHS		Minor verbiage changes, Working Alone Procedure and Guidelines, Minor Changes to Chemical Prior Approval Process.
2.4	Rodrick Esaw, Matthew Rosenberg	04/17/2020	EHS		Minor verbiage and formatting changes, checked hyperlinks, changes to Incident Reporting procedure, minor changes to Chemical Prior Approval process.
2.5	Rodrick Esaw	04/12/2021	EHS		Minor verbiage and formatting changes, checked hyperlinks, changes to Incident Reporting procedure
PROG_EHS_01	Whitney Green	09/15/2022	EHS		Major changes to content and formatting. Addition of new document control versioning (PROG_EHS_01). Approval from University Safety Council during meeting on 09/15/2022.