Hudson Valley Community College

Chemical Hygiene Plan

Revision Date: February 2018

Chemical Hygiene Plan

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Introduction

The purpose of this ***Chemical Hygiene Plan*** describes the College's safety, health and environmental plan for all laboratory based work.

Laboratories at HVCC included in the scope of this Plan are those where hazardous chemicals are handled on a "laboratory scale" for conducting testing and experiments and are not part of a production process. "Laboratory Scale" is work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person.

The intent of this Plan is to define the minimum standards necessary to avoid exposures to hazardous chemicals through any of the established "routes of entry" into the body, as well as to provide general guidelines for laboratory safety. The Chemical Hygiene Plan is intended to meet compliance with the NYS Public Employee Safety & Health (PESH) regulation governing labs, OSHA 29 CFR 1910.1450 and all other applicable occupational safety and health PESH regulations. In addition this Plan addresses compliance with all applicable regulations of the U.S. Environmental Protection Agency and NYS Department of Environmental Conservation with respect to environmental requirements and disposal of hazardous wastes. All faculty, staff, students working in a laboratory at the College are expected to follow this plan and other specific policies developed for their lab.

Section 1. Responsibilities

1.1 Chemical Hygiene Officer

The Director of Environmental Health and Safety (EHS) is the College's Chemical Hygiene Officer. This individual is responsible for the overall Chemical Hygiene Plan of the College, and assists lab faculty and staff with implementation of the Plan. The Chemical Hygiene Officer is responsible for ensuring that training is provided in a timely fashion, and is responsible for all record keeping associated with the Chemical Hygiene Plan.

1.2 Laboratory Faculty and Staff

Lab Faculty and Staff in each Department are responsible for ensuring that all experiments/analysis conducted under his/her direction do not pose undue risks to individuals performing the work, and that all aspects of the Chemical Hygiene Plan are adhered to in their lab. Also it is their responsibility to ensure that all individuals working under his/her direction are informed and familiar with the location of all emergency equipment, routes of egress, and the specific safety rules and requirements of the Chemical Hygiene Plan in that lab. Each Department is responsible for ensuring that any lab-specific procedures needed to supplement this Plan are developed and implemented in a timely manner.

1.3 Laboratory Worker/Student

It is the responsibility of each Lab Worker/Student to abide by the general safety requirements set forth in the Chemical Hygiene Plan and as instructed by the Lab Faculty and Staff, as well as the specific procedures and requirements of the lab in which they work. Laboratory Workers/Students must realize that their actions may affect the safety of others.

Each chemistry lab student is required to read and sign acceptance of the "Safety Program for Chemistry Laboratories", included as Appendix A of this program.

Section 2 Prudent Experiment Planning

2.1 Responsibility for Experiment Planning

The proper planning of laboratory experiments is an essential component of lab safety. When planning a new lab experiment or process, the lab faculty will review and identify all potential hazards and determine proper safety precautions to be followed. This will also give the lab faculty an opportunity to determine if there are safer chemical substitutes that can be used in the experiment or process. Further, the planning process allows an opportunity to consider what hazardous waste will be generated and determine if there are ways to minimize the volume of hazardous waste generated. These steps can save the department money in purchase of chemicals as well as waste disposal costs, in addition to keeping the process/experiment as safe as possible.

Laboratory faculty member is responsible for identifying all the potential hazards of the experiments/processes they will be teaching or doing. They must communicate these potential hazards to their students and instruct them on safety precautions to be followed. Other department lab staff or the Environmental Health & Safety Department can assist in this process. At a minimum, the planning must ensure that all applicable health, safety and environmental regulations are followed as well as this Chemical Hygiene Plan and any other department specific procedures.

2.2 Planning Steps

While the format and degree of specificity included in the experiment planning process is entirely dependent upon the judgment of the lab faculty, once the goals and objectives of the experiment(s) have been clearly formulated, several aspects of the experiment process must be considered. These include:

- Risk assessment
- Acquisition and storage of chemicals
- Handling of chemicals
- Equipment/Apparatus to be used
- Disposal of waste

It is important that considerations for personal safety are an integral part of the planning process and are included in the evaluation of the goals and objectives of the laboratory work.

2.3 Chemical Management

As part of the experiment planning process efforts should be made to reduce both the quantity and degree of toxicity of the chemicals to be used. Successful source reduction efforts result in at least three beneficial factors:

- Minimization of the quantities of chemicals to be used
- Minimization of waste chemicals that require proper disposal
- Minimization of risk and future liability

The easiest way to help insure safety and the proper handling of chemicals and hazardous waste is to prevent the handling and generation of such wastes whenever possible. This requires meticulous experiment planning and a complete hazard assessment of the waste products that may be generated. Consider the following examples of waste minimization strategies:

- Micro-Scale: Whenever possible consider carrying out experiments and laboratory procedures on as small a scale as possible.

- Product Substitution: Whenever possible, substitute less hazardous chemicals in experiments. This might include alternate synthetic routes or procedures for working up reaction mixtures.

- Look at the "Big Picture": What may seem like a frugal purchase may, in the end, create an expensive liability. Consider the following example, based on actual chemical prices from a large manufacturer and actual disposal estimates. Professor X needs 1500 g of Ethyl Ether-Anhydrous for an experiment. Upon obtaining prices Professor X finds that 3 x 500g of the Ether costs $64.50, whereas 6x 500g costs $115.50, an apparent savings of $13.50 for the extra 1500 g. Although Professor X does not currently have a need for the extra 1500 g of ether, it's a good deal and a commonly used product. If that extra 1500 g were to go unused, and be stored in excess of 12 months, the estimated cost for disposal of the material to the College would be $2,500.00. Certain compounds, Ethyl Ether included, tend to form explosive peroxides in storage and must be remotely opened and stabilized prior to disposal. Further, excess materials create labor costs in storage and handling, and create a potential liability in storage. The best practice is, to the best of your estimating ability, order only what is needed for a specific set of experiments.

- Recycle and Reuse: When the reuse or recycling of chemicals is possible, it is always preferable rather than disposal.

- Prevent Waste Commingling: Preventing non-hazardous chemicals from being mixed with hazardous chemicals will help to reduce the quantity of hazardous waste generated.

2.4 Acquisition and Inventory of Chemicals

The act of purchasing chemicals, and tracking their shelf life, is an important part of waste minimization and laboratory safety. Before chemicals are ordered several factors should be considered.

- The experiment(s) should be reviewed to determine the minimum quantity of the chemical(s) that is required to complete the necessary work.
- Fire codes, internal policies and regulatory restrictions may limit the amount of a certain chemical or group of chemicals that may be stored in a given area. This fact should be considered when ordering a quantity of a specific chemical.
- Some chemicals require special handling and storage once they have arrived. Some examples might include: refrigeration, dry box, freezing or storage away from light and/or moisture. Consideration must be given to special storage and handling requirements prior to chemical arriving.
- The stability of the chemical must be considered. Inherently unstable materials may have very short storage times and should be ordered on a "just in time" basis. Other materials may degrade to form explosive mixtures. These materials must be closely tracked in storage to identify signs of dangerous degradation. Some of these classes of materials are identified in *Section 4, Chemical Hazards.*
- The potential waste produced by the chemical and process in question should be considered from both a health and safety and a cost perspective.

Once a determination has been made for purchase of chemicals, the purchaser is responsible for ensuring that the chemicals are added to the department's or laboratory's chemical inventory listing. A Safety Data Sheet (SDS) for all chemicals purchased must be obtained and kept on file with all other SDSs for your department or lab.

If there are any questions or safety concerns about the potential use of a new chemical substance, the Director of Environmental Health & Safety (EHS) should be contacted.

2.5. Donated or Otherwise Acquired Chemicals

It is the College's policy that no chemicals can be brought onto College property that have not been purchased by the College department or otherwise received prior approval of the Department Chair. All of the above considerations described in Section 2.4 apply to donated or otherwise acquired chemicals and an SDS sheet must accompany the chemicals when allowed to be brought onsite by the Department Chair. These chemicals become the responsibility of

the College's once on College property and must be used, stored and handled the same as all other chemical products.

Section 3 General Lab Safety Principles/Standard Operating Procedures

3.1 Basic Laboratory Rules

- Do not work alone in the laboratory.
- Smoking, eating, drinking, the application of cosmetics and contact lens insertion or removal is not permitted in laboratory preparation areas or in areas where chemicals are used or stored. Chemical vapors can be absorbed by foods, especially breads and tobacco.
- Food or drink for human consumption is not permitted to be stored in the laboratory areas.
- Never mouth pipette or start a siphon by mouth

3.2 Personal Hygiene and Conduct

- Use good personnel hygiene. Keep hands and face clean. Wash hands frequently with soap and water to minimize chemical exposure through ingestion and direct contact with skin. Always wash hands before eating, drinking, smoking, applying cosmetics or handling contact lenses after working in the laboratory.
- Confine long hair and loose clothing.
- Avoid behavior which might confuse, startle, or distract another worker.
- Report dangerous activities or situations and unsafe conditions.
- Report any accidents or exposure incidents.
- Ask questions. Consult with lab staff and EHS staff.

3.3 Personal Attire and Personal Protective Equipment

- Clothing should be worn that will minimize exposed skin surfaces. Avoid short sleeved shirts or very short skirts.
- **Shorts are not acceptable attire for lab workers.**
- **Closed toed shoes are required.**
- **Standard PPE for anyone working with hazardous chemicals, at a minimum, is: lab coat, eye protection and gloves**
- Wear PPE as indicated by the chemical's SDS, any recognized hazards, and task involved at all times as appropriate and inspect before use.
- Wear an apron over lab coats when working with hazardous chemicals that could cause serious injury from splashing.
- Wear splash goggles to avoid eye contact when handling chemicals.
- Wear heavy, chemical resistant gloves over disposable gloves when handling hazardous chemicals that are corrosive or otherwise could cause serious injury upon contact.
- Remove gloves when leaving laboratory to prevent contamination (doorknobs, etc).
- Remove laboratory coats upon significant contamination. Do not take lab coats home for laundering. The College provides an industrial laundry service for reusable coats; disposable lab coats must be discarded when contaminated.

For more information about Personal Protective Equipment, See Section 6

3.4 General Housekeeping

- Keep work areas clean and uncluttered.
- Clean work areas and return equipment and supplies to proper storage areas at end of work day.
- All broken glass should be immediately disposed of in the glass waste containers provided.
- Do not ignore wet areas on floors – dry to prevent falls.
- Clean all minor spills promptly.
- Use proper waste receptacles and follow established waste procedures.
- Do not store boxes on the floor.
- Keep aisles and walking areas free of clutter (carts, etc). Routes of egress (including those within the department work areas) must remain open.
- Clean glassware and return to storage promptly. Clutter near sinks invites accidents.
- Do not clutter work area with unnecessary supplies. Store in proper location.

3.5 Laboratory Equipment and Glassware

- Laboratory equipment should be used for only its intended purpose.
- Receive training and learn how to use the equipment.
- Emergency equipment will be inspected periodically.
- Do not use damaged equipment; tag for repair or notify supervisors or appropriate repair personnel.
- Do not use damaged glassware. Inspect for damage prior to use.
- Equipment should be cleaned periodically (refrigerators, incubators, freezers) and spills treated quickly and appropriately.
- Secure all compressed gas cylinders to walls or benches.

Section 4 Chemical Hazards

4.1 Chemicals pose both health and physical hazards

According to OSHA, **physical hazard** means "a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive."

According to OSHA, **health hazard** means "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term health hazard includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, or agents which act on the hematopoietic system and agents which damage the lungs, skin, eyes, or mucous membranes."

A brief hazard description is given here of all the categories of physical and health hazards described above. Additional details on appropriate control measures for each is covered in other Sections of this Plan. Also, you should consult the SDS and other reference materials for additional information on the nature of the hazards.

4.1.1 Compressed gas

Compressed gases are commonly used in laboratories for a number of different operations. While compressed gases are very useful, they present a number of hazards for the laboratory worker:

- Gas cylinders may contain gases that are flammable, toxic, corrosive, asphyxiants, or oxidizers.
- Unsecured cylinders can be easily knocked over, causing serious injury and damage. Impact can shear the valve from an uncapped cylinder, causing a catastrophic release of pressure leading to personal injury and extensive damage.
- Mechanical failure of the cylinder, cylinder valve, or regulator can result in rapid diffusion of the pressurized contents of the cylinder into the atmosphere; leading to explosion, fire, runaway reactions, or burst reaction vessels.

Refer to the Resources Page in Appendix B for further information on the safe handling and storage of compressed gas cylinders

4.1.2 Explosives

These are chemicals that cause a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature. Fortunately, the College does not use many chemicals that are explosive. Some chemicals can become unstable and/or potentially explosive over time due to contamination with air, water, other materials such as

metals, or when the chemical dries out.

If you ever come across any chemical that you suspect could be potentially shock sensitive and/or explosive, do not attempt to move the container as some of these compounds are shock, heat, and friction sensitive. In these instances, you should contact EHS at 629-7163 for proper disposal.

Examples include: nitrocellulose, di- and tri- nitro compounds, peroxide forming compounds such as picric acid when dried out, 2,4-dinitrophyenylhydrazine (dry), or compounds containing the functional groups: azide, acetylide, diazo, notroso, haloamine, perioxide and ozonide.

4.1.3 Peroxide forming compounds

Some solvents can form explosive organic peroxides. Solvents, like other chemicals will degrade over time. Solvent deterioration is dependent on several factors—elapsed time since purification, shipping and storage conditions, individual solvent properties and the presence or absence of stabilizers. In some solvents, a byproduct of this degradation includes explosive organic peroxides, which may explode if subjected to thermal or mechanical shock. This shock may occur by simply unscrewing the container's cap. Since sunlight and oxygen promote peroxide formation, these conditions should be avoided during storage.

4.1.4 Oxidizers and organic peroxides

Oxidizers and organic peroxides are a concern for laboratory safety due to their ability to promote and enhance the potential for fires in labs. Oxidizers can supply the oxygen needed for the fire, whereas organic peroxides supply both the oxygen and the fuel source. Both oxidizers and organic peroxides may become shock sensitive when they dry out, are stored in sunlight, or due to contamination with other materials, particularly when contaminated with heavy metals. Most organic peroxides are also temperature sensitive.

As with any chemicals, but particularly with oxidizers and organic peroxides, quantities stored on hand should be kept to a minimum. Whenever planning an experiment, be sure to read the SDS and other references to understand the hazards and special handling precautions that may be required, including use of a safety shield. Also be aware of the melting and auto ignition temperatures for these compounds and ensure any device used to heat oxidizers has an over temperature safety switch to prevent the compounds from overheating.

Laboratory personnel should be particularly careful when handling oxidizers (especially high surface area oxidizers such as finely divided powders) around organic materials.

Avoid using metal objects when stirring or removing oxidizers or organic peroxides from chemical containers. Plastic or ceramic implements should be used instead. Laboratory personnel should avoid friction, grinding, and impact with solid oxidizers and organic peroxides. Glass stoppers and screw cap lids should always be avoided and plastic/polyethylene lined bottles and caps should be used instead.

If you suspect your oxidizer or organic peroxide has been contaminated (evident by discoloration of the chemical, or if there is crystalline growth in the container or around the cap), then do not use - contact EHS 629-7163 for proper disposal.

4.1.5 Flammable or combustible liquids

Flammable liquids are those with a flashpoint less than 100 degrees F; combustible liquids are those with a flashpoint between 100 and 200 degrees F. See Section 4.4.2 for more information on flashpoints. Flammable and combustible liquids are capable of ignition and therefore pose a fire hazard.

When using flammable liquids, keep containers away from open flames; it is best to use heating sources such as steam baths, water baths, oil baths, and heating mantels. Never use a heat gun to heat a flammable liquid. Any areas using flammables should have a fire extinguisher present. Always keep flammable liquids stored away from oxidizers and away from heat or ignition sources such as radiators, electric power panels, etc. Always clean up spills promptly. Be aware that flammable vapors are usually heavier than air (vapor density > 1). For those chemicals with vapor densities heavier than air (applies to most chemicals), it is possible for the vapors to travel along floors and, if an ignition source is present, result in a flashback fire.

It is important to store flammable liquids only in specially designed flammable storage cabinets, refrigerators/freezers designed for flammable storage. Do not store flammable liquids in standard (non-flammable rated) refrigerators/freezers. Standard refrigerators are not electrically designed to store flammable liquids. If flammable liquids are stored in a standard refrigerator, the buildup of flammable vapors can be sufficient to ignite when the refrigerator's compressor or light turns on, resulting in a fire or an explosion.

4.1.6 Flammable Solids

OSHA defines a flammable solid as a "solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited, burn so vigorously and persistently to create a serious hazard." An example of a flammable solid is magnesium. Many of the same principles for handling and storage of flammable liquids apply to flammable solids. Always keep flammable solids stored away from oxidizers, and away from heat or ignition sources such as radiators, electric power panels, etc.

4.1.7 Pyrophoric Materials

Pyrophoric material is a liquid or solid that will ignite spontaneously in air, therefore it is highly hazardous and demands special handling procedures and equipment to prevent any air contact. No pyrophorics are used at the College. If a lab department has a need to use a phyrophoric material,

EHS must be contacted at 629-7163 to assist in addressing the hazards before the material is brought onto campus.

4.1.8 Unstable (Reactive) or water reactive chemicals

Reactive chemicals, whether they are a water reactive, air reactive, or unstable in nature, must be handled with extreme care. SDS sheets should be carefully reviewed to verify safe handling procedures for specific chemicals/compounds. Laboratory work involving reactive chemicals should be completed in fume hoods or glove boxes. Reactive chemicals should be stored such that proper compatibility is insured and conditions such as temperature and sunlight are maintained within safe limits for each specific type of chemical. Refrigerators used for storing flammable or reactive chemicals should be explosion proof. Standard Operating Procedures must be created and reviewed specific to reactive chemicals and processes.

4.1.9 Cryogens (chemicals at extremely low temperatures- e.g. liquid nitrogen)

Cryogenic liquids and dry ice are capable of causing freezing injuries such as frostbite which actually are similar to a burn. SDS sheets should be reviewed whenever handling cryogenic materials to determine the appropriate personal protective equipment. This would include at a minimum tight fitting gloves which prevent cryogenic material from being trapped next to the skin, and face shields. In the event of skin contact with a cryogenic material, immediately rinse the skin with warm, not hot, water for a full fifteen minutes and then seek professional medical attention. When dispensing liquid Nitrogen, a full face shield with goggles underneath, chemical splash apron and cryogenic protective gloves must be worn.

4.1.10 Corrosives

Corrosive materials present a hazard due to their ability to destroy human tissue. Although the exact definition of corrosive varies slightly between regulatory agencies, all definitions are closely tied to pH**.** (OSHA defines corrosive material by a chemical's ability to cause destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.) The pH value of a substance represents the acidity or alkalinity of a solution. Proper personal protective equipment, including adequate skin protection, gloves and face shields with goggles must be worn whenever corrosive materials are being utilized. Acidic materials and alkaline materials should be segregated in storage to prevent reactions from occurring. Chemical carriers should be utilized whenever chemicals are being transported to help prevent breakage in the event that the materials are dropped or struck. Additionally, use dilute acidic or alkaline solutions instead of concentrated solutions for adjusting the pH of reagents and other solutions made in the laboratory whenever possible.

4.1.11 Sensitizers (allergens)

A sensitizer is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Examples of sensitizers used in laboratories include: formaldehyde, many phenol derivatives, and latex proteins (commonly found in latex lab gloves). Handling processes should be designed to minimize the potential for splash, splatter, or other likely scenarios for accidental contact. When working with sensitizers, follow all safety precautions as outlined in this Plan as with any other hazardous chemicals.

4.1.12 Toxic Chemicals

Toxins affect particular target organs**.** *Target Organ Effects*: Chemically caused effects from exposure to a material on specific listed organs and systems such as liver, lungs, and central nervous system. Chemicals can have adverse effects - acute or chronic, on many different organs of the body as a result of exposure. A wide range and diversity of effects and hazards can be found in the workplace. The following chart illustrates the broad scope which may be encountered.

PHYSIOLOGICAL CLASSIFICATION	TARGET ORGAN(s)	SIGNS & SYMPTOMS	EXAMPLE CHEMICAL(s)
Hepatoxins	Liver	Jaundice; liver enlargement	Nitrosamines; 1-Propanol
Nephrotoxins	Kidney	Edema, proteinuria	Halogenated hydrocarbons- cumene; hexane
Neurotoxins	Nervous system	Narcosis; behavorial changes, decrease in motor functions	1-propanol, Mercury compounds
Agents that act on blood or hematopotic system	Decrease hemoglobin function; deprive body tissues of oxygen	Cyanosis; loss of consciousness	carbon monoxide; cyanides; acetonitrile
Reproductive toxins	Chemicals that effect the reproductive capabilities; including: mutations and affects on fetuses (teratogenesis)	Birth defects; sterility	Lead; nickleous chloride; hexane
Agents that damage the lung	Irritate or damage the pulmonary tissue	Cough; tightness in chest; shortness of breath	Silica; asbestos; Thionyl chloride
Cutaneous hazards	Affect the dermal layer of the body	Defatting of the skin; rashes; irritation	Ketones; chlorinated compounds
Eye hazards	Affect the eye or visual capacity	Conjunctivitis; corneal damage	Organic solvents; acids; aluminum nitrate; Crystal violet; Fast violet B salt

The SDS of a chemical will list both the known physical and health hazards of that substance. You must review SDS sheets and other reference materials before initiating work with all unfamiliar chemicals. Toxic materials should be opened and handled only within a functioning ventilation enclosure, such as a laboratory hood, unless alternate work practices can achieve an equal or greater level of personal protection. Generally speaking, there are several safety related items that should be considered when utilizing toxic materials.

Routes of Entry: Be mindful of the routes of entry as they relate to toxic materials.

- ***Absorption through skin or mucous membranes:*** Use appropriate PPE including gloves goggles, chemical aprons etc. as required and/or needed.

- ***Inhalation:*** Perform chemical manipulations involving toxic materials in fume hoods and/or where adequate ventilation exists. If respiratory protection is required, you must have received appropriate training, fit-testing and medical surveillance through the EHS Department first.

- ***Ingestion:*** Practice appropriate hygiene in the laboratory. Wash your hands often; keep surfaces clean of chemical residue; never eat, drink or smoke in the laboratory.

- ***Injection:*** Be mindful of broken glass and sharps hazards. Dispose of contaminated sharps/glass immediately to prevent cuts or punctures.

Certain chemical procedures involving toxic materials require prior approval before they may be used. Review the components of this plan that relate to proper chemical handling, personal protective equipment, ventilation controls and laboratory fume hoods, and proper disposal of hazardous wastes prior to working with toxic materials.

4.2 Particularly Hazardous Substances

OSHA defines Particularly Hazardous Substances as those chemicals that are:

- Select carcinogens
- Reproductive toxins
- Substances having a high degree of acute toxicity-chemicals that have the ability to cause a harmful effect after a single exposure.

Lab staff and faculty must give consideration to additional protective measure where appropriate when work assignments involve these materials to minimize risk.

4.2.1 Carcinogens

The Occupational Safety and Health Administration (OSHA) has developed specific use requirements for thirteen (13) known carcinogens. These materials include:

4-Nitrobiphenyl
alpha-Naphthylamine
Methyl Chloromethyl ether
3-Dichlorobenzidine
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminodiphenyl
Ethyleneimine
Beta-Popiolactone
2-Acetylaminofluorene
4-Dimethylaminoazo-benzene
N-Nitrosodimethylamine

The Ehs Department must be notified of intended use of any of these materials prior to their introduction into the workplace. In addition to this list, there are other known or suspected carcinogens listed by other independent agencies. Consult the SDS for potential carcinogenicity of any substance you are using.

4.2.2 Reproductive Hazards

Chemicals that are collectively referred to as reproductive hazards cause a diverse group of harmful effects and in varying degrees. They can affect both male and female reproductive capabilities, cause chromosomal damage (mutations), and can have an effect on pregnancy and the stages of fetal development (teratogenesis-physical defect manifestations) such as malformations and/or death. Many chemicals found at the College and commonly used in most workplaces exhibit some degree of reproductive hazard.

4.2.3 Other substances that exhibit a high degree of acute toxicity

Some chemicals can cause serious, adverse health effects immediately upon contact. A careful review of the toxic effects section of the SDS is necessary in identifying such substances. For example: hydrofluoric acid used in the SMT Lab at TECSMART.

Additional safety precautions when working with particularly hazardous substances must be developed. Consult with the Environmental Health & Safety Department (EHS) in developing and implementing appropriate precautions.

4.3 Chemicals or Substances of Unknown Hazard

In some cases a chemical's toxicity and overall data for hazards is incomplete as stated on its SDS. In these cases the substance must be assumed to be hazardous and appropriate exposure control measures taken for the tasks involved: fume hood, gloves, goggles, etc.

Any unknown by-product of a procedure must be considered as a hazardous chemical.

Any unlabeled substance encountered must be considered to be hazardous

4.4 Assessing Chemical Hazards

Safety Data Sheets list chemical properties which can help the user to determine the hazards of the chemicals they are using. It is important to know and understand the terms used to describe these properties in order to recognize these hazards. Some of the key terms encountered on the SDSs are explained in this section.

4.4.1 Vapor Pressure

What is a vapor?

A vapor is a gas that evaporates from a substance which is a liquid at room temperature (usually 68°F or 20°C on an SDS). For example, a vapor forms when a bottle of rubbing alcohol is opened and the alcohol then evaporates.

What is vapor pressure?

As temperature rises more of the liquid evaporates. Vapor pressure is the measure of how much of the liquid evaporates to form a vapor. It actually is a measure of the tendency of the liquid to form a vapor at a given temperature. Typically vapor pressure is measured in millimeters of mercury (mmHg), the same unit of measure as weather atmospheric pressure.

Why is vapor pressure important?
Chemicals with high vapor pressures will vaporize more readily than ones with low vapor pressure. Acetone has a high vapor pressure. High vapor pressure means the chemical is more likely to contaminate the air, and thus more of the vapor may be inhaled by people in the area.

Examples:
High: A vapor pressure above 10 mmHg (millimeters of mercury) at room temperature.
Benzene (75 mmHg)
Acetone (266 mmHg)
Moderate: A vapor pressure between 1 and 10 mmHg at room temperature.
Turpentine (5 mmHg)
Nitric acid (10 mmHg)
Low: A vapor pressure of less then 1 mmHg)
Sulfuric acid (0.001 Hg)

What are the hazards of high vapor pressure?

- Vapor pressure indicates which chemicals are more likely to get into the air and more easily breathed in. Chemicals with a vapor pressure above approximately 10 mmHg at room temperature are likely to become airborne inhalation hazards.
- Vapor pressure can provide an explosion warning. Sealed containers of chemicals with a high vapor pressure can explode if the temperature rises due to the buildup of pressure. Excess heat in room or a nearby fire can create this condition.

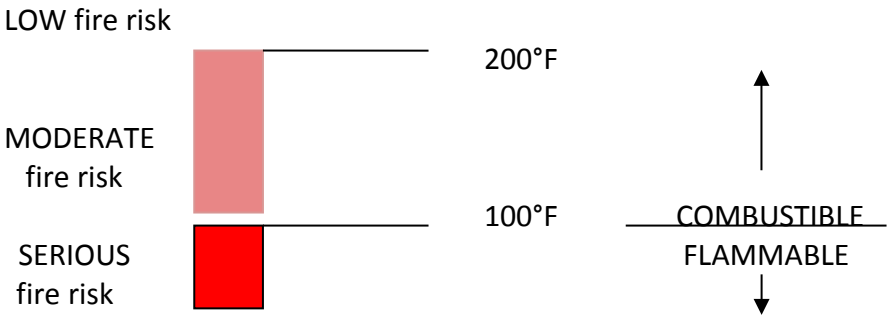
4.4.2 Flashpoint
The flashpoint of a chemical is the lowest temperature at which there is enough vapor to make a fire in the presence of an ignition source.

An example: Benzene has a flashpoint of 12°F. At room temperature liquid benzene would give off enough vapors to start burning if a match were lit near the surface of the liquid.

Flammable and Combustible chemicals

If the flashpoint of a liquid chemical is less than 100°F the chemical is flammable (example: ethyl benzene has a flashpoint of 59°F)

If the flashpoint of a liquid chemical is higher than 100°F the chemical is called combustible (example: phenol has a flashpoint of 174°F).



What does the flashpoint tell you?

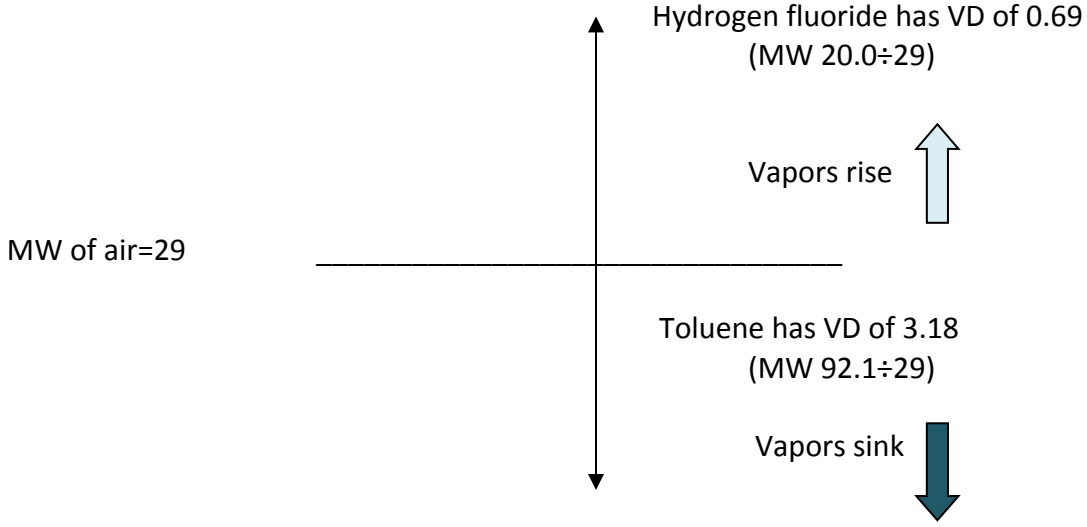
- Flammable liquids are high fire risks.
- Any chemical with a flashpoint below 100°F is a serious fire risk.
- Combustible chemicals with flashpoints between 100 and 200°F are moderate fire risks.
- Combustible chemicals with flashpoints above 200°F are low fire risks.

4.4.3 Vapor Density

Vapor density (VD) is a measurement of how "heavy" a vapor or gas or its "weight" compared to that of air. Air has a vapor density of 1.

- A vapor density of **less than 1** indicates that the vapor is lighter than air and will rise and disperse into the atmosphere. These vapors can collect in pockets near ceilings.
- A vapor density **of greater than 1** is heavier than air and will sink toward the floor. These vapors can sink toward the floor, roll along the ground or floor and collect in "pools" along the ground or bottom of an area such as a reaction vessel.

$$\text{Vapor density} = \frac{\text{molecular weight (MW) of chemical}}{29 \text{ (MW of air)}}$$



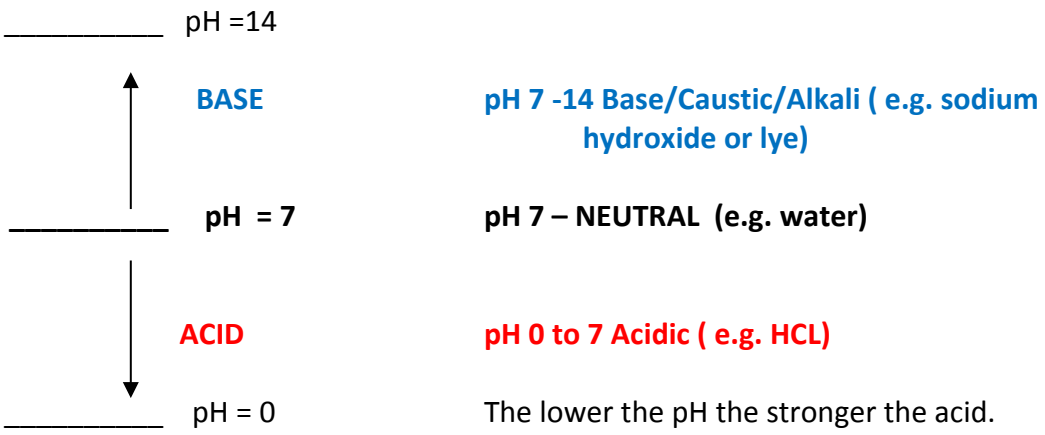
What does vapor density tell you?

- It can tell you where to find the highest concentration of a chemical vapor.

- High density vapors, both toxic and non-toxic, collect in low areas and confined places and displace the oxygen that is there. If enough oxygen is displaced, you could suffocate.
- Therefore, a dense vapor of even a non-toxic chemical can be extremely dangerous.
- High density vapors can travel far from their liquid source and sink into areas where you might not expect to find them, especially when the air is very still (no mechanical ventilation). The concentration of toxic vapors in low-lying or confined spaces may be very high.
- High density vapors typically are also flammable. A pocket of a dense flammable vapor can easily ignite from careless smoking or when sparks occur.
- Whenever a gas or vapor is heated it expands and becomes less dense and a normally dense vapor can rise. So in cases of increased temperature the concentration of the vapor near the ground may decrease but the concentration around where you breathe may increase.

4.4.4 pH

The pH of a chemical tells you if the chemical is an acid, a base (also called alkali or caustic), or if it is neutral. The pH scale range is from 0 to 14.



What can the pH tell you?

- The pH tells you if the chemical is a corrosive which can destroy body tissues and burn skin.
- Bases are more dangerous to the eyes than are acids. Acids can cause eye damage also but they don't work as fast as bases. Permanent damage maybe prevented if the eyes are washed immediately after exposure to acids or bases but bases can cause permanent eye damage very quickly.

4.4.5 Oxidizers

Oxidizers give off oxygen during chemical reactions. Their presence makes it easier for fires to start and to burn. Oxidizers are incompatible with many other chemicals. They must be stored carefully away from incompatibles.

Why is it important to know what chemicals are oxidizers?

- Oxidizers can react violently in a fire.
- Oxidizers may react violently with water.
- Oxidizers should never be stored near flammable or combustible chemicals.

4.4.6 Fire and explosion hazards

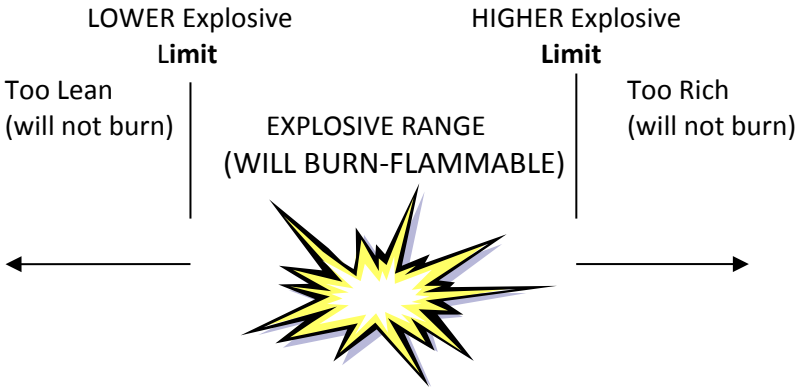
In order for a fire and explosion to occur three things are needed.

- Oxygen
- An ignition source (flame, spark, or heat)
- Fuel (wood, oil, paper, chemicals - liquid, gas or vapor)

This is important to know because most fires can be extinguished if any **ONE** of these three things is removed. Water can extinguish many fires because it removes the source of heat whereas foam or a dry chemical removes the oxygen by forming a barrier between the fire and the air.

Explosive (Flammable) Range: Lower and Upper Explosive Limits

- Fires cannot burn without a source of fuel.
- However, in order for the fire to ignite there must be a certain amount fuel (chemical gas or vapor).
- If there is too little fuel the fire will not ignite.
- If there is too much fuel the fire will not ignite either. If there is so much fuel that it replaces too much of the oxygen there will not be enough oxygen remaining for the fire to burn.
- Fuels can ignite and keep a fire going when their concentration in the air is within a certain range called the ***explosive range*****.**
- The lower end of the explosive range is called the **Lower Explosive Limit (LEL)**. Below the LEL there is not enough fuel to keep a fire going. Below the LEL the fuel/air mixture is, therefore, too ***lean*** to burn.
- The upper end of the explosive range is called the **Upper Explosive Limit (UEL).** Above the UEL there is too much fuel and too little oxygen to keep a fire going. Above the UEL the fuel/ air mixture is, therefore, to ***rich*** to burn.



For example: Benzene: LEL is 1.3% or 13,000 ppm
UEL is 7.1% or 71,000 ppm
Explosive or flammable range between 1.3% to 7.1%

IT IS IMPORTANT TO NOTE: The UEL and LEL are not fail-safe. Fuel/air mixtures may be too lean but have concentrated pockets which can ignite. Also, a mixture that is too rich one minute can disperse and become flammable in a matter of seconds!

What does the explosive range tell you?

- If you know the explosive range of a substance, you know if you may face a fire risk.
- Allow a margin of error for these ranges. If in doubt do not enter!

4.4.7 Oxygen Deficiency

Normal air is about 21% oxygen. When the percentage of oxygen drops below 19.5%, the atmosphere is considered to be oxygen deficient. When the level falls below 16% very serious health effects can start to occur: bad coordination, irrational thinking, rapid breathing, and increased heartbeat.

Why is it important to know about oxygen deficiency?

- Too little oxygen in the air can cause asphyxiation.
- If compressed gases or liquids are present, a leak into the room air can reduce the amount of oxygen by displacement.
- Chemical emergency spill teams need to know if the air may be oxygen deficient and the oxygen displaced by a hazardous chemical. Chemical inventories and locations are very important. In case of a spill, it is important to know the identity of the chemical.
- In cases if oxygen deficient atmospheres emergency workers must wear a self contained breathing apparatus (SCBA) or other air-supplied respirator. Air purifying respirators are useless because there is not enough oxygen and they do not supply oxygen.
- Oxygen deficiency causes low readings on combustible gas indicators.
- Monitoring atmospheres is a very important tool in maintaining safety conditions

4.4.8 Exposure Limits

An occupational exposure limit is the maximum average air concentration that most workers can be exposed to for an 8 hour work day, 40 hour work week for a working lifetime (40 years) without experiencing significant adverse health effects.

Types of Exposure Limits

Many organizations research occupational exposures and establish recommended exposure limits. Recommended exposure limits are not enforceable by law. One of the most active in this research is the American Conference of Governmental Industrial Hygienists (ACGIH) who publish exposure limits called Threshold Limit Values (TLV). The National Institute of Occupational Safety and Health (NIOSH), another research organization, publishes the Recommended Exposure Limits (REL). Governmental agencies like OSHA set maximum workplace exposure limits into law, known as Permissible Exposure Limits (PELs). Most limits are expressed as an acceptable concentration averaged over a period of time.

- The 8 Hour Time Weighted Average (8 Hr TWA) is the average concentration for an 8 hour work period. Brief periods slightly above and below this value are typical, as long as the average for the 8 hour period does not exceed the TWA.
- Short Term Exposure Limits, (STELs), are allowable 15 minute exposure levels above the TWA. There may be no more than 4 STEL periods in a work day and there must be 60 minutes

between the periods. STELS must be balanced with much lower exposures during the day so the average exposure doesn't exceed the TWA. STELS are not available for all substances.

- Ceiling (C) limits are concentrations that must never be exceeded during any part of the day.
- Action levels are found only in certain substance specific standards by OSHA. This is the air concentration that triggers a series of actions the employer must take to protect the employee. Action levels are typically one half of the permissible exposure limit.
- A "SKIN" notation that follows the exposure limit indicates that a significant exposure can be received if the skin is in contact with the chemical in either the gas, vapor or solid form.

Units of Measurement

A workplace exposure level, such as a PEL or TLV, is expressed as the concentration of the air contaminant in a volume of air. The most common units are:

ppm	parts per million (the number of "parts" of air contaminant per million parts of air)
mg/M^3	milligrams of substance per cubic meter of air
f/cc	fibers per cubic centimeter of air

The smaller the concentration number, the more toxic the substance is by inhalation.

Section 5 Control Measures and Safety Equipment

Chemical safety is accomplished by awareness of the chemical hazard and by keeping the chemical under control through a variety of engineering controls, work practice (administrative) controls, and Personal Protective Equipment. Laboratory personnel should familiarize themselves with these safeguards. OSHA dictates that engineering and work practice controls initially be used to reduce employee exposure below the PEL.

5.1 Engineering Controls

Engineering controls are physical or mechanical systems installed in the laboratory that are designed to reduce or eliminate employee exposure to chemical and physical hazards in the workplace. They must be maintained in proper working order for this goal to be realized. Employees should be able to detect the malfunction of equipment and bring it to the attention of a supervisor. All work processes that require the use of this equipment should cease immediately and not resume until proper repairs have been executed. No modification of engineering controls may occur unless the modification is tested and employee protection will continue to be adequate. Engineering controls are the primary method of exposure control.

5.1.1 Building and Laboratory Design

The college's various laboratories contain a number of engineering controls as standard equipment. Locked doors, separate chemical storage areas or cabinets, ventilation systems, alarm systems, emergency lighting, compressed cylinder storage area, fire doors are among the features designed to protect workers.

5.1.2 Fume Hoods

The fume hood is the major protective device to the laboratory worker. It is designed to capture chemicals that escape from their containers and remove them from the laboratory environment before they can be inhaled. General laboratory room ventilation is not adequate to provide proper protection against bench top use of hazardous chemicals. Laboratory personnel need to consider available engineering controls to protect themselves against chemical exposures before beginning any new experiment(s) involving the use of hazardous chemicals. Conducting the work in a fume hood is one of the best methods to control exposure.

Work done with volatile chemicals (those with high vapor pressures) and low TLV's (threshold limit values) should be done in a fume hood. Phrases on SDS that indicate a need for ventilation may include:

- Use with adequate ventilation
- Avoid vapor inhalation
- Use fume hood
- Provide local exhaust ventilation

NOTE: Fume hoods should never be used to contain biological hazards.

See the Resources Page in Appendix B for details on the operation of the fume hoods on this campus.

Fume hood maintenance
The EHS Department coordinates annual testing and inspection of fume hoods on campus. After each inspection, an inspection sticker is affixed to the fume hood. If your fume hood does not have an inspection sticker or if the existing inspection sticker on your fume hood indicates a year or more has passed since the hood was last inspected, then please call the EHS Department (629-7163) for air flow measurements or other questions.

5.1.3 Biosafety Cabinets

Biological safety cabinets (BSCs) are engineering devices that reduce the risk of working with biohazardous and infectious microorganisms. Cabinets are also used for maintaining aseptic conditions when working with cell cultures. BSCs utilize High Efficiency Particulate Air (HEPA) filters in the supply air and exhaust systems to create a nearly sterile work environment. Thus, BSCs provide personnel, environmental, and product protection when appropriate practices and procedures are followed.

There are different types of biosafety cabinets. Contact the EHS Department before installation for proper selection and certification.

NOTE: Hazardous Chemicals cannot be used in a biosafety cabinet. Damage to the cabinet could result rendering the cabinet ineffective.

Biosafety Cabinet maintenance
The Environmental Health & Safety Department coordinates inspection and certification of all biosafety cabinets on an annual basis. After each inspection, an inspection sticker is affixed to the BSC. If your BSC does not have an inspection sticker or if the existing inspection sticker indicates a year or more has passed since the BSC was last inspected, then please call the EHS Dept (629-7163) for inspection and certification.

See the Resources Page in Appendix B for information on the operation of the Biosafety Cabinets.

5.1.4 Fire Alarm System

Whenever a fire alarm activates in any College building, **you must assume there is a real emergency condition**. Therefore, do the following:

- If time safely permits, promptly shut down any equipment that could create a hazard if left unattended.
- Immediately evacuate the building using the shortest evacuation route. (Evacuation routes are posted in buildings and you should familiarize yourself with all routes from the location of your work.) Be sure to consider an alternate exit route in the event that the primary route is unavailable.
- If you originated the evacuation alarm, proceed to a safe location and call Public Safety at ext.7210 or from a cell phone: 629-7210. Be prepared to provide information on the hazard and the exact location of the emergency.
- No person is to re-enter a building until response officials give the all clear. Even if the alarm has been silenced – do not re-enter until told it is safe to do so.

The fire alarm system is maintained and inspected annually. This work is coordinated by the EHS Department and the Physical Plant department. If you think there is a problem with the fire alarm system, contact the Physical Plant (629-7356).

5.2 Other Control Measures and Safety Equipment

5.2.1 Portable containers

Flammable liquids should be kept in approved, portable containers specifically designed and allocated for flammable liquids (commonly called safety cans). These containers will have a UL approval label, or other comparable label indicating that it is approved for use with flammable liquids. The container must be labeled with the chemical identity and appropriate hazard information. Containers will be used for their intended purpose using common safety practices:

- The container must be closed except when adding or removing liquid.
- The flame arrestor screen must be kept in place at all times and replaced if punctured or damaged.
- As with all chemicals, flammable liquids in safety cans must be stored in the designated storage areas and not in laboratory fume hoods.
- All flammables must be protected against sources of ignition.

5.2.2 Flammable Storage Cabinets

When significant quantities (generally, more than 10 gallons) of flammable liquids will be stored, an approved flammable storage cabinet will be provided. These cabinets are designed for the safe storage of flammable chemicals, with the following features: fire resistance construction and liquid tight; labeled; door has three point lock; sill is raised two inches above the bottom of the cabinet; vents are provided on opposite sides of the cabinet for air movement. Observe prudent safety practices such as:

- Always read the manufacturer's information
- Store chemicals of similar vapor density together (e.g. Heavier than air-vapors near the top vent and lighter than air vapors toward the bottom vent).
- Do not exceed the limits of the cabinet (as affixed on the door label)
- Return materials to cabinet when not in use.
- DO NOT block cabinets or impair the closing of the doors.
- DO NOT block or obstruct doors
- Do not dispense from the cabinets

5.2.3 Acid and Corrosive Storage Cabinets

Acids and other corrosives cannot be stored in flammable storage cabinets due to the incompatibility of the materials. In addition, the acid or corrosives must be stored in a cabinet that is resistant to corrosion. When a cabinet is needed for storage of acids, bases and corrosives, the lab must provide a cabinet specifically designed for this purpose. Note that acids should be stored separately from bases and this can be accomplished using one corrosive cabinet that has separation into multiple compartments. Corrosive storage cabinets are made of acid/corrosive resistant material, including the door hinges; they typically contain a spill well to contain spills; and they may be vented. Observe prudent safety practices such as:

- Always read the manufacturer's information
- Store chemicals of similar vapor density together
- Do not exceed the limits of the cabinet (as affixed on the door label)
- Return materials to cabinet when not in use.
- Do not block cabinets or impair the closing of the doors.

- Do not block or obstruct doors
- Do not dispense from the cabinets

5.2.4 Eyewashes and Safety Showers

Eyewash units and safety showers will be installed in all lab areas where acid, bases and other corrosive chemicals are handled and used. All lab faculty and staff have the responsibility to be aware where they are located within their work assignment areas and know the proper functioning of the equipment. Flush eyes for a minimum of 15 minutes. As with any safety equipment, these can only be useful if they can be used, therefore:

- ***Keep access to the eyewash and shower clear of any obstacle at all times***.
- Showers should be checked routinely to be assured that access is not restricted and the start chain is within reach. (safety shower)
- Eyewash units will be flushed weekly by lab staff, faculty or Physical Plant.
- Physical Plant staff will flush showers semi-annually

5.2.5 Safety Shields

A safety shield is a barrier made of a durable transparent polymer. It can be placed on a bench top to protect against a spill or splash. It is not intended to be a substitute for a fume hood or PPE such as face shields and goggles. Liquids and other debris may travel on the bench top around the shield. Hand and arm protection is still needed along with eye and face protection.

Note: a fume hood sash also acts as a shield and can provide the same type of protection.

5.2.6 Explosion proof refrigerators

Explosion proof refrigerators are the only ones approved for storing flammable chemicals. The interior of a refrigerator is a confined area where flammable fumes or vapors can build up. In a normal refrigerator a spark could occur and ignite the flammable vapors leading to a fire or explosion. The spark can be generated because the refrigerator compressor, relays and thermostat are connected by and electrical switch. In explosion proof refrigerators, these are enclosed and so that the interior of the refrigerator is spark proof.

If the laboratory has the need to store flammable liquids at cold temperatures, an explosion proof refrigeration must be provided. All refrigerators of this type must labeled “explosion proof.” Food should never be stored in “laboratory use” refrigerators. Refrigerators should be free of clutter and with the contents secure (contents should not be stacked upon one another, setting on their sides, or left unopened). Lab staff must routinely check for outdated materials and properly dispose. No flammable chemicals are to be stored in any controlled temperature rooms/enclosures (e.g. walk in refrigerators, incubators) if not specifically designed for this purpose.

5.2.7 Fire Extinguishers

All labs are equipped with portable fire extinguishers, and fire extinguishers are located in the hallways of all College buildings. If an employee sees smoke or fire, they can use a fire extinguisher if it is safe to do so. If not, or if the fire becomes more involved, they should immediately find the nearest fire alarm pull station to alert building occupants and Public Safety. Evacuation plans are also available on posters in various rooms directing the occupants to the nearest evacuation routes. Fire safety guidelines and

information on how to use a fire extinguisher is posted on the EHS and Public Safety websites and included in lab safety training for faculty.

Any fire extinguisher that has been used at all, even if it wasn't fully discharged, needs to be reported to Public Safety for two reasons: the fire must be reported and a replacement fire extinguisher can be provided in place of the one used.

See the Resources Page in Appendix B for more information on fire safety and how to use a fire extinguisher.

Section 6 Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) represents one strategy that can be utilized to protect laboratory workers from potential hazards. It is the final barrier to prevent exposure to hazards if available engineering and work practice controls are not sufficient.

There are various types of PPE which are designed to protect the body from chemical hazards by creating a physical barrier to entry.

6.1 OSHA/PESH Requirements and Responsibilities:

6.1.1 Employers are required to:

- Provide appropriate PPE at no cost to their employees
- Determine what types of PPE is required for the hazards that are present
- Provisions to clean, repair, and maintain PPE
- Provide needed training.

6.1.2 Employees have a responsibility to:

- Use PPE in conjunction with engineering and work practice controls and established safety precautions.
- Use the appropriate PPE for the specific hazard and task. This is mandatory for employees per OSHA regulation. Using the wrong PPE may offer little or no protection at all. Also, more than one type of PPE may be needed at the same time.
- Know how to use and maintain PPE so that it works as intended.
- WEAR YOUR PPE whenever exposed to the hazards for which it is designed.

HVCC has developed a minimum set of standards for the use of PPE use in laboratories. Proper PPE selection is based on the individual laboratory hazard analysis which should be completed during the experiment planning process and should be included in the Standard Operating Procedures (SOP) for the lab. It is the responsibility of the Instructor to ensure that all students have available and are wearing the appropriate PPE. Lab instructors must be dressed in the same protective gear and clothing as their students, not only for their own protection, but to set a good example for their students. All PPE for instructors must be provided by the College, at no cost to the employee.

6.1.3 Minimum PPE to be worn in labs:

- Street clothing should minimize exposed skin surfaces - long sleeves shirts, long pants, closed toed shoes. *Shorts and open toed shoes are not acceptable as laboratory attire.*
- Where hazardous materials are handled the **minimum PPE** to be worn is:

    - **Skin contact***: Lab coats must* be worn as a minimum to protect arms and body. When using concentrated acids or other highly hazardous chemicals, a chemical resistant apron must be worn over the lab coat.

    - **Eye protection**: *chemical resistant goggles* must be worn when handling hazardous chemicals. (Or goggles plus a face shield as appropriate).

      Chemical Splash Goggles provide a measure of splash protection superior to safety

glasses. Chemical splash goggles that are indirectly vented, and are close fitting all around must be worn in areas where chemical manipulations that may result in splashing are being performed. Further, gas-proof goggles should be worn when working with chemicals that may be irritating to the eyes

Safety Glasses provide eye protection from moderate impact and particles associated with grinding, sawing, scaling, broken glass, etc. Safety glasses come in a variety of styles, but must have side shields to be acceptable. College employees may obtain prescription safety glasses at no cost when they are needed to fulfill job responsibilities. Contact the EHS Dept for prescription safety glasses.

Face shields provide additional protection to the eyes and face when used in combination with safety glasses or splash goggles. They should be used in operations when the entire face needs protection and should be worn to protect the eyes and face from flying particles, metal sparks, and chemical/biological splashes. Face shields must **not** be used alone and are **not** a substitute for appropriate eyewear. Face shields should always be worn in conjunction with a primary form of eye protection such as safety glasses (impact protection) or goggles (chemical protection).

- **Hand protection**: *Gloves* should be worn that are appropriate to the task and materials being used. Disposable nitrile gloves (examination 4 mil.) are appropriate for general work. If concentrated acids, bases, or other chemical with severe contact hazards are being handled, thicker 8 mil nitrile or neoprene supported gloves should be worn. These heavier gloves can be worn directly over the disposable gloves and shared by all lab workers. In the Chemistry and Biology labs, these gloves are available in the lab or from Technical Services.

6.2 Hazard Assessment

The above are the minimum PPE that should be worn. Instructors must evaluate the hazards and ensure that the PPE to be worn is appropriate for the situation.

6.2.1 Glove selection:

Care should be taken to insure that the gloves chosen for a specific application are suitable, properly fitting, and will provide adequate protection. In order to make an informed decision regarding the style and type of glove that will provide adequate protection for a given procedure, the following information must be taken into consideration:

- Specific chemical(s) to be used and their chemical properties
- Degree of chemical contact/concentration
- Dynamics of the procedure i.e. puncture hazards, thermal hazard etc.
- Amount of hand and/or arm to be protected
- Physical dexterity requirements of the procedure

See the Resources Page in Appendix B for more information regarding proper glove selection and glove types. You can also contact the EHS Department to assist you in selecting the proper type of gloves.

6.2.1 Care and Use of Gloves:

Before wearing gloves, inspect them to ensure there are no tears, holes or split seams. If damaged, replace immediately. Be aware that gloves and other protection will eventually degrade after continual exposure to chemicals. If you notice wrinkling, peeling, cracking, replace immediately.

Do not leave the work area with gloves still on!! Do not eat, drink or smoke while wearing gloves. Remove gloves as soon as your work is completed and wash your hands. Proper procedures for removal of gloves:

- Pinch the glove only just below the wrist and pull it off slowly, allowing it to turn inside out as it is pulled off
- Use the inside of the first glove to grasp the second glove and pull off slowly, allowing the glove to turn inside out as you go
- If the gloves are contaminated, place in the same container as other solid hazardous waste in the lab.
- Wash your hands

Disposable 4 mil gloves should be discarded at the end of the work shift or after any procedure where they were in direct contact hazardous chemicals. Never re-use disposable gloves. The heavier 8 mil gloves are intended for reuse. They can be rinsed under water and hung to dry. Inspect them each time before using and replace when there are any signs of deterioration.

No glove or other form of PPE will protect you from everything, and the material will degrade after continuous use – chemicals will eventually penetrate them, or they may be torn or punctured. Replace immediately when this occurs. Also be aware that wearing gloves may reduce dexterity, touch and finger movement to some degree.

6.3 Respiratory Protection:

The use of respirators to protect from inhalation hazards are not expected to be needed in the labs at HVCC. If there is a laboratory procedure where a respirator is warranted, you MUST contact the Director of EHS for a workplace assessment. Departments may purchase and use disposable N95 respirators for protection from nuisance particulate on a voluntary basis. For all other respirators needed for protection from a hazardous material, the Director of EHS will do an evaluation to determine the type of respiratory protection will be determined at that time. All use of respirators will be in accordance with the HVCC Respiratory Protection Program.

See Resources Page in Appendix B for a link to the HVCC Respiratory Protection Program.

6.4 Employee Input

Additional PPE, such as hearing protection, full body protection, foot protection, as well as other safety items may be requested by any instructor or staff member who has a need based upon SDS or lab hazard identified in the course of their duties. Employee input is welcomed and requested concerning assessments and reviews of appropriate PPE and needs based on tasks and procedures as required by department function. Contact the Department Chair and/or EHS Dept for assistance.

6.5 PPE Training

All instructors and staff must be trained in the proper use, care and selection of PPE. This training is covered in lab safety training, which is mandatory for all HVCC lab workers. See Section 8 for more information.

Section 7 Chemical Waste Disposal

Hazardous chemical waste storage and disposal is regulated by the U.S. Environmental Protection Agency (EPA) and in New York State, by the Department of Environmental Conservation (DEC). All chemical wastes are subject to inspection and enforcement actions by the EPA and the DEC

7.1 Waste Determination

The first step in properly handling chemical waste is to determine whether it must be segregated from the normal waste for disposal, based on its hazardous characteristics. *Before* disposing of any chemical waste or product by sink or trash, this waste determination must be made. Questions to answer in determining if a waste product is hazardous include:

- Is it flammable or combustible?
- Is it corrosive to other materials or skin?
- Will it undergo spontaneous chemical reaction or react violently with air or water?
- Does it present a health hazard to humans?

The SDS will aid in answering these questions. If one or more of these properties are exhibited, the Environmental Health & Safety Department must be contacted for further evaluation and a determination of the proper disposal method. When in doubt, contact EHS for assistance.

Most materials used in the labs have been assessed and a waste determination made. Materials that must be segregated from the regular trash or not disposed by sink have a waste container provided for use by lab workers.

7.2 Hazardous Waste Container Requirements

Lab workers must be aware of and handle all hazardous waste according to the following requirements:

- Each waste container must be clearly marked “Hazardous Waste” and other words that identify the contents
- Keep the containers in good condition, replace leaking ones
- Keep containers closed except when adding waste
- Inspect the containers for leaks and corrosion weekly
- Ensure the right waste is added to the container – do not mix wastes that might be incompatible
- Ensure the container material is compatible with the waste that it will contain
- Check the fullness of the container on a regular basis and contact the EHS department when ¾ full. Do not move the container from its location.
- No more than 55 gallons of hazardous waste can be stored in the work area

EXCEPTION: In Chemistry and Biology labs, Technical Services will provide all needed waste containers and move them to the hazardous waste storage area when full. Chemistry and Biology instructors are responsible for ensuring they have the needed containers, checking for fullness and making sure their students use them as appropriate. Any concerns with the above container requirements must be brought to the attention of Technical Services.

Chemistry and Biology instructors can check chemical disposal methods on line: Blackboard BCP, course documents, technical services, select the appropriate work order.

Further specific instruction for hazardous waste handling in each department's lab areas are outlined in the Departmental Best Management Practices. Go to the Resources Page in Appendix B and click on the link to view the Best Management Practices.

7.3 Other Waste Segregated for Separate Disposal or Recycling

While not considered a "hazardous" waste under State and Federal environmental laws, the following types of materials must be collected for special disposal or recycling by the college:

- Biohazardous materials
- CRTs (computer monitors and electronics)
- Scrap metal
- Used oils
- Fluorescent & other specialty bulbs, batteries, and mercury-containing articles

For a complete listing with instructions, use the Resources Page in Appendix B to link to the HVCC Recycle Guide.

Section 8 Emergency Preparedness

FOR CAMPUS EMERGENCY ASSISTANCE
DIAL 911 FROM A CAMPUS PHONE
OR 518-629-7210 FROM A CELL PHONE

8.1 College Campus Preparedness

Numerous categories of emergencies can occur: bomb threat, civil disturbance, fire, hazardous material, road closing, medical, weather, etc. The college has established a College Emergency Preparedness Plan which covers major emergency preparation. There is also basic emergency information for all staff and students available through the HVCC web page.

To link to the HVCC Emergency Preparedness Plan and other emergency information, go to the Resources Page in Appendix B.

8.1.1 SUNY Alert

Employees and students can register for this program to receive warnings of impending or ongoing emergency situations on campus. Individuals must "opt in" to receive alerts by cell phone (text or voice), telephone, email, or fax.

SUNY Alert can be accessed by following the link on the Resources Page in Appendix B.

8.1.3 Medical Emergencies

When possible an individual with a health/ first aid concern or emergency should proceed if possible to the College Health Services office. In cases where this is not possible or to obtain emergency services for another individual, call **911 from any college phone, red emergency phone, or to 518-629-7210 from any cell phone**. This call will connect to Public Safety. County EMS services will be called to respond and in the meantime, the caller can be patched through to County EMS for advice on what to do while awaiting arrival of the ambulance.

First Aid Procedures - chemical splashes to skin or eyes:

- Skin contact: remove contaminated equipment and/or clothing immediately
- Wash the affected area with soap and large amount of water for at least 15 minutes
- Eye contact: wash eyes immediately at eye wash station, occasional lifting eyelids, for at least 15 minutes
- After washing seek medical treatment follow up as instructed below

First Aid Procedures – Inhalation of chemicals:

If you are experiencing any of the following signs and symptoms related to exposure to chemical exposure:

- Irritation to the upper respiratory tract and eyes
- Tearing of eyes
- Difficulty breathing
- Burning of the nose and throat, cough
- Skin discoloration, smarting, drying, cracking and scaling
- Skin numbness, hardening or tanning (due to chronic skin exposure)
- Clouding of vision some time after a splash to the eyes

GO IMMEDIATELY TO THE HVCC HEALTH OFFICE, 2nd floor CAMPUS CENTER OR THE EMERGENCY ROOM

- If possible, bring the Safety Data sheet or information on what you believe you were exposed to.

8.3 Fire Emergencies

The college maintains and tests fire extinguishers, fire alarms and suppression systems. Fire drills are conducted three times per year. Employees should know the location of fire alarm pull stations and emergency phones. These are usually found in the hallways (egress paths) and near building exits. If an employee observes smoke or fire, they can use a fire extinguisher if it is safe to do so. First, notify others of the fire by pulling the fire alarm. If one extinguisher does not eliminate the fire, or if it is not safe to use an extinguisher, evacuate the building immediately and report details of the fire to Public Safety or other emergency responders. If an extinguisher is used under any circumstances, report this to Public Safety after the emergency is over so that the extinguisher can be serviced.

8.3.1. Evacuation Procedures

Evacuation plans are posted in classrooms and hallways, directing the occupants to the nearest evacuation routes. Follow these procedures when evacuating:

- Secure hazardous materials (e.g. close bottles) and turn off equipment, and quickly shut down any hazardous process to render them safe.
- Take your personal belongings (purse, coat, keys ,etc,)
- Faculty should direct their students out
- Close all doors (but do not lock) as you leave.
- Move away from building to allow room for others to exit.
- Provide any pertinent information to fire/security officials (someone in building, cause of fire, etc.)
- Do not reenter building unless alarm stops and you are instructed to do so.

For more information on fire safety including evacuation, follow the link listed on the Resources Page in Appendix B.

8.3.2. Foam Fire Suppression Systems

The SCI Chemical Vault and Lower Level Chemical Storeroom are equipped with a foam suppression system which will discharge automatically through sprinkler heads in the event of a fire. If the system is initiated, it will also set off the building fire alarm. Stop all work and evacuate.

8.4 Power Outages

Should you lose power while conducting lab experiments, follow these procedures:

- Assess the extent of the outage and report it to the College's Physical Plant department
- If power to the fume hoods or other safety equipment is lost, stop all work, cap chemical containers and render all hazardous processes safe.
- If daylight is not sufficient to light aisles and walkways, evacuate the area while the emergency lighting is working (power to emergency lighting will be operational for up to one hour)

8.5 Chemical Spills and Accidents

When a hazardous material is spilled, the faculty member or employee in charge in the lab will first determine if any injury has occurred and ensure the safety of the students. The identity of the spilled material and amount will be determined so as to assess whether this is a small, incidental spill that can be handled by faculty or employees in the immediate area, or whether it is a large spill, requiring outside assistance.

8.5.1 Incidental Spills

A spill is incidental if:

- The spill is a small enough quantity of a known chemical that it is not posing an acute health hazard.
- No gases or vapors are present that require respiratory protection
- It can be adequately cleaned up using the spill cleanup materials on hand
- You have the necessary personal protective equipment available.
- You understand the hazards posed by the spilled material and can follow the spill kit directions to conduct the clean up

Procedures for small, incidental spill cleanups:

- Clear the area by removing all students and employees not involved in the clean up from the area.
- Use appropriate protective equipment (chemical splash goggles, chemical resistant apron, chemical resistant gloves)
- If a flammable material is involved, remove all sources of ignition from the area
- Remove all surrounding materials that could be especially reactive with the materials involved in the spill.
- If the container is still leaking, stop the leak if possible (stopper, upright container, etc) and place it in a well-ventilated area.
- Neutralize/clean up spill by using the appropriate chemical absorption material. If necessary dike the spill to contain it first to prevent it from reaching a floor drain.
- Place all used spill material, chemical waste and debris, and used protective equipment, in plastic bag labeled “hazardous waste” provided with spill kit.
- Label the container with a Hazardous waste label, the name of the chemicals that were in the spilled material, and the date.
- Notify the Environmental Health & Safety office so that the material can be properly disposed. (Chemistry and Biology Department: notify the Technical Services Department for proper disposal)
- **If any chemical has been or is suspected to have been discharged to the sink or floor drain, contact the EHS office (7163) ASAP. Off-hours or if EHS is not available, contact Public Safety at x7210, 911 from a campus phone or 518-629-7210 from a cell phone.**

8.5.2 Large Spills

If the spill is large enough that it poses an adverse exposure hazard or is too large to be absorbed, neutralized or controlled by staff in the immediate area, then evacuate the area and contact:

Department of Public Safety 911 from a campus phone or 518-629-7210

Do not re-enter the area until it is cleared by EHS

Section 9 Information and Training

Laboratory employees are provided with information and training to ensure that they are informed of the hazards presented by the chemicals in the workplace and the steps that they should take to protect themselves from these hazards. This information and training is provided at the time of initial assignment where hazardous chemicals are present and prior to assignment involving new exposure situations.

9.1 Information Required under the Laboratory Standard

All employees covered by the Laboratory Standard are informed about and have access to the following information:

- The content of the laboratory Standard - 29CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" and its appendices.
- The location and availability of the College's Chemical Hygiene Plan.
- The hazardous chemicals used in the laboratory
- The location and availability of known reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory, such as Safety Data Sheets, other department-specific procedures and manuals and other reference materials.

9.2 Training

Training for college lab employees will be accomplished by group classroom presentations delivered by EHS or other qualified individuals, or on-line through the HVCC lab safety training program available on Blackboard.

The training includes:

- The methods and observations that may be used to detect the presence or release of a hazardous chemical (such as visual appearance, odors, monitors, continuous monitoring devices).
- The physical and health hazards of chemicals in the workplace
- The measures employees can take to protect themselves from these hazards, including specific procedures the College has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used
- Determination, collection and disposal of hazardous waste
- Applicable details of the College's Chemical Hygiene Plan.

9.3 Chemical Safety Information

In addition to training, chemical safety information will be made available to all lab workers through the use of Safety Data Sheets (SDSs), labels and signage.

9.3.1 Safety Data Sheets

Safety Data Sheets (SDSs) include information such as the properties of each chemical; the physical, health, and environmental health hazards; protective measures; and safety precautions for handling, storing, and transporting the chemical. Sections 1 through 8 contain

general information about the chemical, identification, hazards, composition, safe handling practices, and emergency control measures (e.g., firefighting). This information should be helpful to those that need to get the information quickly. Sections 9 through 11 and 16 contain other technical and scientific information, such as physical and chemical properties, stability and reactivity information, toxicological information, exposure control information, and other information including the date of preparation or last revision. Additional information on SDSs can be found in Appendix B.

Each College department maintains a listing of all chemicals used or stored in the department and their associated SDS in the online MSDSOnline database.

Instructions and links to access MSDSOnline are found on the Environmental Health & Safety website. Backup copies for emergency access are kept on flash drives by Technical Services, Public Safety, EHS and Health Services. Hard copy SDSs for the Biology, Chemistry and Physics chemicals are maintained in the SCI 200 Faculty Room by Technical Services.

Chemicals listings and SDSs are updated as changes are made and are verified annually.

9.3.2 Chemical labeling

All chemical containers received from manufacturers, suppliers or importers shall be labeled with the following information:

- Identity of the chemical
- Appropriate warning indicating hazards of the chemical.
- Name and address of the manufacture

The original container labels must not be removed, defaced, or covered over with another label. If the label becomes illegible it must be replaced with a label containing the indicated information. As long as the chemical is in its original container, no other labeling requirements are expected or required.

When the chemical is transferred into another container, it will be labeled with the chemical identity and a brief hazard statement. EXCEPTION: no labeling is necessary when the transferred chemical is intended for the immediate use of the person performing the transfer during that work shift or lab session.

Where it is not feasible to label transfer containers due to the nature of the work in the lab, the following alternatives can be used to identify chemicals:

- Signs, placards, process sheets, operating procedures (in lab manuals), or other such written materials, as long as it is clear what containers the information applies to and is readily accessible to employees in the lab.

9.3.3 Chemical Labeling in Biology Chemistry Physics labs

Technical Services ensures labeling requirements are met for the Biology Chemistry Physics Department labs, as follows:

- Portable containers into which hazardous chemicals are transferred from labeled containers are intended for immediate use of the faculty and students within a laboratory experiment.

Chemicals left in portable containers beyond this period of instruction will be labeled according to the standard (name and hazard warning). All containers that refer to a particular experiment will be labeled with the course number and the experiment involved. Portable containers used for chemistry course experiments will also be labeled with a color-coded label particular to that course.

- All containers of chemicals produced in the student laboratories that remain at the end of a lab session should be labeled. It is the responsibility of the faculty to ensure no unlabeled and/or "abandoned" containers (beakers, flasks, test tubes, etc.) remain in student laboratories when the lab session is over.
- The issue of what and when to label becomes more complicated in a laboratory where one or more substances are often combined to create stock solutions and unknowns. Since unknowns are requested and dispensed at the request of faculty for the purpose of identification by students, a code system is necessary. For unknowns, faculty members will be provided with a chemical unknown code sheet (unless unknown specifications are stated in experiment work orders) which identifies the contents of the unknown compound or solution. Unknowns will be labeled either qualitative or quantitative, with a number or code keyed to the code sheet or work order. Stock solutions will be labeled with the chemical name and concentration as appropriate. Since additional information is required other than what will appear on the label a safety data sheet is available through MSDSOnline and hard copies are maintained by Technical Services.

9.3.4 GHS Chemical Labeling

The Globally Harmonized System (GHS) for chemical classification and labeling was adopted by OSHA in 2012 and phased in during subsequent years. . It includes established criteria for classifying hazards and for further categorizing (or rating) the hazards according to their relative risks. The GHS provides established language and symbols for each hazard class and each category within a class. This language includes a signal word (such as "danger" or "warning"), a symbol or pictogram (such as a flame within a red-bordered diamond), a hazard statement (such as "causes serious eye damage"), and precautionary statements for safely using the chemical. An important part of this hazard classification system is the set of criteria that describe a given class of hazard (e.g., flammable liquids) and the ratings (categories) of the hazards within each hazard class. The hazard categories are numbered from 1 to perhaps as high as 5. The important thing to know is that the LOWER the number, the GREATER the severity of the hazard; thus, Category 1 hazards are the most dangerous.

You should be aware that this GHS numbering system is the opposite of the NFPA rating system; under the NFPA system, the most dangerous rating is 4 (see page 25), while 0 would pose a minimal hazard. NFPA diamonds are posted on doors of chemical storage areas to notify firefighters of the hazards contained in the area. NFPA ratings may also be found on old chemical containers that were shipped prior to the OSHA implementation deadline for GHS labels.

Refer to Appendix B for additional information on GHS chemical labels and a comparison of GHS and NFPA labels.

9.3. 5 Chemical waste labeling

Chemical hazardous waste containers must also be labeled at all times, with the term "hazardous waste", the hazard and the identity of all contents in the container. Waste containers must remain securely closed, except when actively adding waste and the containers must not be moved until they are

full and are being transferred to the designated waste storage area for pick up by the College's hazardous waste vendor.

9.3.5 Signage

Numerous signs are displayed throughout the labs to inform the staff of various regulations, safety notices, hazards, and practices. For example: Regulatory: RTK poster; Caution: Hazardous Waste Storage Area Notice: Authorized admittance, Spill station locations, Keep vents below clear, No food or beverages allowed, No food allowed in this refrigerator, Caution: Chemical storage, Connect ground wires before using, Acid to Water Danger: Flammable, No Smoking, No Food or Drink in Labs.

Section 10 Exposure Evaluation & Medical Consultations

10.1 Exposure Evaluation

Any complaint of odors, chemical exposure or other health/safety conditions should be brought to the attention of the EHS office. The EHS Department will further investigate and conduct any appropriate follow up air monitoring and workplace evaluations. Employees reporting the complaint and their supervisor will be kept fully informed of the evaluation and findings.

10.2 Medical Consultations

The College will provide lab employees an opportunity to receive medical attention and any necessary follow-up examinations under the following circumstances:

- An employee exhibits signs or experiences symptoms associated with exposure to a hazardous chemical in the laboratory.
- Where air monitoring reveals an employee is routinely being exposed above the Action Level, or in the absence of an Action Level, above the PEL for an OSHA regulated substance for which there is exposure monitoring or medical surveillance requirements.
- Whenever and event takes place such as a spill, leak, explosion or other accident where an employee likely encountered a hazardous exposure

The purpose of the consultation is to determine whether the employee needs a medical examination. All medical consultations and examinations and must:

- Be performed by or under the direct supervision of a licensed physician. Every effort should be made to refer employees to licensed physicians who have been trained to recognize chemical related signs and symptoms of exposure and disease.
- Be provided at *no cost* to the employee.
- Be provided without loss of pay to the employee.
- Be performed at a reasonable time and place for the employee. Every effort should be made to schedule medical consultations and examinations during the employee's regularly scheduled work hours, provided there is no undo delay in medical attention.

10.2 Information to the Physician

The physician will be provided with the following information:

- The identity of the hazardous chemical(s) to which the employee may have been exposed. Such information can be found in the SDSs for the chemical(s).
- A description of the conditions under which the exposure occurred including quantitative exposure data, if available.
- A description of the signs and symptoms of exposure that the employee is experiencing, if any.

10.3 The Physician's Written Opinion

The physician's written opinion for the consultation or examination shall include:

- The results of the medical examination and any associated tests.
- Any medical condition that may be revealed in the course of the examination, which may place the employee at increased risk as a result of exposure to a hazardous workplace.

- A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- The written opinion shall not reveal specific findings of diagnoses unrelated to the occupational exposure.

All records of medical consultations, examinations, tests, or written opinions shall be maintained at the College's Health Services Office

Section 11 Records and Recordkeeping

The College will maintain for each employee an accurate record of any air measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by the OSHA laboratory standard.

11.1 Air Monitoring Records
Air monitoring records include workplace air monitoring, biological monitoring, safety data sheets or any records that reveal the identity of a hazardous substance. Monitoring records are maintained by the EHS Department.

11.2 Chemical Inventory Records
SDSs or some other record of the identity (chemical name if known) of the substance or agent, where it was used, and when it was used is maintained for 30 years. For example, Technical Services archives "on paper" the chemical inventory lists which are provided to the EHS Department biannually.

11.3 Medical Consultation and Examination Records
The records or results of any consultation and examinations, including tests or physician medical opinions are retained by the College's Health Service Office for the duration of employment plus 30 years.

11.4 Employee Access to Records
Employees will have access to all exposure records and medical records that apply to that employee, As per 29 CFR 1910.20. If an employee or designated representative request a copy of any related exposure health record, it will be provided by the College within 15 days of the request.

Section 12 Annual Reviews of the Chemical Hygiene Plan

This plan will be reviewed annually by the College's Chemical Hygiene Officer and updated where necessary. Reviews will be documented using the form in Appendix C.

APPENDIX A

SAFETY PROGRAM FOR CHEMISTRY LABORATORIES

INTRODUCTION

Safety in the workplace is an important issue for all of us. You may already work for an employer who provides safety training, requires that certain procedures be followed, and is regulated by one or more governmental agencies. If not, most likely you will encounter the issue of workplace safety sometime during your future employment.

The Chemistry Laboratories in the college setting are a regulated workplace. You are not an employee, but your work in the laboratory is still regulated by both governmental and college policies.

You are expected to learn and follow the policies and procedures regarding safety in chemistry laboratories. This is part of the educational experience, and the penalty for failure to obey safety regulations can include not only the possibility of injury (or even death), but also failure of the course. This may seem harsh, but keep in mind that failure to follow safety procedures in the future could result in loss of employment. Now is the time to learn good work habits that you can apply in the future.

This safety program is part of every chemistry laboratory manual at the college. If you take more than one course, you will see it again. If so, read it again. This manual contains the following information on laboratory safety:

I. Key Safety Regulations
II. General Safety Policies and Procedures
III. Operation of Fume Hoods
IV. Proper Labeling, Storage and Disposal of Chemicals

PART I - KEY SAFETY REGULATIONS

Protection is important! Chemical Splash Goggles, approved by the College, must be worn by **ALL** occupants of the laboratory when hazardous materials are in use. Chemical resistant gloves and a lab coat must also be worn when handling chemicals. Proper use of protective equipment is mandated by State Law and College policy.

Goggles. These form a liquid proof seal around the eyes necessary when working with liquid chemicals. **Chemical splash goggles are required in all Chemistry Department laboratories whenever hazardous materials are in use, and whenever pressurization or partial vacuum are employed. Heating of any liquid, including water, above 60 degrees Celsius, also requires the use of goggles. Persons who do not wear goggles in the proper position, i.e. covering their eyes, will be asked to leave the laboratory.**

Gloves and lab coat. These form a barrier to prevent skin contact with chemical substances. Gloves and lab coat must be worn when handling liquid chemicals. Persons who do not wear gloves and a lab coat when necessary will be asked to leave the laboratory.

Always know what you're doing before you do it. When performing an experiment, written and

verbal instructions must be followed. No unauthorized experiments are allowed. Special safety precautions, such as the use of ventilation (fume hoods), must be followed. Chemical wastes must be disposed of properly and all accidents (e. g. significant spills, broken glass) or injuries must be reported to the instructor.

PART II - GENERAL SAFETY POLICIES AND PROCEDURES

Chemical compounds can be hazardous. Some are irritating to the skin or other body tissue. Others may have disagreeable odors and/or hazardous vapors. Many are flammable and some are explosive. Many are poisonous if ingested. Consequently all chemicals should be handled with caution, and thoughtful consideration must be given to their safe use. With due precautions, chemists have lived long and productive lives even when working continuously with or near hazardous materials. Therefore, you should understand and practice these precautions.

ANTICIPATING AN EMERGENCY

1. Learn the location of the eye-wash and emergency shower. Know how to operate the eyewash, even with your eyes closed.
2. Learn the location of, and how to use the fire blanket.
3. Learn the location of the nearest exits from the laboratory, and consider the shortest and quickest route by which to leave the building.
4. Learn the location of the emergency telephone.
5. Learn the location and operation of the fire extinguisher. Most extinguishers are dry chemical, but some are carbon dioxide. Note that extensive use of a CO_2 extinguisher on a person can cause frostbite. Extinguishers should be aimed at the base of flames.
6. Keep a cool head in accidents; panic never helps - think situations through.

PERSONAL PRECAUTIONS

1. Wear eye protection at all times in the laboratory. **Chemical splash goggles are required by state law.** You must also wear gloves and a lab coat when handling liquid chemicals. **Contact lenses** should not be worn in the laboratory. They can trap chemicals in the eye, and may be damaged by gases, vapors and fumes. If you have a medical condition that requires the wearing of contact lenses, inform your instructor, and always wear goggles.
2. Never eat, drink, or smoke in the laboratory. Furthermore, do not place objects in your mouth (e.g. pens, pencils) or wipe your eyes or face with your hands.
3. Be especially careful not to contaminate your clothing, books, or other personal belongings with chemicals. Students often carelessly place coats, textbooks, purses and other such items on laboratory benches contaminated with chemicals.
4. Never work alone; a minimum of 2 people familiar with lab safety should always be present.
5. Notify the instructor immediately in case of an accident, even if minor. (In the event the instructor is not immediately available, you can obtain assistance by using the emergency telephone located in the laboratory to notify the Public Safety Office. Public Safety can be reached at extension 7210 from a campus phone or 518-629-7163 from a cell phone.)
6. Do not wear loose, floppy clothing that might catch fire from a burner or knock over a container of chemicals. Keep long hair tied back. Never come to laboratory barefoot and do not wear open-toed shoes, sandals or high heels.

PROPER LABORATORY ATTIRE

- Prevent skin exposure by covering your skin
- Feet must be completely covered, and no skin should be showing between the top of the shoe and the bottom of the skirt or pants. As you choose your laboratory footwear, keep in mind that the shoes you wear in the laboratory should not expose the tops of your feet and should offer stability for standing and walking.
- Confine long hair, avoid wearing loose clothing, and remove scarves and jewelry.

7. Wash spilled chemicals off hands with soap and water without unnecessary delay. Do not touch your face or eyes when working with chemicals.
8. If **CLOTHES CATCH FIRE**, do not run. If the distance to a shower is considerable and flames are sizable, roll on the floor and call for a fire blanket.
9. If clothes have organic chemicals spilled on them, avoid approaching flames. Wash off chemicals that have not soaked in, or remove the clothing, flushing your skin with water. Follow with soap and water wash. Many chemicals are absorbed through the skin.
10. If chemicals spatter in your face, flush your face immediately with large volumes of water, using the eyewash station provided in the laboratory.
11. Avoid prolonged exposure to fumes and vapors. If these are present, notify your neighbors and your instructor, and move away to fresh air.
12. Always wash your hands after completing you laboratory work even if they look clean.

SAFETY AT THE LABORATORY BENCH

1. Read and understand an experiment before you begin work. Ask your instructor to explain any procedures that are not clear to you, and look or ask for information about any special hazards (e.g. "What is the flammability of this solvent?").
2. Be careful to use only chemicals and solutions designated for your course and experiment. Check labels, and if necessary check with the instructor. Information on the hazards of the chemicals you are using can be obtained from your instructor, and from Material Safety Data Sheets. These sheets are located in a yellow binder in each laboratory prep room.
3. Always keep desks and cupboard doors closed except when removing or replacing equipment. Open drawers can cause trips and falls.
4. Never perform unauthorized experiments.
5. Do not leave hazardous materials unattended while they are being heated or are reacting.
6. Never look down into a test tube or reaction flask; bumps from super-heating occur upwards. In addition, do not point container openings at your neighbors.
7. Check for cracked flasks or beakers before using them. This is important when heating.
8. Turn off gas flames as soon as you are finished with them.
9. Use ventilation hoods whenever hazardous or irritating gases, vapors or fumes are generated.
10. Do not pipet anything by mouth. Use a pipet bulb for all liquids.
11. When mixing chemicals, always follow directions. Add acid to water; never water to acid. Apply the “AAA phrase” = always add acid.
12. Never leave flammable solvents (most commonly ether, acetone, toluene, or ligroin (petroleum ether) in open containers, nor pour them near an open flame. Low boiling organic liquids are flammable (ether vapors can ignite by contact with a hot plate).
13. Use a steam bath, an oil bath, or a hot plate to heat or distill solutions of volatile solvents.
14. When refluxing or distilling solutions of organic materials, make sure all joints in the apparatus are vapor-tight.
15. Make sure sufficient water is running through condensers before refluxing or distilling.
16. Never heat a closed system (apparatus with no openings to allow gases to escape). The expansion and forced opening may splatter chemicals, and could cause a fire.

Note: Practically all vapors of organic compounds are heavier than air and tend to settle, but most compounds will mix with air enough to form potentially explosive mixtures. Some compounds (notably those with over 35% of nitrogen) are explosive when heated.

17. Fire-polish all glass tubing or rod that you use. (Fire polishing is the melting of the sharp edges of cut glass tubing using a flame). Your instructor may demonstrate this procedure.

18. Gas cylinders should be securely clamped to the laboratory bench and capped when not in use. Always use a cart when moving gas cylinders.

GOOD HOUSEKEEPING

1. Clean up any broken glass, chemical drips or leaks, or other debris. Brushes, dustpans, mops, sponges, etc. are either available in the laboratory or can be obtained from the stockroom.
2. Always weigh chemicals in a weighing bottle or other container to avoid spillage on balances.
3. Never return unused reagents to storage bottles. Ask your instructor how best to dispose of chemicals. They are usually placed in designated waste containers.
4. Replace stoppers or caps on the correct bottles.
5. Do not dip pipet into stock bottles. Pour some of the liquid into a beaker and remove the pipet aliquot from this solution.
6. Keep community areas (balances/fume hoods) clean. It is the responsibility of all students to keep these areas neat and orderly.
7. Never clean balances by blowing powders from the balance pan. If you are uncertain as to how to clean the balance consult your instructor.
8. Chemical spills should be reported to your instructor immediately. If the nature of the spill is such that additional spill clean up materials are needed, or if the spill presents a safety or health hazard, your instructor will notify Tech Services for assistance. Identify the substance spilled, approximate amount and location to Tech Services. All chemical spill clean up material will be collected for proper disposal.

PART III - OPERATION OF FUME HOODS

BASIC OPERATION:

The proper operation of fume hoods is essential to laboratory safety. Often students are aware that a fume hood should be used, but then proceed to use the hood incorrectly. The college's fume hoods are simple to operate. To use the fume hood, simply take the following steps:

1. Turn on the lights. Good illumination will reduce eyestrain.
2. Place any necessary apparatus in the hood, but do not open any chemical containers, mix anything, or heat anything until after the sash is closed.
3. Close the hood sash as low as possible to perform the work. Chemicals should not be used when the sash is open greater than 18 inches or to the stop marked on the hood.
4. Proceed to do the reaction or other process. If the experiment can be left unattended, then is acceptable to close the hood sash completely.
5. The hood has a flow meter and alarm. If the flow is insufficient, an alarm will sound. If the hood alarm sounds, close the sash if it is open and immediately tell your instructor. Hoods in the Science Center are designed as low flow hoods to ensure effective containment while minimizing energy consumption. The hoods are designed for a face velocity of 60-80 feet/minute.
6. Clean up chemical spills as soon as possible. Avoid damage to countertops and buildup of large quantities of vapors.
7. All electrical equipment connected to fume hood receptacles must be certified or approved and in good condition including electrical ground if applicable.
8. Avoid excessive heat within the fume hood. Special hood configurations are available for high heat situations.

FUME HOOD FLOW PATTERNS: It is important to not to adversely impact the air flow inside a fume hood. Please note the following:

1. The presence of the worker affects the air flow. The air flow results in a high concentration of

potential air contaminants on the inside of the lower part of the sash. For this reason the "stop" for the hood sash is set to a position that will ensure the flow rate is between 60 – 80 feet per minute.

2. When inserting and removing arms and objects into the fume hood, ensure that movement is parallel with the airflow direction. Avoid any scooping type motions. Avoid rapid removal of objects or arms from hood.
3. Set up apparatus as close to the back as possible. In no case should apparatus be closer than 6 inches (15 cm) from the door.
4. Don't block airflow. Raise large objects 2 inches (5 cm) off the counter by placing them on blocks. This allows airflow underneath and prevents stagnant areas.
5. Never store large quantities of chemicals in the fume hood. Chemical containers block airflow and create unnecessary hazards.
6. Since objects placed in the hood affect air flow, it is important not to "clutter up" a hood with extraneous items. No more than 50% of the available work surface should be covered with materials or equipment.
7. Hoods sashes should be fully closed when not in use. This conserves energy both winter and summer (when air conditioning is in use).
8. Never allow the area immediately in front of a fume hood in use to become a traffic area. Others walking by the hood face will adversely affect containment.

PART IV - PROPER LABELING AND HANDLING OF CHEMICALS

The majority of chemicals that you will use are already labeled, either by the supplier, or by Technical Services. However, you will be preparing solutions, and occasionally other materials, all of which must be labeled so that others can identify them if necessary. The dispensing and disposal of chemicals is also important, and certain procedures must be followed.

A. Temporary Labels in the Laboratory:

You will find it necessary to label containers for two reasons. First, you must be able to tell them apart. If materials are to be used only by yourself during a single laboratory period, then they need to be labeled so that you can identify their contents. In some cases, only numbers are necessary, such as when different weights or volumes of the same material are measured into separate containers. In that case your notebook or laboratory data sheet should indicate what these numbers stand for.

Second, you may save materials for the next laboratory session. In that case, the label must contain sufficient information so that someone else can identify the material. This normally means the **correct chemical name or formula**, and for solutions, **the concentration**. It is especially important to identify concentrated solutions, such as acids or bases, which may pose a real hazard if mishandled. Don't forget to place your name on the label.

B. Dispensing of Chemicals:

It is important that chemicals be dispensed in an appropriate manner. Students must **avoid spillage**, and **take only the quantities that are necessary** for the experiment.

1. Concentrated acids, ammonia, and volatile solvents must be poured in a fume hood. Be sure that the hood is operating.
2. Solutions prepared by Technical Services come in containers of different sizes. Be sure you take only the amount required. Ask if you do not know how much you need. Do not leave the drain valves on containers partially open causing leaks. Avoid waste.
3. Solids are usually weighed. This can get messy! Follow instructions for dispensing solids so as to minimize spills. If spills occur, **do not** brush the material onto the floor or blow it away. **Consult with your instructor concerning proper disposa**

C. Disposal Of Chemicals: Proper disposal of chemicals is important.

Most chemical wastes must be collected in special waste containers. There are limited exceptions, including dilute acids and bases that have been tested by the instructor and found to be in the pH range of 5.5 to 9.5. All other chemical wastes must be collected in special waste containers.

These waste containers will be provided by Technical Services and labeled by your instructor as to the type of waste (Acid, Base, Organic Solvent, Heavy Metals, etc.). Other chemical waste containers will be provided as requested by the instructor to ensure proper segregation of incompatible wastes

Each chemical shall be placed in the proper container according to Lab Waste Determinations and the directions of your instructor. All chemical contents must also be written on the container's waste label to ensure proper classification and treatment. These containers, once full or at the end of the semester, will be transferred to the Technical Services area for disposal by a hazardous waste contractor.

Do not dispose of chemicals in the trash along with paper products! Ensure that all waste containers are properly labeled and kept closed at all times when not be actively used. Take care to use the proper container for your waste. Follow the directions given by your instructor.

Waste containers in the chemistry lab are usually stored in the chemical fume hood and will look like this:

Your instructor will inform you of what waste container, if any, is needed for each experiment. As always, read the label on the waste container before adding your waste – not all chemicals are compatible with one another!

We appreciate your efforts to keep hazardous chemicalwaste out of the plumbing systems at Hudson Valley Community College. Assuring that chemical waste is collected is you doing your environmental duty!

HUDSON VALLEY COMMUNITY COLLEGE DEPARTMENT OF

CHEMISTRY

I, the undersigned, have read the **SAFETY PROGRAM FOR CHEMISTRY LABORATORIES** on the preceding six pages, and I agree to adhere to all facets of the safety program in effect. Before acknowledging here with my signature, I have resolved any questions about lab safety with my professor. I am eager for a safe semester in the chemistry lab.

PRINT NAME

SIGNATURE

DATE of ACCEPTANCE _____

APPENDIX B

RESOURCES PAGE

TOPIC	DESCRIPTION	LINK
Best Management Practices	Department guidelines for disposal of hazardous waste. Go to link and select HVCC department of interest	https://www.hvcc.edu/ehs/environmental/bmp/index.html
Biosafety Cabinets – Safe Operating Practices	CDC BSC Information	https://www.cdc.gov/biosafety/publications/bmbl5/bmbl5_appendixa.pdf
Chemical Compatibility Chart	EPA's Method of Determining the Compatibility of Hazardous Wastes	https://www.epa.gov/hwpermitting/method-determining-compatibility-hazardous-wastes
Chemical Label Pictograms	OSHA GHS Label Pictograms System	https://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html
Chemical Label Comparison	Comparison of GHS and NFPA Labels	https://www.osha.gov/Publications/OSHA3678.pdf
EHS Department	Contact the HVCC Director of EHS at 629-7163 or l.vivekanand@hvcc.edu	https://www.hvcc.edu/ehs/index.html
Emergencies	HVCC Emergency Preparedness Manual	http://www.hvcc.edu/publicsafety/emergency-prep-manual.pdf
Emergencies	HVCC emergency information for staff and students	https://www.hvcc.edu/publicsafety/emergency.html
Emergency Notification	SUNY Alert – how to be notified of emergencies on campus	https://www.hvcc.edu/nyalert/index.html
Fire Extinguishers – how to operate	Watch how to use an extinguisher properly	http://www.youtube.com/watch?v=BLjoWjCrDqg
Fire Safety Information	HVCC information related to fire prevention, what to do in an	https://www.hvcc.edu/ehs/fire/index.html

	emergency, building evacuation plans, etc.	
Glove Chemical Resistance Guide	From Ansell	https://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf
Glove Selection Guide	From Oxford University	https://www.hvcc.edu/ehs/health/glovesguide.pdf
Glove Types	Description of types of gloves and their uses	https://www.hvcc.edu/ehs/health/glove-descriptions.pdf
Recycling	HVCC guidelines on what and how to recycle on campus	https://www.hvcc.edu/ehs/recycle/index.html
Regulations – OSHA and PESH	Lab Safety Standard	http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106
Regulations – Environmental	NYS Dept. Of Environmental Conservation solid and hazardous waste regulations	http://www.dec.ny.gov/regs/2491.html
Respiratory Protection Program	HVCC respiratory protection program	https://www.hvcc.edu/ehs/health/respiratoryprotection.pdf
Safety Data Sheet Information	OSHA Safety Data Sheet Brief	https://www.osha.gov/Publications/OSHA3514.html
Safety Data Sheet Access	Accessing HVCC SDSs	https://www.hvcc.edu/secure/staff/ehs/safety-data-sheets.html
Safety Shoes and Safety Glasses	Employee voucher program	https://www.hvcc.edu/ehs/health/safety.html

APPENDIX C

Chemical Hygiene Plan Review Form

Date of review	Review Name	Title	Changes Made
January, 2010	Patty Watt	Director of EHS	
March 31, 2011	Patty Watt	Director of EHS	
July 11, 1011	Patty Watt	Director of EHS	
September 10, 2012	Laurie Vivekanand	Director of EHS	Minor formatting and corrections, no changes to technical content
September 25, 2014	Laurie Vivekanand	Director of EHS	No Changes
July 17, 2015	Laurie Vivekanand	Director of EHS	No changes
February 16, 2018	Laurie Vivekanand	Director of EHS	Added SDS access instructions. Updated Appendix B. Added student laboratory safety instructions.