

**Working Safely
with
Hazardous Materials**

A Handbook for Employees



**Environmental Health & Safety
Oregon State University, Corvallis, Oregon**

**Health & Safety
Phone Directory**

Emergency Numbers

| | |
|---------------|--------------|
| Fire | 911 |
| Ambulance | 911 |
| Police | 911 |
| Public Safety | 541-737-7000 |

Environmental Health & Safety

| | |
|-------------|---------------------|
| Main Office | 541-737-2273 |
| Manager | 541-737-2505 |
| Web Page | oregonstate.edu/ehs |

Other Numbers

| | |
|--|--------------|
| Campus Operations Work Coordination Center | 541-737-2969 |
| Human Resources | 541-737-3103 |
| Public Safety – non-emergency | 541-737-3010 |

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1. Introduction

This handbook for University employees is designed to increase awareness of hazardous materials in the work place, their potential health effects, safe work practices, and emergency procedures. It describes legislation which gives employees the “right to know” about hazardous chemicals, and shows how to use a Safety Data Sheet.

Oregon State University has employees in many different occupations. In their job, employees may work with or around potentially hazardous materials. Here are a few examples.

- Custodians use cleaning agents, bleach, and floor finishes.
- Office employees work with copying machine chemicals, cleaners, and disinfectants.
- Maintenance employees work with paints, glues, acids, cutting fluids, metals and solvents.
- Automotive mechanics can be exposed to carbon monoxide, petroleum products, solvents, and degreasers.
- Landscape personnel may apply or work in areas where pesticides have been applied. They may also use fertilizers and other agricultural chemicals.
- Food service employees use cleaning products and disinfectants.
- Photographers and graphic artists work with developers, fixatives, toners, inks, and many other chemicals.
- Laboratory employees may work with everything from viruses to radioactive materials, solvents, and rare metals.

2. The “Right to Know” Law

The purpose of Oregon’s Hazardous Communication rules (also called the RIGHT TO KNOW law) is to give both employees and employers access to important up-to-date information about thousands of regulated chemicals used in the work place.

Research laboratory workers fall under a different set of regulations (the “Lab Standard”).

Manufacturers and distributors of hazardous chemicals are required to provide a Safety Data Sheet (SDS) for each hazardous chemical or chemical product they distribute. The SDS describes the chemical, its potential health and safety hazards, and safe work procedures. Employers must make this information available to employees.

There are other occupational hazards not covered by the Right to Know law, such as biohazards and radiation. Specific campus policies are contained in the OSU Administrative Policies and Procedures manual. EH&S provides information and training on these as well.

The OSU Hazard Communication program involves a series of steps:

Identifying Hazardous Chemicals on Campus.

- Departments inventory hazardous chemicals used in each work area.
- EH&S will make sure a SDS is available for all chemicals.

Informing employees.

- Supervisors are responsible for informing employees of the hazardous chemicals present in the workplace.
- This will be accomplished (a) when an employee begins employment, or (b) when a new chemical is introduced into the workplace.

Training.

- EH&S will work with departments to provide training to employees on hazardous chemicals in their work areas.
- Training will cover health hazards, special handling precautions and disposal, personal protective equipment required, and emergency procedures to be followed for spills, fire, and first aid.

Access to SDS's

Safety Data Sheets (SDS) are widely available in electronic format. EH&S keeps a copy of all SDS received from manufacturers. Employees have access to SDS by means of:

- Web search – SDS sites must be bookmarked to meet OSHA rules.
- Requesting a specific SDS from EH&S
- EH&S website access: <http://oregonstate.edu/ehs/msds.php>
- In an emergency, contacting OSU Public Safety, who will then contact EH&S

3. What is a Hazardous Material?

A hazardous material is any substance, chemical, or mixture of chemicals which can harm the body, either at the time of exposure or later. These materials may be in the form of a solid, liquid, gas or vapor, dust, fume, or mist and may be either a physical hazard or a health hazard.

Physical Hazards

Physical hazards associated with a material run the gamut from minor injury, such as burns, to major injury, such as from an explosion. Examples of chemicals presenting a physical hazard are compressed gases, oxidizers, flammables, and unstable or reactive materials.

Health Hazards

The extent to which a substance will cause harmful health effects is called the toxicity of that substance. The degree of health hazard depends on several factors:

Chemical Makeup. Certain substances are inherently more hazardous than others because of their chemical ingredients or structure.

Amount. How much of a substance an individual is exposed to (the DOSE) affects the degree of hazard.

Type of contact. Substances can enter the body through the skin, eyes, lungs, or oral routes. Each of these routes of entry may cause a different effect.

Length of exposure. For some substances, short-term exposure may cause no effect, but long-term exposure may be harmful.

Chemical combinations. Often two or more chemicals react with each other to produce new substances, with health effect different from the original chemicals. They can be more hazardous. In some cases, the health effects of two substances in combination can be much greater than the combined effects of each chemical acting alone. This effect is called synergism.

Personal Susceptibility. Individuals may have personal traits which put them at risk. These can include diet, smoking, sensitization or allergy, and pregnancy.

Health Effects of Hazardous Chemicals

Common terms and concepts used in discussing health effects of hazardous chemicals are presented in this section. Understanding these basic principles should help with interpretation of information found on a SDS. A more complete list can be found in the glossary.

Acute and Chronic Effects

Acute effects are symptoms that show up soon after a single exposure to a chemical, and include rashes, burns, headaches, and nausea. These effects vary according to the nature and dose of a chemical. Acute effects are often reversible when exposure ceases.

Chronic effects are not seen right away, but occur later. They result from repeated, cumulative exposure over a period of time, and may take weeks, months, or even years to show up. The effects depend on the nature of the substance and the level of exposure. Examples of chronic effects are liver and kidney disease,

nerve and brain damage, and reproductive disorders. Often, chronic effects cannot be reversed even if exposure ends.

Combined acute and chronic effects are produced by some chemicals. One example is the solvent trichloroethylene. Acute effects may include dizziness, drowsiness, nausea, vomiting, and blistering of skin, while it may also cause chronic effects such as liver damage and cancer.

Latent effect is a special type of chronic effect, in which an adverse condition or disease arises many years after the original exposure to a hazardous substance. Certain cancers have latency periods of 20-40 years after exposure to a cancer-causing substance.

Local and Systemic Effects

Local effects are expressed when a chemical causes harm at its original contact point with the body, usually the skin, eyes, or lungs.

Symptoms of **skin exposure** may include: dryness and whitening; redness and swelling; rashes, blisters, and itching.

Eye exposure may result in irritation or burning.

Symptoms of **respiratory tract exposure** may include: headache, nose and throat irritation, increased mucus, dizziness, and disorientation.

Systemic effects are expressed when chemicals pass through the original point of contact with the body and cause harm to other organ systems, such as the liver, kidneys, heart, nervous system, and muscles.

The **Liver and Kidneys** are commonly affected sites when chemicals get beyond the original entry points. The liver modifies many chemicals, detoxifying many in the process. The kidneys filter impurities from blood for elimination from the body. As they perform these functions, the liver and kidneys may themselves be damaged by the chemicals.

The **Central Nervous System** is made up of the brain and spinal cord. These organs connect with thousands of nerves, extending throughout the body, which control all sensation and activity. Brain functions can be affected by a lack of oxygen, caused by inhaling certain chemicals such as solvents or carbon monoxide. The first symptoms are typically dizziness and drowsiness, which may lead to unconsciousness. Nerve function can be altered or stopped by certain chemicals which block nerve impulses, especially some pesticides and heavy metals (mercury, lead). The result may be loss of reflexes, loss of feeling, tremors, or even paralysis. These effects may be temporary or permanent.

Specific Agents

Carcinogens

Carcinogens are chemicals which are known or suspected to cause cancer. There are many human carcinogens which are subject to special regulation in Oregon, and more than 1000 other suspected carcinogens. Many mutagens are also carcinogens. EH&S can provide more information on carcinogen requirements.

Reproductive toxins

Certain materials may create reproductive hazards by affecting either the female or male reproductive system or the fetus. Reproductive effects may result from exposure to certain types of chemicals, biological agents, or ionizing radiation.

A **mutagen** is a chemical which directly affects the genetic material in human cells, causing changes in the cells called mutations. Mutagens can present two kinds of hazards: reproductive damage and cancer. Reproductive damage can affect both men and women. Exposure to a mutagen may damage or kill sperm or egg cells, which may prevent conception. If conception does occur, there may be a miscarriage or a fetus with genetic defects. Many mutagens are also carcinogens.

A **reproductive toxin** is a chemical which interferes with the reproductive system. It may, for example, prevent conception by causing menstrual problems in women, or lowered sperm count or sperm motility in men. In either, sex, it may cause decreased sex drive.

A **teratogen** is a chemical that affects the developing fetus. The fetus may be more sensitive to some chemicals than its pregnant mother, and may be exposed to chemicals through the mother's bloodstream. The

fetus may suffer damage even if the mother experiences no problems. Reducing fetal exposure to chemicals is especially important.

Biological agents cause infections that are of particular concern for pregnant women. Most of these are viral infections such as rubella (German measles), varicella (chicken pox) or human parvovirus B19.

Ionizing radiation can cause impairment of testicular and ovarian function and cause gene mutation and chromosomal damage. This damage is usually related to a high dose of ionizing radiation. Individuals who work with ionizing radiation are trained how to keep exposure as low as possible. Given proper precautions, most pregnant women can work with ionizing radiation without harm to themselves or their unborn child.

Fetal protection. All employees of childbearing age should be aware of known or suspected reproductive hazards in the work place and take necessary actions to minimize risks to themselves or their unborn child. Pregnant employees are encouraged to discuss their work environment and duties with their personal physician.

Bloodborne Pathogens

Bloodborne pathogens are micro-organisms that are present in human blood that can cause disease in humans. The two most common of these are the Human Immunodeficiency Virus and Hepatitis B Virus. Although both of these viruses are found in other body secretions and excretions, blood and semen have been shown to be the most infectious. The primary means of work place exposure is through contact with infected blood as a result of a needle stick, splash to the eyes, nose or mouth, or through existing skin cuts or lesions. The University has established a Bloodborne Pathogens Exposure Control program which has specific procedures that must be followed by employees who have a reasonably anticipated exposure resulting from the performance of their duties. As a general rule, all blood or body fluids should be considered contaminated and handling should be avoided without appropriate protective equipment.

Asbestos

Asbestos is a naturally occurring mineral that was heavily used between 1950-1970 in building products such as thermal insulation on pipes, ceiling tiles, sprayed on roofing, cement asbestos board (transite), floor tile and mastic (glue), linoleum and its backing. Buildings at OSU have been surveyed for asbestos containing material (ACM). The report is located in the EH&S Office and is available for review during working hours. OSU has developed an Asbestos Management Plan consistent with the EPA's philosophy of managing asbestos in place. The goal is to maintain ACM in good condition by using an active inspection and repair program. The plan will significantly diminish the potential hazard from inhaling asbestos fibers. You can help:

- DO NOT hang items from any insulation or ceiling tiles
- DO NOT store items on top of any insulated pipes
- DO NOT disturb or damage ACM while moving or transporting items
- DO NOT drill, cut or perforate ACM
- DO NOT use brooms, dry brushes, or standard vacuums in the vicinity of damaged asbestos-insulated pipe.
- DO call Campus operations Work Coordination Center about any damaged areas.

Radioactive Materials

Radioactive materials are used extensively in OSU laboratories. Exposure to high levels of ionizing radiation has been shown to increase the risk of cancer and reproductive effects. Prior to working with or in the near vicinity of radioactive material, employees must receive additional training. Contact EH&S for more information.

4. Safety Data Sheets

A Safety Data Sheet (SDS) is intended to provide important information about chemical products and their ingredients. For definitions of terms commonly used on an SDS, see Glossary.

The Globally Harmonized System (GHS) SDS format, shown here, is the international standard. It has sixteen sections. Here's what they tell you:

Section 1 Identification of the substance or mixture and of the supplier

- GHS product identifier
- Other means of identification
- Recommended use of the chemical and restrictions on use
- Supplier's details (including name, address, phone number, etc.)
- Emergency phone number

Section 2 Hazards identification

- GHS classification of the substance/mixture and any national or regional information
- GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones)
- Other hazards which do not result in classification (e.g., dust explosion hazard) or are not covered by the GHS

Section 3 Composition/information on ingredients

- Substance
 - Chemical identity
 - Common name, synonyms, etc.
 - CAS number, EC number, etc.
 - Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance
- Mixture
 - The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present above their cutoff levels

Section 4 First-aid measures

- Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion
- Most important symptoms/effects, acute and delayed
- Indication of immediate medical attention and special treatment needed, if necessary

Section 5 Firefighting measures

- Suitable (and unsuitable) extinguishing media
- Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products)
- Special protective equipment and precautions for firefighters

Section 6 Accidental release measures

- Personal precautions, protective equipment and emergency procedures
- Environmental precautions
- Methods and materials for containment and cleaning up

Section 7 Handling and storage

- Precautions for safe handling
- Conditions for safe storage, including any incompatibilities

Section 8 Exposure controls/personal protection

- Control parameters, e.g., occupational exposure limit values or biological limit values
- Appropriate engineering controls
- Individual protection measures, such as personal protective equipment

Section 9 Physical and chemical properties

- Appearance (physical state, color, etc.)
- Odor & odor threshold
- pH.
- Melting point/freezing point, initial boiling point and boiling range
- Flash point, flammability (solid, gas), evaporation rate
- Upper/lower flammability or explosive limits
- Vapor pressure & density, relative density
- Solubility, partition coefficient: n-octanol/water
- Auto-ignition & decomposition temperature

Section 10 Stability and reactivity

- Chemical stability
- Possibility of hazardous reactions
- Conditions to avoid (e.g., static discharge, shock or vibration)
- Incompatible materials
- Hazardous decomposition products

Section 11 Toxicological Information

- Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including:
 - Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact)
 - Symptoms related to the physical, chemical and toxicological characteristics
 - Delayed and immediate effects and also chronic effects from short- and long-term exposure
 - Numerical measures of toxicity (such as acute toxicity estimates)

Section 12 Ecological information

- Ecotoxicity (aquatic and terrestrial, where available)
- Persistence and degradability
- Bioaccumulative potential
- Mobility in soil
- Other adverse effects.

Section 13 Disposal considerations

- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.

Section 14 Transport information

- UN Number
- UN Proper shipping name
- Transport Hazard class(es)
- Packing group, if applicable
- Marine pollutant (Yes/No)
- Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises

Section 15 Regulatory information

- Safety, health and environmental regulations specific for the product in question.

Section 16 Other information including information on preparation and revision of the SDS

5. Chemical Information

Common Types of Hazardous Chemicals

Three common types of hazardous chemicals used in OSU workspaces are organic solvents, corrosives, and compressed gases. These chemicals can be used safely when their effects are understood and proper precautions are taken. The adverse health effects described usually result from overexposure, when chemicals are not handled properly, or when protective equipment or other controls are not used. Proper procedures for handling, storage, and disposal of these and other types of hazardous chemicals are described in Section 6.

Organic Solvents

Organic solvents are the most common industrial chemicals. They are found in almost all workplaces. Solvents are present in paints, lacquers, varnishes, paint removers, adhesives, pesticides, plastics, textiles, rubber products, and floor finishes. They are used to dissolve oils, greases, and resins. They have many other uses in laboratories.

All organic solvents can cause skin problems. Repeated skin contact with a solvent can cause the skin's protective fats and oils to dissolve, resulting in reddening, itching, blistering, and pain. Exposure to solvent vapors can irritate the respiratory tract and mucous membranes. Inhalation can cause dizziness, drowsiness,

headache, lack of coordination, and nausea. Overexposure for a prolonged period may result in damage to the liver, kidneys, lungs, blood, nervous system, and other organs.

Many organic solvents are flammable. Some can produce an explosive atmosphere. Some can react with heat or other substances to create different hazardous chemicals.

Corrosives

Corrosives (acids and bases) are also very common. They may be either liquid or solid and are found in laboratories and in cleaning agents used on metal, clothing, dishes, and drains.

Corrosives can seriously harm body tissue on contact. They can cause dermatitis and eye damage. Exposure to vapors or mists can affect the respiratory tract and mucous membranes. Ingestion can damage the throat and stomach, and may be fatal. Corrosives are not flammable, but some can react with each other and with other chemicals to produce heat, fire or explosion.

Compressed Gases

Compressed gases are found in many university workplaces, including laboratories, maintenance areas, and service areas. Many of these gases are flammable, corrosive, or toxic. There is also the danger of a powerful propellant effect, sufficient to drive the cylinder through a wall, if the pressurized gas within a cylinder should suddenly escape.

Hazardous Chemicals Resource Information

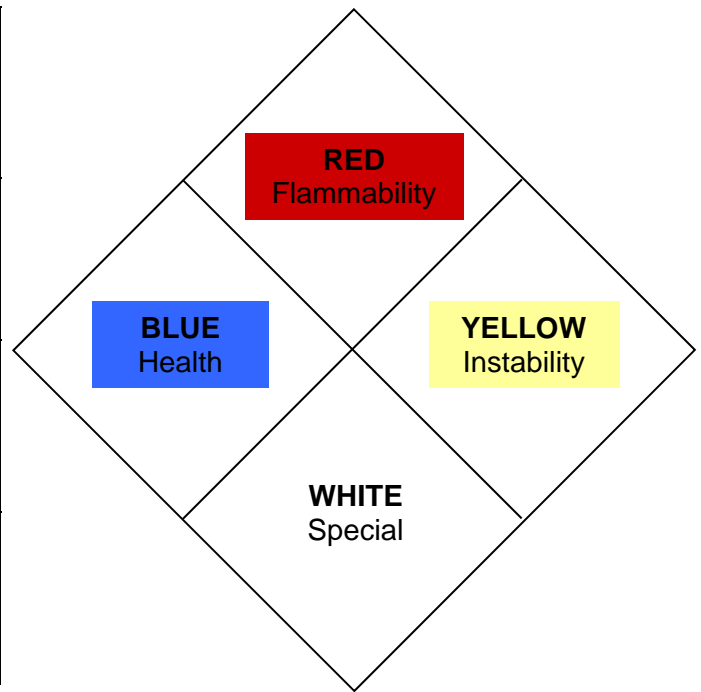
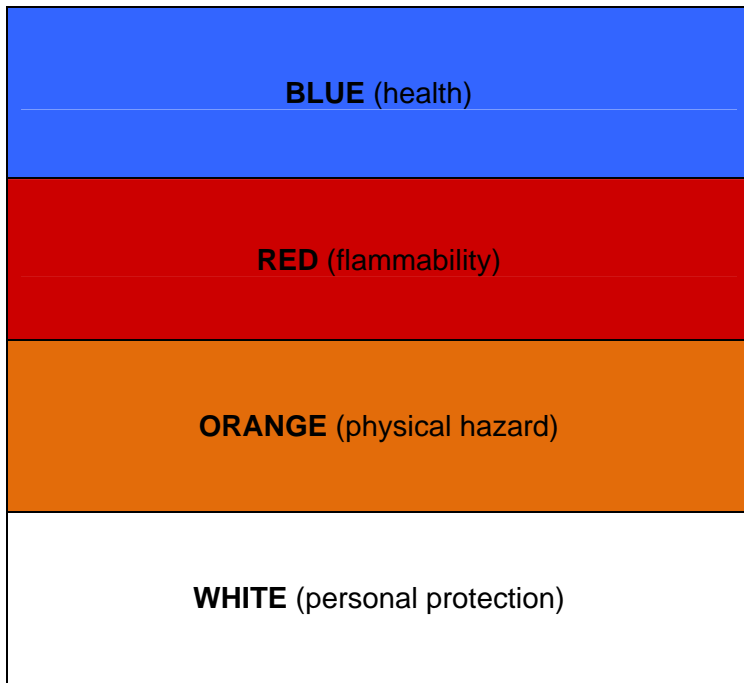
- Check with your supervisor for the correct way to handle any chemical you use.
- Contact EH&S for the most up-to-date information about a specific chemical.
- Check EH&S website for safety instruction on chemical use.
- Check reference books and resources.

Hazard Information Labels – NFPA/HMIS

Many chemical suppliers use systems originally developed by the National Fire Protection Association (NFPA) or American Coatings Association (HMIS) to label the relative hazard of materials. The systems use a combination of colors and numbers to rate the hazard of a material in a way that is easily interpreted. The original NFPA system is arranged as four squares mounted inside a larger square-on-point. HMIS labels are typically four colored rectangles drawn in a vertical pattern.

The system provides information on the **health, flammability, instability/physical hazard, and special hazard/personal protection** of materials and indicates the severity of each hazard by use of a numerical ranking of 0 (no hazard) to 4 (extreme hazard). The numerical NFPA system is based on chemical hazards in a **fire situation**. The HMIS system numbers are based on **normal use conditions**.

These label systems can be used to transfer hazard information from original manufacturer labels to secondary containers.



Blue – Health Hazard

- 4 **Deadly:** Very short exposure may cause death or major residual injury even though prompt medical treatment is given.
- 3 **Extreme Danger:** Short exposure may cause serious injury. Do not expose any body surface to this material.
- 2 **Dangerous:** Exposure may be hazardous to health. Protective measures are indicated.
- 1 **Slight Hazard:** Exposure may cause irritation or minor injury.
- 0 **No Hazard:** Exposure offers no significant risk to health.

RED – Flammability Hazard

- 4 **Flash Point (FP) below 73° F:** Materials are very flammable, volatile or explosive depending on state; will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature.
- 3 **FP below 100° F:** Liquids or solids that are flammable, volatile or explosive under almost all normal temperature conditions.
- 2 **FP below 200° F:** Moderately heated conditions may ignite these substances.
- 1 **FP above 200° F:** Materials must be preheated to ignite; most combustible solids are in this category.
- 0 **Material will not burn.**

NFPA YELLOW – Instability/Reactivity Hazard


- 4 **May Detonate:** Substances readily capable of detonation or explosion at normal temperatures and pressures.
- 3 **Explosive:** Substances readily capable of detonation or explosion by a strong initiating source, such as heat, shock or water.
- 2 **Unstable:** Violent chemical changes possible at normal or elevated temperatures and pressures. Potentially violent or explosive reactions may occur when mixed with water.
- 1 **Normally Stable:** Substances may become unstable at elevated temperatures and pressures or when mixed with water.
- 0 **Stable:** Substances remain stable when exposed to heat, pressure, or water.

HMIS ORANGE – Physical Hazard























- 4 **Readily capable** of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure

- 3 **May form explosive mixtures** with water; capable of detonation or explosive reaction in the presence of a strong initiating source. May polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion
- 2 **Unstable** and may undergo violent chemical changes at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air
- 1 **Normally stable**; can become unstable (self-react) at high temperatures and pressures. May react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.
- 0 **Normally stable, even under fire conditions**; will not react with water, polymerize, decompose, condense, or self-react.

NFPA WHITE – Special Hazard

- W** = water reactive (refer to reactivity)
- OX** = oxidizer
- COR** = corrosive
- ACD** = acid
- ALK** = alkali
-  = radioactive

HMIS WHITE – personal protection

| HAZARDOUS MATERIALS IDENTIFICATION SYSTEM | | | |
|---|--|---|---|
| HAZARD INDEX | | PERSONAL PROTECTION INDEX | |
| 4 = SEVERE HAZARD | An asterisk(*) or other designation corresponds to additional information on a data sheet or separate chronic effects notification | A  | |
| 3 = SERIOUS HAZARD | | B  | |
| 2 = MODERATE HAZARD | | C  | |
| 1 = SLIGHT HAZARD | | D  | |
| 0 = MINIMAL HAZARD | | E  | |
| Additional Information | | F  | |
| PERSONAL PROTECTION EQUIPMENT | | | |
| A  Safety Glasses | n  Synthetic Goggles | o  Face Shield & Eye Protection | p  Goggles |
| q  Boots | r  Synthetic Apron | s  Full Suit | t  Ear Respirator |
| u  Vapor Respirator | w  Chem. & Vapor Respirator | y  Full Face Respirator | z  Airline Hood or Mask |
| | | G  | H  |
| | | I  | J  |
| | | K  | X Consult your supervisor or S.O.P. for "SPECIAL" handling directions |

Hazard Information Labels – GHS

The international system known as GHS is replacing all other systems used by manufacturers. Employees should be trained to recognize the new format and be aware of the meaning of the pictograms

Hazard Class –categories of hazard; examples include:

- Oxidizer
- Corrosive
- Flammables
- Carcinogen
- Irritant
- Acute toxicity (severe)
- Acute toxicity (harmful)
- Mutagen

Signal words – Used to denote the relative degree of hazard severity










- **Danger** for more severe hazards
- **Warning** for less severe hazards

Category – Numeric value also used to denote relative hazard within hazard classes. Five categories are used, ranging from 1 (highest hazard) to 5 (lowest hazard)

Hazard Statements – Standard phrases assigned to a hazard class and category that describe the nature of the hazard. Example statements for acute oral toxicity hazard classes are:

- Fatal if swallowed (category 1 & 2)
- Toxic if swallowed (category 3)
- Harmful if swallowed (category 4)
- May be harmful if swallowed (category 5)

Pictograms and related hazard classes:

| GHS Pictograms and Hazard Classes | | |
|---|---|--|
|  |  |  |
| <ul style="list-style-type: none"> • Oxidizer | <ul style="list-style-type: none"> • Flammables • Self-Reactive • Pyrophoric • Self-Heating • Emits Flammable Gas • Organic Peroxides | <ul style="list-style-type: none"> • Explosives • Self-Reactive • Organic Peroxides |
|  |  |  |
| <ul style="list-style-type: none"> • Acute toxicity (severe) | <ul style="list-style-type: none"> • Corrosives | <ul style="list-style-type: none"> • Gas Under Pressure |
|  |  |  |
| <ul style="list-style-type: none"> • Carcinogen • Respiratory Sensitizer • Reproductive Toxicity • Target Organ Toxicity • Mutagenicity • Aspiration Toxicity | <ul style="list-style-type: none"> • Environmental Toxicity | <ul style="list-style-type: none"> • Irritant • Dermal Sensitizer • Acute toxicity (harmful) • Narcotic Effects • Respiratory Tract • Irritation |

6. Chemical Handling, Storage, and Disposal

Chemical Handling

1. Know what you are working with and how to use it safely. Ask yourself these questions before using a chemical:
 - Is it dangerous to inhale?
 - Is skin contact dangerous?
 - Is it flammable?
 - Is it reactive?
 - What is recommended to handle it safely?
 - Is a fume hood, other engineering controls, or protective equipment needed?
 - Get the answer to these questions from the container label, SDS, your supervisor, or EH&S
2. Use the right protective clothing and equipment for the job.
 - Protective clothing and equipment includes eye protection (safety glasses, goggles, face shield); gloves to protect the hands; safety shoes; impermeable suits; and various types of respirators.
 - Contact your supervisor or EH&S if you have questions about what is required.
3. Prevent ingestion of chemicals.
 - Wash your hands thoroughly before eating or smoking.
 - Do not carry food or cigarettes into an area where chemicals are present.
 - Never smoke or eat around chemical use areas.
 - Never store food or cigarettes near chemicals. They can be contaminated by fumes or vapors, or hands can be contaminated and then cross-contaminate food or cigarettes.
4. Keep the workplace clean and uncluttered. Follow good housekeeping practices.
5. Be aware of warning signs, which may read “Caution”, “Danger”, “Restricted Area”, “Do Not Enter”, “Hearing Protection Required”, or “Eye Protection Required”. If it is unclear what a sign means, ask for clarification.

Know what to do in an emergency. (Section 7.)

Personal Protective Equipment

Personal protective equipment (PPE) for employees is necessary in compliance with state safety laws. The general rule is that PPE is required when there is a reasonable probability that injury can be prevented by such equipment. In cases where PPE is required, the cost of the equipment is considered a departmental expense.

Full-time or part-time OSU employees who require eye protection in their job activities may participate in the OSU Safety Glasses Program. The program provides for procurement of safety glasses at a reduced cost to the employing department. OSU employees can also participate in the Safety Shoe Program.

Another type of PPE available through EH&S is respirators. Respirator use requires participation in the respiratory protection program.

EH&S can also recommend PPE based on protection against specific chemicals.

Chemical Storage Guidelines

1. **Know** what chemicals you have and what their hazards are.
2. **Label** ALL chemical containers and storage areas, including waste containers. Containers must be labeled with chemical name, and major hazard(s), and should be labeled with the owner’s name and

date. Storage areas should be clearly marked with hazard classifications (e.g., acids, flammable, inorganic).

3. **Separate** chemicals according to their hazard class. Do not arrange them alphabetically, except within hazard classes. Separate flammables from oxidizers, corrosives, and toxics; separate acids and bases. Some materials may react dangerously with each other if they are stored together. For example, acids stored near metal dust can produce hydrogen gas.
4. **General guidelines:**
 - Use secondary containment for liquids.
 - Shelving should be sturdy and secured to a wall.
 - Storage areas and cabinets should be ventilated when feasible.
 - Store chemicals away from direct sunlight and heat. Some chemicals are light or heat sensitive and may breakdown into other chemicals, build up pressure in containers, or pose a fire hazard.
 - Protect chemicals from movement during seismic activity by providing a lip on shelving.
 - Date all chemical containers when received. Some chemicals, such as ethers, become unstable 3-6 months after opening, and may become explosive.
 - Never store flammables near any potential source of ignition (spark or flame).
 - Don't smoke in areas where chemicals are stored.
5. **Solvent storage** areas should be clean and well ventilated. Drums should always be stored upright in a cool, dry place away from direct sunlight and heat sources. Bottles and cans should be kept in fireproof storage cabinets. Make sure metal solvent containers are grounded when transferring flammable solvents. Don't use gravity feed when dispensing solvents from drums, because failure of valves will cause a solvent to spill.
6. **Corrosives** (acids and bases) should be stored separately. Storage areas should be clean and well ventilated. Acid drums and carboys should be stored in a cool, dry place away from direct sunlight and heat sources. Store below eye level. Always use secondary containment. Acids and bases in dry form should be kept in airtight containers.
7. **Compressed gas** cylinders must be secured by chain, rack or other means to prevent falling or rolling. Valve protection caps should be securely in place when the cylinder is not in use. Store away from direct sunlight and heat sources. Full and empty cylinders should be separated and clearly marked. Separate cylinders based on hazard class.
8. **Other chemicals.** EH&S can advise on storage of other types of chemicals and on special situations.

Chemical Disposal

OSU recognizes the importance of protecting the environment, along with protecting the health and safety of faculty, staff and students. It is OSU policy to reduce the use of toxic materials in University operations whenever reasonably possible and to reduce the amount of hazardous waste generated.

Disposal of hazardous materials should be considered only after attempts to recycle, recover or otherwise reuse the material. It is the responsibility of each employee to handle and dispose of hazardous material in a manner that is in accordance with the guidelines established by EH&S. These guidelines have been developed so that hazardous waste disposal at OSU will be in compliance with state and federal regulations and in an environmentally sound manner.

1. All chemical waste must be properly prepared and labeled before EH&S can pick it up for disposal. Special guidelines are available from the EH&S web site.
2. Contact EH&S for advice and assistance on all questions regarding chemical waste disposal or to request removal of hazardous waste.
3. Do not pour potentially hazardous materials down the drain or toilet, even if they have been diluted. Never put them in regular trash containers or dumpsters.
4. EH&S must perform an official hazardous waste determination for all chemical waste that is disposed by OSU.
5. Discarded or broken glass can cause cuts and punctures, and may also be contaminated. Dispose of non-contaminated glass by packaging in impervious containers and placing in building trash dumpsters.

6. Needles and syringes (plastic or glass) must be incinerated as bio-hazardous waste; call EH&S to arrange disposal.
7. If any of your clothing (either street clothes or protective clothing) becomes contaminated, do not launder it with other clothing. Consult the SDS and launder it separately or dispose of it entirely.
8. Call EH&S to arrange clean-up of all chemical spills.
9. Call Campus Operations for clean-up and repair of leaking fluorescent ballasts, which may contain PCB's. For advice on PCB hazards, contact EH&S.

7. Emergencies and First Aid.

Chemical Emergencies

Responding quickly is important. Always be ready for an emergency:

- Know the location of the nearest emergency and first aid equipment, including eye washes, emergency showers, fire alarms and fire extinguishers.
- Be aware of those employees in your workplace or nearby who have special emergency training or skills.
- Know emergency phone numbers and the location of medical help. Post this information in the workplace.
- Be able to tell emergency personnel the exact name of the chemical(s) involved.

Fire. Never try to put out a fire unless you know what substance is involved and how to extinguish that type of fire, you know that you can safely put it out, you have already called for assistance, and you have been trained in fire extinguisher use. Remember that some materials become toxic when they burn. Evacuate the area and get help.

Unconsciousness. Call 911 for help. Before entering an area to help an unconscious person, make sure that you will not be in danger from hazardous fumes or inadequate oxygen. Respirators and lifelines may be needed but should only be used by individuals previously trained. Many respirators only provide protection against certain hazardous substances, and may not be adequate for all situations.

If you are able to enter the area remove the victim to fresh air immediately. Provide adequate first aid if trained while waiting for medical personnel. If the victim's eyes or skin are contaminated, flush with running water. Remove any contaminated clothing.

Fumes. If you work with chemicals, be aware of warning symptoms of overexposure to hazardous fumes. Get fresh air immediately if you sense a burning or irritation in your nose, throat, or lungs; have difficulty breathing; feel weak, dizzy or nauseous; or notice a strong odor. Close containers; open windows; turn on hoods or other ventilation. If these measures don't help, leave the area.

Eye Contact. Flush your eye immediately with running water. Use an emergency shower or any other available source of water – eye wash, sink, fountain or hose. Hold your eyelids apart and roll your eyeballs. Do not use ointments or salves, which may be dangerous. Continue flushing for at least 15 minutes. Get immediate medical attention.

Skin Contact. Drench your clothing and skin thoroughly with plenty of water. Use any available source of water – even a faucet, fountain or hose. Remove contaminated clothing while drenching it and continue to flush skin with water for at least 15 minutes. Get medical attention.

Spills. If there is a leak or spill, keep away from it unless you know what it is and how to clean it up safely. Don't try to deal with any large spills of hazardous material yourself - get help. In the case of a large solvent or corrosive spill evacuate the immediate area but don't leave the material unattended. If solvents are involved, remove sources of ignition. Don't flush a spill with water in case it might be a substance which reacts with water. EH&S has proper protective gear and disposal equipment and will assist in the clean-up of all spills.

First Aid and Emergency Medical Care - Campus

Determine the extent of a person's injury by checking airway, breathing, and signs of circulation. Other life-threatening conditions include unconsciousness, trouble breathing, persistent chest pain, severe bleeding, severe burns, persistent pain in the abdomen, vomiting blood, seizure, injury to the head, neck, or back, poisoning, and shock.

First aid or CPR should only be administered by trained individuals. Many employees have received this training. Departments should contact EH&S about obtaining adequate first aid equipment or training.

If the seriously injured person is:

- **Unconscious or has other life-threatening conditions** – call 911 and provide care until emergency personnel arrive and take over.
- **Conscious and NON Life-threatening** – Care for the conditions found. For students, arrange for transportation to Student Health Services (SHS), during open hours, by calling Public Safety. For others, or when SHS is closed, arrange for transport to personal physicians, medical clinic immediate care facilities, or the local hospital, as desired by the injured or ill person.
- Employees should notify their supervisors if possible before leaving their job site.

Contact Human resources for more information on the Workers Compensation Program.

8. Glossary.

Listed below are many common terms used on a Materials Safety Data Sheet or in other reference materials about toxic chemicals.

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| ACGIH | American Conference of Governmental Industrial Hygienists, a professional society which recommends exposure limits (TLVs) for toxic substances. |
| Acid | A substance which dissolves in water or certain other solvents, and releases hydrogen ions. For example, hydrogen chloride in solution is an acid, also referred to as hydrochloric acid. (See pH.) |
| Acute | Acute exposures and acute effects involve short-term exposures to high concentrations and show immediate results of some kind (illness, irritation, or death). Acute exposures are usually related to an accident. They typically are sudden and severe, and are characterized by rapid absorption of the material. The effect of a chemical is considered acute when it appears with little time lag, such as within minutes or hours. |
| Alkaline | Same as Basic. Having the ability to neutralize an acid and form a salt. Such a substance is called an alkali. (Also see Caustic and pH.) |
| ANSI | American National Standards Institute, a private organization that recommends work practices and engineering designs pertaining to safety and health. |
| Asphyxiant | A vapor or gas that can cause loss of consciousness and death due to lack of oxygen. |
| Asthma | Constriction of the conducting airways (bronchial tubes) in the lungs in response to irritation, allergy, or other stimulus. |
| Basic | See Alkaline. |
| Boiling Point | The temperature at which a liquid boils and changes rapidly to a vapor state at a given pressure. Often expressed in degrees at sea level pressure. |
| Carcinogen | A chemical or physical agent capable of causing cancer. Such an agent is often described as carcinogenic. |
| CAS | The Chemical Abstracts Service Registry Number (CASRN) is a numeric designation which uniquely identifies a specific chemical compound. This number may appear on the SDS, reference books, and chemical catalogs. |
| Caustic | Something that strongly irritates, corrodes, or destroys living tissue. (See Alkaline). |
| Ceiling Limit | The maximum concentration of a material in air that should never be exceeded, even momentarily. (See PEL and TLV.) |
| Cell | The structured unit of which tissues are made. There are many types (e.g., nerve cells, muscle cells, blood cells), with each type performing a special function. |

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| Chemical family | A group of single elements or compounds with a common general name, such as "Ketones". |
| Chronic effect | An adverse effect with symptoms which develop slowly over a period of time, or which recur frequently. |
| Circulatory system | The heart and blood vessels. |
| Combustible | Able to catch fire and burn. Also used to describe a class of materials with a flash point above 100 degrees F (37.8 degrees C). (See Flammable.) |
| Concentration | The relative amount of one substance mixed into another substance. |
| Corrosive | A liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact. |
| Cubic centimeter (cc) | A metric unit of volume. One cc is equal to one milliliter (ml) in most instances. |
| Cubic meter | A metric unit of volume. One cubic meter equals 35.3 cubic feet or 1.3 cubic yards. One cubic meter also equals 1000 liters or one million cubic centimeters. |
| Decomposition | Breakdown of a chemical (by heat, chemical reaction, etc.) into simpler parts, compounds, or elements. |
| Dermal | Pertaining to the skin. |
| Dose | The amount of chemical absorbed in a unit mass of tissue or in the whole body. Usually expressed in milligrams per kilogram (mg/kg). |
| Duration | The length of time you are exposed to a substance. |
| Edema | A swelling of body tissues due to water or fluid accumulation. |
| Evaporation | The process by which a liquid is changed into a vapor state and mixed into the surrounding air. |
| Evaporation rate | The ratio of the time required to evaporate a measured volume of a liquid chemical to the time required to evaporate the same volume of a reference liquid. In general, the higher the ratio, the lower the boiling point. |
| Excursion Limit | The maximum concentration allowed over a short time period (usually 5 to 30 minutes). It's magnitude is above the 8-hour allowable limit. (see PEL.) |
| Flammable | Catches on fire easily and burns rapidly, with a flash point below 100 degrees F (37.8 degrees C). |
| Flash Point | The lowest temperature at which a liquid gives off enough flammable vapor to ignite and produce a flame when an ignition source is present. |
| GHS | Globally Harmonized System; internationally agreed-upon scheme, created by the United Nations, for classification and labeling of chemicals. |
| Gram (g) | A metric unit of mass. One US ounce equals 28.4 grams; one US pound equals 454 grams. |
| Hazard | The probability that a person will be harmed due to working with a toxic substance under given conditions of use. "Hazard" is also used to refer to a dangerous agent, as in being exposed to a health hazard (example: benzene) or a physical hazard (example: heat). |
| IDLH | Immediately Dangerous to Life or Health. A term used to describe certain very hazardous environments, usually with high concentrations of toxic chemicals, insufficient oxygen, or both. |
| Ignition temperature | The lowest temperature at which a substance will catch on fire and continue to burn. |
| Incompatibles | Materials which could cause dangerous reactions from direct contact with one another |
| Inflammable | Same as Flammable. |
| Ingestion | Taking in a substance through the mouth. |
| Inhalation | Breathing in a substance. |
| Irritant | A substance which can cause an inflammatory response or reaction of the eye, skin, or respiratory system. |
| Kilogram (kg) | A metric unit of mass. Equals 1000 grams or about 2.2 pounds. |
| Latency | The time between exposure and the first manifestation of health damage. |
| Latent effect | An effect which occurs a considerable time after exposure to a toxic substance. |

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| Lethal Concentration | A concentration of chemical in air that will kill a test animal inhaling it. |
| LD50 (Lethal Dose-50%) | The dose of a chemical that will kill 50% of the test animals receiving it. The chemical may be given by mouth (oral), applied to the skin (dermal), or injected (parenteral). A given chemical will generally show different LD50 values depending on the route of administration. |
| Liter | A metric unit of volume. One US quart is about 0.9 liters. One liter equals 1000 cubic centimeters. |
| Local effect | An effect which a toxic substance causes at its original contact point with the body, e.g., eye damage. |
| Local exhaust ventilation | A system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (as in welding, grinding, sanding, laboratory experiments, etc.). |
| Melting Point | The temperature at which a solid substance changes to the liquid state. |
| Milligram (mg) | The metric unit of mass. One gram equals 1000 mg. One US ounce equals 28,400 mg. |
| Milligrams per cubic meter (mg/m³) | A measure of concentration, often used to express PEL's and TLV'S. |
| mm Hg | Millimeters (mm) of the metal mercury (Hg). A unit of measurement for pressure. At sea level, the earth's atmosphere exerts 760 mmHg of pressure. |
| MSHA | Mine Safety and Health Administration, an agency in the US Dept. of Labor which regulates safety and health in the mining industry. Also tests and certifies respirators. (See NIOSH). |
| Mutagen | A chemical or physical agent that affects the genetic material in cells in such a way that it may cause an undesirable mutation to occur in some later generation. Such agents are called mutagenic. Many mutagens are also carcinogens. |
| Nervous system | The nerves, brain, and associated mechanisms in the body which control its processes. |
| NFPA | National Fire Protection Association. NFPA has developed a scale for rating the severity of fire, reactivity, and health hazards. References to these ratings frequently appear on SDS's. |
| NIOSH | National Institute for Occupational Safety and Health. NIOSH is a federal agency which conducts research on occupational safety and health questions and recommends new standards to federal OSHA. NIOSH, along with MSHA, tests and certifies respirators. |
| Oral | Pertaining to the mouth. |
| OSHA | Occupational Safety and Health Administration, an agency in the US Dept. of Labor, which regulates safety and health conditions in most of the nation's private sector workplaces. |
| Oxidation | A reaction in which oxygen combines with a substance. (See Reduction). |
| Oxidizing Agent | A substance which brings about an oxidation reaction. |
| Oxygen Deficiency | An atmosphere having less than the normal oxygen content of air, which is 21% oxygen (volume-by-volume). When the oxygen concentration in air falls to 16%, many people become dizzy, experience a buzzing in the ears, and have a rapid heartbeat. |
| PEL | Permissible Exposure Limit. For federal purposes, PEL's refer to three different types of exposure limits: a ceiling limit, an excursion limit, and an eight-hour time weighted average (TWA) limit. These have the force of law. |
| pH | A unit for expressing how acidic or how alkaline a solution or chemical is, on a scale of 1 to 14. A pH of 1 indicates a strongly acidic solution; pH indicates a neutral solution; and pH 14 indicates a strongly alkaline solution. |
| Polymerization | A chemical reaction in which small molecules combine to form much larger molecules. A hazardous polymerization is a reaction that occurs at a fast rate, releasing large amounts of energy. |
| ppm | Parts per million. A measure of concentration. (Usually parts of a substance per million parts of air.) PEL's and TLV's are often expressed in ppm. |
| psi | Pounds per square inch. A unit of pressure. At sea level, the earth's atmosphere exerts 14.7 psi. |
| Reaction | A chemical transformation or change. |

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| Reactivity | The ability of a substance to undergo a chemical reaction such as combining with another substance. |
| Reducing Agent | A substance which brings about a reduction reaction |
| Reduction | A reaction in which oxygen is lost from a substance, or a chemical change in which an atom gains one or more electrons. A reduction reaction always occurs simultaneously with an oxidation reaction. One substance is oxidized while the other is reduced. |
| Reproductive toxin | A chemical which can interfere with the reproductive system. |
| Respirator | A device worn to protect against inhalation of hazardous substances. |
| Respiratory system | The breathing system. Includes lungs, air passages, larynx, mouth, nose, and the associated nerves and blood vessels. |
| Route of entry | The means by which a hazardous substance enters the body. Common routes are skin contact, eye contact, inhalation, and ingestion. |
| SDS | Safety Data Sheet. A form listing the properties and hazards of a hazardous substance. |
| Sensitizer | A substance which on first exposure causes little or no reaction in a person, but which on repeated exposure may cause an intense response, not necessarily limited to the site of initial contact. |
| Solubility | The degree to which a chemical can dissolve in a solvent (such as water). |
| Solution | A mixture in which the components are uniformly dispersed. All solutions are composed of a solvent (water or other fluid) and the dissolved substance (called the solute). |
| Solvent | A substance (usually water or an organic compound) which dissolves another substance. See Solution. |
| Specific Gravity | The ratio of the mass of a volume of material to the mass of an equal volume of water, at a given temperature. |
| STEL | Short-Term Exposure Limit. The maximum average concentration allowed for a continuous 15-minute exposure period. (See TVL). |
| Susceptibility | Increased risk of harm from toxic substances due to personal traits such as diet, smoking, drinking, allergy, and pregnancy. |
| Systemic effect | An effect of a hazardous material on a part of the body other than that at which it entered. |
| Teratogen | A chemical or physical agent which can lead to structural malformations in the fetus and birth defects in live-born offspring. Such an agent is called teratogenic. |
| Thermal | Involving heat. |
| TLV | Threshold Limit Value. An exposure limit recommended by the ACGIH. There are three types of ACGIH TLVs: TLV-TWA: The allowable Time Weighted Average concentration for a normal eight-hour work day; TLV-STEL: The Short-Term-Exposure Limit or maximum average concentration for a continuous 15-minute exposure period; TLV-C: The Ceiling Limit, or maximum concentration that should not be exceeded even instantaneously. |
| Toxicity | The extent to which a substance will cause harmful effects. |
| Trade Name | The trademark name or commercial name used by the manufacturer or supplier for a material. |
| TWA | Time Weighted Average. The average concentration of a chemical in air over the total exposure time. (See PEL and TLV.) |
| Vapor Pressure | The pressure exerted by a saturated vapor above its own liquid in a closed container at given conditions of temperature and pressure. |

9. Environmental Health and Safety

Environmental Health and Safety (EH&S) is responsible to help OSU units provide a safe and healthful University environment for all staff, faculty, and students.

EH&S staff includes specialists in chemical and laboratory safety, carcinogens, biohazards, asbestos, PCBs, industrial and office safety, video display terminals, fire, sanitation, pest management, hazardous waste disposal, and employee training.

Services Available Through EH&S

Consultation. EH&S offers information and advice on such issues as safe handling procedures for chemicals, asbestos hazards, and the design of VDT work stations. Staff provide assistance on health and safety questions or problems, and interpret regulations and standards, including special campus regulations for carcinogenic, radioactive and hazardous biological materials.

Evaluation and Control of Hazards. EH&S staff inspect, monitor, and evaluate hazardous materials and conditions; make recommendations for controlling or eliminating hazards; and suggest practices to minimize harmful exposure. EH&S also coordinates hazardous waste disposal for the campus.

Assistance to Departments. EH&S advises and supports the health and safety efforts of departments and departmental safety committees.

Worker's Compensation and Risk Management. In cooperation with the Human Resources Department, EH&S staff investigate the causes and injuries and illnesses, and develop accident prevention programs. The Risk Management Program seeks to minimize the risks and losses on campus.

Education and Training. EH&S offers training programs and educational materials on a number of safety topics including chemical hazards, lab safety (biological, chemical, and radiological), fire safety, and the "right to know".

University Safety Policies and Procedures. In cooperation with various campus safety committees, EH&S coordinates the documentation of OSU Safety Policies. These are contained in the Safety section of the Administrative Policies and Procedures Manual, available on the OSU web. In addition, EH&S provides Safety Instructions that detail specific practices that assist OSU units to comply with environmental, occupational health, and safety regulations.

Areas of Emphasis

- Asbestos
- Biological Safety
- Chemical Safety
- Ergonomics
- Hazardous Waste Disposal
- Radiation Safety
- Training

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