College of Natural Sciences & Mathematics

Hazardous Materials Procurement Training

Science Safety Office

Updated December 2023

www.csulb.edu/cnsm/safety

Training Outline

- **CSULB Hazardous Materials Procurement Policy**
  - Outlined in Environmental Health & Safety (EHS) memo effective November 1, 2019
  - Hazardous materials defined as per CSULB policy
  - Non-restricted vs. restricted defined as per this training
  - Dean's designation to allow direct purchasing of non-restricted hazardous materials
- **Restricted Hazardous Materials**
  - Restricted categories of hazardous materials for which prior approval required by CNSM Safety (and sometimes EHS)
  - Examples
  - Summary
  - Supplemental information from CNSM General Safety Training (slides 17-42)

Hazardous Materials Procurement Policy (EHS)

- Extension of existing ordering policies and procedures.
- Mandates that ***ALL* hazardous materials** be approved prior to purchase.
- Approval is granted by CNSM Safety Officer staff, the Dean or the *Dean's designee.*
- Upon completion of this training, *the trainee* will be considered a *designee of the Dean* and be authorized to place orders for certain hazardous materials without prior approval.
    - This training is to educate those with purchasing responsibilities about what materials can (non-restricted) and cannot (restricted) be ordered without CNSM Safety (and sometimes EHS) prior approval.
    - Approvals will be for the current purchase and future purchases of the same material when used within the scope of the initial approval.
    - Approvals may be sought for multiple chemicals well in advance of when needed.

Hazardous Materials Defined

- The EHS memo states hazardous materials “may include **hazardous goods**, compressed gases, radioactive materials, biological organisms, and controlled substances and precursor chemicals, as defined by federal, state, and local regulations and University policies.”

- CSULB Purchasing defines **hazardous goods** as “any substance or chemical which is a "health hazard" or "physical hazard," including: chemicals which are carcinogens, toxic agents, irritants, corrosives, sensitizers; agents which act on the hematopoietic system; agents which damage the lungs, skin, eyes, or mucous membranes; chemicals which are combustible, explosive, flammable, oxidizers, pyrophorics, unstable-reactive or water-reactive; and chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists or smoke which may have any of the previously mentioned characteristics.”

Non-Restricted vs. Restricted Hazardous Materials

- Upon completion of this training, the purchaser will be considered a designee of the CNSM Dean and will be allowed to order non-restricted hazardous materials.
- Restricted hazardous materials requiring prior approval by CNSM Safety *even with completion of this this training*:
    - Particularly Hazardous Substances (PHSs)
        - EHS approval also required for Cal-OSHA regulated carcinogens
    - Organic peroxide forming materials
    - Air reactive (pyrophoric), water reactive or explosive materials
    - Radioactive materials
    - Biological hazards
    - Compressed gases

Restricted Hazardous Materials: Particularly Hazardous Substances

- CCR Title 8 §5191 defines particularly hazardous substances (PHSs) as any of the following:
  - Select carcinogens (known, presumed or suspected)
  - Reproductive toxins (known, presumed or suspected)
    - Including germ cell mutagens
  - Highly acute toxins (Category 1 or 2 acute toxicity)
- PHSs are found in many CNSM labs and common examples include methanol, cadmium compounds, acrylamide, benzene, chloroform, toluene, cyanide compounds, many others.

Identifying PHSs

- If ANY of the following phrases appear in Section 2 (Hazard(s) Identification) of the current Safety Data Sheet (SDS), the material is a PHS:
  - Carcinogen or Carcinogenicity (category 1A, 1B or 2)
  - Reproductive toxin or toxicity (category 1A, 1B or 2)
    - Germ cell mutagen or mutagenicity (category 1A, 1B or 2)
  - Category 1 or 2 acute toxicity (any exposure route)
- The CA Proposition 65 list of chemicals known to the state to cause cancer or reproductive toxicity lists many (but not all) PHSs.
- For PHSs that are Cal-OSHA regulated carcinogens, CNSM Safety will contact EHS for further approval.

Restricted Hazardous Materials: Organic Peroxide-Formers

- These materials form shock sensitive crystals upon exposure to air and include the following:
  - Diethyl ether (ether)
  - tetrahydrofuran (THF)
  - Cyclohexene
  - Acetaldehyde
  - any material on which the SDS states that it can form organic peroxides
- For the names of additional peroxide-formers and for more information, see CNSM's Safety Requirements for Peroxide-Forming Materials.
  - Note: Faculty or staff that have completed CNSM training on peroxide-formers do not need to seek additional approval.

Other Restricted Hazardous Materials

- Air reactive (pyrophoric), water reactive or explosive materials
  - Use the SDS to identify these materials. Statements identifying them will be in Section 2 and may be stated as Hazards Not Otherwise Classified (HNOC)
- Radioactive Materials
- Biological hazards
  - Human blood, cell lines or other potentially infectious material (OPIM)
  - Infectious agents requiring biosafety level 2 or higher facilities
- Compressed gases

Example 1

Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 10.24.2014 Page 1 of 7

Ascorbic Acid, Reagent Grade

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Ascorbic Acid, Reagent Grade**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25184**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Not classified for physical or health hazards under GHS.

Ascorbic acid – **non-hazardous** therefore, ordering pre-approval NOT needed.

Example 2

Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 01.08.2015 Page 1 of 8

Hydrochloric Acid,ACS

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Hydrochloric Acid,ACS**

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Corrosive
Serious eye damage, category 1
Corrosive to metals, category 1
Skin corrosion, category 1B

Irritant
Specific target organ toxicity following single exposure, category 3

Corr. Metals 1
Corr. Skin 1B
Eye Damage 1
STOT. SE 3

Signal word :Danger

Hydrochloric Acid – **hazardous** but non-restricted; ordering pre-approval not needed IF the purchaser has completed this training.

Example 3

SAFETY DATA SHEET

Creation Date 03-Dec-2010 **Revision Date** 25-Apr-2019 **Revision Number** 8

1. Identification

Product Name	**Sodium azide**
Cat No. :	**S227I-1; S227I-25; S227I-100; S227I-500; S227I-500LC**
CAS-No	26628-22-8
Synonyms	Sodium salt of hydrazoic acid; Smite
Recommended Use	Laboratory chemicals.
Uses advised against	Food, drug, pesticide or biocidal product use

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 2
Acute dermal toxicity	Category 1
Specific target organ toxicity - (repeated exposure)	Category 2

Target Organs - Central nervous system (CNS), Cardiovascular system, Liver, Kidney, Heart, spleen.

Sodium Azide – PHS; **category 1 acute toxicity (dermal), category 2 acute toxicity (oral)**. Restricted hazardous material; ordering pre-approval REQUIRED from Science Safety Office

Example 4

Safety Data Sheet

Material Name: Methanol **SDS ID: Methanol-SG**

SECTION 1: Identification

Product identifier
Material Name
Methanol
Synonyms
Methyl alcohol, wood alcohol, methyl hydroxide
Chemical Family
Alcohols

SECTION 2: Hazards identification

Singapore Standard SS 586-2:2014
Flammable Liquids - Category 2
Acute Toxicity - Oral - Category 3
Acute Toxicity - Dermal - Category 3
Acute Toxicity - Inhalation - Vapor - Category 3
Category 2
Reproductive Toxicity - Category 1B
Exposure - Category 1 (optic nerve , central nervous system , retina , systemic toxicity , eyes)
Specific Target Organ Toxicity - Single Exposure - Category 3
Label elements
Hazard symbols

Methanol – PHS; on CA Proposition 65 list, has **reproductive toxicity**. Restricted hazardous material; ordering pre-approval REQUIRED from Science Safety Office.

Example 5

Safety Data Sheet
according to 29CFR1910/1200 and GHS Rev. 3

Effective date : 01.14.2015 Page 1 of 8

Phenolphthalein Indicator

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Phenolphthalein Indicator**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25467**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Flammable
Flammable liquids, category 2

Irritant
Eye irritation, category 2A
Specific target organ toxicity following single exposure, category 3
Acute toxicity (oral, dermal, inhalation), category 4

Health hazard
Carcinogenicity, category 1B

Phenolphthalein – PHS; on CA Proposition 65 list, has **carcinogenicity**. Restricted hazardous material; ordering pre-approval REQUIRED from Science Safety Office.

Example 6

SAFETY DATA SHEET

Creation Date 27-Jan-2010 **Revision Date** 28-Nov-2019 **Revision Number** 7

1. Identification

Product Name Methylene chloride

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/Irritation	Category 2
Carcinogenicity	Category 1B
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Liver, Kidney, Blood.	

CALIFORNIA STATE UNIVERSITY, LONG BEACH

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY

APPENDIX A

CSULB List of Chemicals Requiring EHS Approval For Purchase:

Cal-OSHA Regulated Carcinogens

	Chemical	CAS	8CCR
1	1,2 Dibromo-3-Chloropropane (DBCP)	96-12-8	§5212
2	1,3-Butadiene	106-99-0	§5201
29	Methylene chloride	75-09-2	§5202

Methylene Chloride – PHS; on CA Proposition 65 list, Cal-OSHA regulated **carcinogen**. Restricted hazardous material; ordering pre-approval REQUIRED from Science Safety Office and EHS

Training Summary

- **By completing this training you agree to act as a designee of the Dean and fulfill the following responsibilities:**
  - Perform all necessary due diligence in investigating whether materials to be purchased are hazardous,
  - Use the information you have learned in this training to properly identify hazardous materials requiring additional pre-approval (restricted hazardous materials) by CNSM Safety. CNSM Safety will facilitate approval by EHS when necessary.
  - Maintain an accurate inventory of all hazardous materials (updated at least annually) for your area/operations.

END OF TRAINING

Supplemental information: the following slides present content found in the CNSM General Safety Training and are intended to aid in your understanding of Procurement Training material.

Safety Data Sheet (SDS)

- These documents are a source for information including but not limited to the hazards, safe handling, accidental release measures, and disposal method for chemicals/products used in the workplace.
- Must be readily accessible to all personnel when they are in their work areas:
  - Hard copies in a binder
  - Electronically available via MSDSOnline database
  - As files on a computer with unrestricted access
- Key health information found on initial page(s) including chemical specific exposure symptoms.

SDS Example

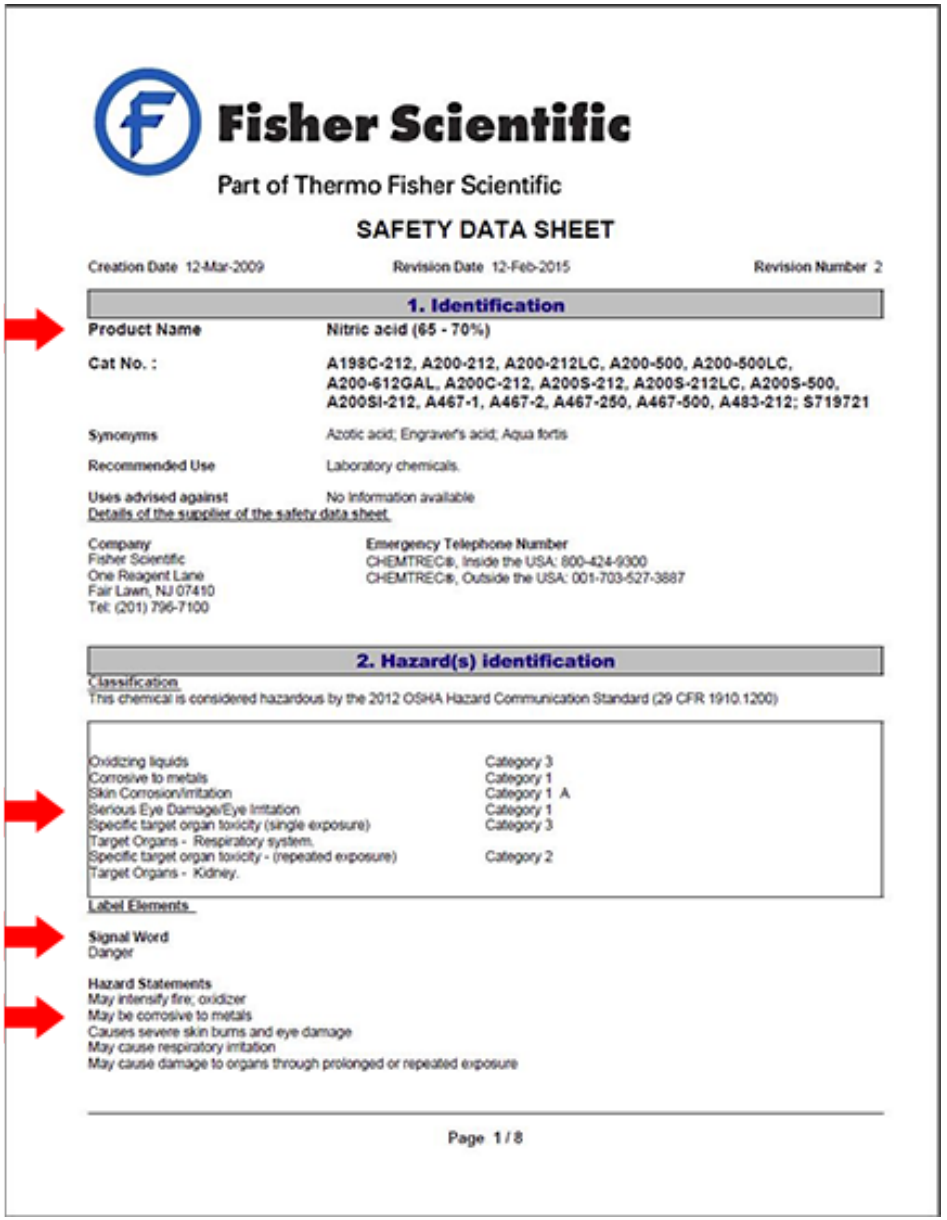
Material Name

Very Important to Understand:

Hazards with Category

Signal Word

Hazard Statements



Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Creation Date 12-Mar-2009 Revision Date 12-Feb-2015 Revision Number 2

1. Identification

Product Name Nitric acid (65 - 70%)

Cat No. : A198C-212, A200-212, A200-212LC, A200-500, A200-500LC, A200-612GAL, A200C-212, A200S-212, A200S-212LC, A200S-500, A200SI-212, A467-1, A467-2, A467-250, A467-500, A483-212; S719721

Synonyms Azotic acid; Engraver's acid; Aqua fortis

Recommended Use Laboratory chemicals.

Uses advised against No information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Oxidizing liquids	Category 3
Corrosive to metals	Category 1
Skin Corrosion/Irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure) Target Organs - Respiratory system.	Category 3
Specific target organ toxicity - (repeated exposure) Target Organs - Kidney.	Category 2

Label Elements

Signal Word
Danger

Hazard Statements
May intensify fire; oxidizer
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation
May cause damage to organs through prolonged or repeated exposure

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Hazards Specified by GHS

- When using chemicals that have potential health hazards, it is imperative that everyone in the lab/workplace strive to avoid exposure to the chemicals.
- Some low-level exposures may be unavoidable.
- Anyone with concerns about chemical exposures at CSULB can take the list of workplace chemicals to their medical doctor to consider the best course of action.
- Always take the time to read and understand the SDS for any materials you work with. Bring any questions or concerns to your supervisor or the Science Safety Office.
- Most of the reagents used in the lab have hazardous characteristics, many have more than one.
- Under GHS these characteristics fall into three categories: health hazards, environmental hazards, and physical hazards.

Particularly Hazardous Substances

- CCR Title 8 §5191 defines Particularly Hazardous Substances (PHSs) as any of the following:
  - Select carcinogens (known, presumed or suspected)
  - Reproductive toxins (known, presumed or suspected)
  - Highly acute toxins (Category 1 or 2 acute toxicity)
- PHSs are found in many CNSM labs and common examples include methanol, cadmium compounds, acrylamide, benzene, chloroform, toluene, cyanide compounds, ***many others.***
- Review the SDS or contact the Science Safety Office to determine if a material is a PHS.

Particularly Hazardous Substances 2

- PHSs require special provisions including:
  - Establishment of a designated area (may be a lab)
  - Use of containment devices (such as fume hoods)
  - Procedures for safe removal of contaminated waste
  - Decontamination procedures
- Talk to your supervisor to find out what PHSs may be in your assigned area.
- Work with PHSs will require specialized training by your supervisor or the Science Safety Office and the use of a material or category specific SOP.

Health Hazards: Carcinogens

GHS Pictogram

- Some chemicals may be classified as carcinogenic (capable of causing cancer) in addition to the other hazardous properties .
  - e.g., Benzene is a flammable liquid, is toxic, but also can induce leukemia with extended exposure.
- CAL/OSHA designates which chemicals must be labeled as Carcinogen. See the CNSM Chemical Hygiene Plan for more information.

Health Hazards: Carcinogens 2

GHS Pictogram

- Substances in this hazard class are assigned to one of two hazard categories.
- Category 1 carcinogens are known or presumed to cause cancer with exposure.
- Use of category 1 carcinogens requires special training and procedures.

Category 1 **Known or Presumed Carcinogen**		**Category 2** **Suspected Carcinogen**
Subcategory 1A **Known Human Carcinogen** Based on human evidence	Subcategory 1B **Presumed Human Carcinogen** Based on demonstrated animal carcinogenicity	Limited evidence of human or animal carcinogenicity

Health Hazards: Reproductive Toxicity

GHS Pictogram

- Some chemicals (once in the body) target male and/or female reproductive systems or developing fetuses.
- Category 1 reproductive toxins are known to have reproductive effects.

Category 1		Category 2 Suspected	Additional Category
Known or presumed to cause effects on human reproduction or on development		Human or animal evidence possibly with other information	Effects on or via lactation
Category 1A Known Based on human evidence	**Category 1B Presumed** Based on experimental animals		

Health Hazards: Acute Toxicity

GHS Pictogram

- Many of the reagents used in the lab are toxic poisons.
- Ingestion, inhalation, and skin contact (main exposure routes) must be avoided.
  - Exposure can cause a person to become ill and even be fatal
  - The LD_{50} is a measure of toxicity. The lower the LD_{50}, the higher the toxicity
- Instructors or supervisors will provide specific safety and handling warnings as these materials are introduced into the lab.

Health Hazards: Acute Toxicity 2

GHS Pictogram

- 5 Categories under GHS.
- Categories 1 and 2 considered to have high (severe) acute toxicity.
  - Single exposure (even short duration) may be fatal or cause serious organ damage.

Acute toxicity	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Category 5
Oral (mg/kg)	≤ 5	> 5 ≤ 50	> 50 ≤ 300	> 300 ≤ 2000	Criteria: • Anticipated oral LD50 between 2000 and 5000 mg/kg; • Indication of significant effect in humans;* • Any mortality at class 4;* • Significant clinical signs at class 4;* • Indications from other studies.* *If assignment to a more hazardous class is not warranted.
Dermal (mg/kg)	≤ 50	> 50 ≤ 200	> 200 ≤ 1000	> 1000 ≤ 2000	
Gases (ppm)	≤ 100	> 100 ≤ 500	> 500 ≤ 2500	> 2500 ≤ 5000	
Vapors (mg/l)	≤ 0.5	> 0.5 ≤ 2.0	> 2.0 ≤ 10	> 10 ≤ 20	
Dust & mists (mg/l)	≤ 0.05	> 0.05 ≤ 0.5	> 0.5 ≤ 1.0	> 1.0 ≤ 5	

ACUTE ORAL TOXICITY – Annex 1					
	Category 1	Category 2	Category 3	Category 4	Category 5
LD_{50}	≤ 5 mg/kg	> 5 < 50 mg/kg	≥ 50 < 300 mg/kg	≥ 300 < 2000 mg/kg	≥ 2000 < 5000 mg/kg
Pictogram					No symbol
Signal word	Danger	Danger	Danger	Warning	Warning
Hazard statement	Fatal if swallowed	Fatal if swallowed	Toxic if swallowed	Harmful if swallowed	May be harmful if swallowed

Health Hazards: Corrosion/Irritation

GHS Pictogram

- Watch out for corrosive materials as they can cause severe burns and blindness.
- One typical characteristic of corrosive materials is extreme pH (2 or below or 11.5 and above).
- Never mix acids and bases. A violent reaction may occur.
- Use caution when adding concentrated acids or bases to a solution.
    - "Do what you ought'er, add acid to water"
- Neutralize tiny acid spills/drips (NOT injuries) with bicarbonate solution.

Health Hazards: Skin Corrosion/Irritation

GHS Pictogram

- Skin irritation considered to be reversible, corrosion is not.
- Divided into 3 categories, category 1 being most severe.

Skin Corrosion Category 1			Skin Irritation Category 2	Mild Skin Irritation Category 3
Destruction of dermal tissue: visible necrosis in at least one animal			Reversible adverse effects in dermal tissue	Reversible adverse effects in dermal tissue
Subcategory 1A Exposure < 3 min. Observation < 1 hr,	Subcategory 1B Exposure < 1 hr. Observation < 14 days	Subcategory 1C Exposure < 4 hrs. Observation < 14 days	Draize score: ≥ 2.3 < 4.0 or persistent inflammation	Draize score: ≥ 1.5 < 2.3

Health Hazards: Eye Corrosion/Irritation

GHS Pictogram

- Eye irritation considered to be reversible, corrosion is not.
- Divided into 2 categories, category 1 being most severe.

Category 1 Serious eye damage	Category 2 Eye Irritation	
Irreversible damage 21 days after exposure Draize score: Corneal opacity ≥ 3 Iritis > 1.5	Reversible adverse effects on cornea, iris, conjunctiva Draize score: Corneal opacity ≥ 1 Iritis ≥ 1 Redness ≥ 2 Chemosis ≥ 2	
	Irritant Subcategory 2A Reversible in 21 days	**Mild Irritant** Subcategory 2B Reversible in 7 days

Health Hazards: Sensitizers

- Two categories:
  - **Respiratory sensitizers** induce hypersensitivity of the airways following inhalation of a substance.
  - **Skin sensitizers** (equivalent to contact sensitizers) induce an allergic response following skin contact.

Respiratory Sensitizer
GHS Pictogram

Skin Sensitizer
GHS Pictogram

Health Hazards: Germ Cell Mutagenicity

GHS Pictogram

- A mutation is a change in the DNA sequence of a gene and a mutagen is a chemical or other agent that can cause an increased occurrence of mutations.
- Germ cells pass heredity to the next generation.
- Category 1 mutagens are known or presumed to cause mutation with exposure.

Category 1 Known / Presumed		Category 2 Suspected / Possible
Known to produce heritable mutations in human germ cells		• May induce heritable mutations in human germ cells • Positive evidence from tests in mammals and somatic cell tests • *In vivo* somatic genotoxicity supported by *in vitro* mutagenicity
Subcategory 1A Positive evidence from epidemiological studies	Subcategory 1B Positive results in: • *In vivo* heritable germ cell tests in mammals • Human germ cell tests • *In vivo* somatic mutagenicity tests, combined with some evidence of germ cell mutagenicity	

Other Health and Environmental Hazards

GHS Pictogram

- Other GHS health hazards include aspiration (entry of material into your airways) and target organ systemic toxicity (any effect not otherwise included in GHS such as narcotic effects).
- Some chemicals can be particularly damaging to the environment or to aquatic life if released. Under GHS there are multiple categories for acute and chronic aquatic toxicity.

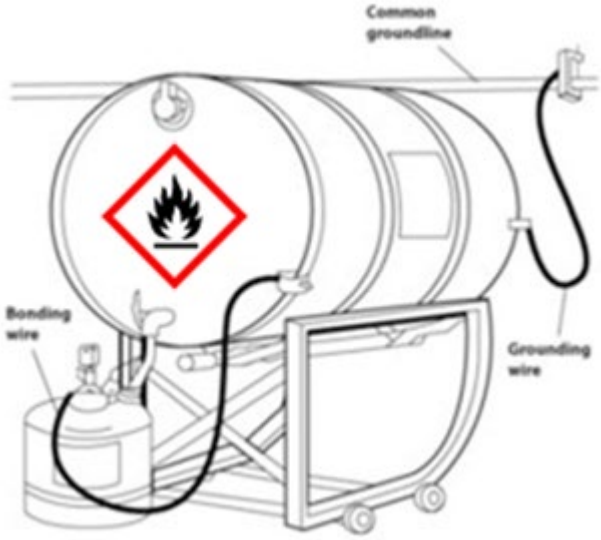
Physical Hazards: Flammables

GHS Pictogram

- Flammable materials ignite easily and burn quickly and may be in the form of liquids, solids, gases or aerosols (fine mists).
- There are several hazard categories under GHS:
  - Flammable liquids – four categories based on flashpoint (the temperature at which a vapor above a solution will ignite in air if with ignition source), category 1 being most dangerous (example: diethyl ether).
  - Flammable solids – readily combustible and may cause a fire if heated or through friction. Two categories, category 1 being most dangerous.

Physical Hazards: Flammables 2

- Bulk (large) quantities of flammable liquids requires that their containers be bonded and grounded.
- Bonding and grounding provides an electrically conductive pathway between a dispensing container, the receiving container and an earth ground.
- This prevents the buildup of static electricity which could cause sparks and lead to a fire.
- Contact the Science Safety Office for more specific information.



Physical Hazards: Oxidizers

GHS Pictogram
(flame over circle)

- Oxidizing materials (“oxidizers”) promote or accelerate combustion and may be in the form of liquids, solids or gases.
- Oxidizers such as hydrogen peroxide, potassium nitrate and many chemicals whose names start with “per”, end in “ate” or end in “ite” are especially dangerous.
- Supervisors must communicate special instruction if oxidizers are to be handled.

Physical Hazards: Oxidizers 2

GHS Pictogram
(flame over circle)

- There are several hazard categories under GHS based on measured increases in ignition time or pressure comparted to control mixtures.
- Oxidizers may ignite or form explosive compounds on contact with organic solvents, materials such as flammables, combustibles, or other reducing materials, or reducing agents such as metals, etc.
- Oxidizers may not be mixed with or stored beside these materials.
    - Concentrated nitric acid is a strong oxidizer and will react violently with flammable organic solvents or acetic acid.

Physical Hazards: Pyrophorics and Water Reactives

- Pyrophoric substances (liquids or solids) will ignite within 5 minutes after coming in contact with air.
- Water reactive substances will release flammable gases or will become spontaneously flammable upon contact with water.
- Pyrophorics and water reactives are separated into several categories depending on level of reactivity.
- GHS *Flammables* pictogram used.
- Work with pyrophorics and water reactives is especially hazardous and requires specialized training.

Physical Hazards: Gases Under Pressure

GHS Pictogram

- Gases that are contained in a pressurized receptacle or as a refrigerated liquid.

compressed gases in cylinders

liquid nitrogen in storage dewars

Physical Hazards: Gases Under Pressure 2

GHS Pictogram

- CNSM Gas Cylinder Safety Training includes training on the safe use of cryogenic materials.
- Only personnel who have completed CNSM Gas Cylinder Safety Training may:
  - Move gas cylinders
  - Work with Liquid Nitrogen
  - Install gas regulators
  - Work with Dry Ice
- GHS categories are based on the state of the gas under pressure.

Group	Criteria
Compressed gas	Entirely gaseous at - 50°C
Liquefied gas	Partially liquid at temperatures > - 50°C
Refrigerated liquefied gas	Partially liquid because of its low temperature
Dissolved gas	Dissolved in a liquid phase solvent

Other Physical Hazards

- Other GHS physical hazards:
  - Explosives - materials capable by chemical reaction of gas with temperature, speed and pressure enough to damage surroundings
  - Self-Reactive Substances - thermally unstable materials able to undergo exothermic decomposition
  - Organic Peroxides - reactive, shock sensitive
- Work with these materials is especially hazardous and is generally not permitted.

Other Physical Hazards 2

- Other GHS physical hazards:
  - **Corrosive to Metal** - materials that by chemical action will damage or destroy metals
  - **Self-Heating Substances** - a substance which by reaction with air, without energy supply can self-heat. Large amounts of material and long time periods are needed

Corrosive to Metal
GHS Pictogram

Self-Heating Substances
GHS Pictogram