

To simplify the discussion of safety considerations for particular chemicals, six categories have been developed. Many chemicals will fall within one of These six groups. Many chemicals will fit into more than one category and a decision would have to be made as to what is the most important characteristic About that chemical. In general, chemicals within these categories will react similarly and will have similar properties. Being aware of these general General chemical categories and properties will aid in the proper storage, handling and use of chemicals.

FLAMMABLES

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<ul style="list-style-type: none"> - Vapors can readily catch fire and burn. - Rate at which vapors are produced depends on vapor pressure. The higher the VP the more readily the liquid will vaporize. VP increases with an increase in temperature. More hazardous when heated. - Flash Point of chemical is minimum temperature at which a liquid gives off vapor in sufficient concentration to form ignitable mixture with air. Many have FPs lower than room temperature. - Limits of flammability or explosivity define range in which a flamm vapor or gas, when mixed with air, can ignite and burn. Lower explosive limit (LEL) is lower end of range and upper explosive is higher end (UEL). If vapor concentration is in this range, there is very high risk of explosion / fire. If outside range, mixture will not burn. - Some flamm have narrow flamm range (benzene) and others have wide range (acetaldehyde). - Most Flammables have vapor density greater than air and will seek lowest elevation. Vapors can also travel great distances. 	<ul style="list-style-type: none"> - Store in safety cans, flamm storage cabinets or inside storage rooms. - Minimize amount stored in lab / work area. - Use only in an area free of ignition sources. - When transferring in metals containers, voltage potentials can result in static sparks capable of igniting vapors. Dispensing and receiving containers must be bonded together before pouring. Large containers (drums) must also be grounded. All connections must be made of metal. - Never heat flammables with open flame. Use steam baths, water baths, oil baths, heating mantles. - Never store flammables in a standard household refrigerator. Can only use explosion proof refrigerator or lab safe. No safety benefit to storing in refrigerator if flash point is below the temperature of refrigerator. 	<p>Vapors of many flammables are irritating to mucous membranes of the respiratory System and eyes and in high concentrations are a narcotic.</p> <p>ACUTE HEALTH EFFECTS:</p> <p>INHALATION: Headache, fatigue, dizziness, narcosis</p> <p>INGESTION: Slight gastro-intestinal irritation, dizziness, fatigue</p> <p>SKIN CONTACT: Dry, cracked and chapped skin</p> <p>EYE CONTACT: Stinging, watering eyes and inflammation of eyelids.</p> <p>CHRONIC HEALTH EFFECTS: Will vary depending on chemical, duration of exposure, extent of exposure. Damage to lungs, liver, kidneys, heart and/or central nervous system may occur. Cancer and reproductive effects also possible.</p> <p>HYDROCARBONS: are narcotic, but systemic toxicity is relatively low.</p> <p>AROMATIC HYDROCARBONS are all potent narcotic agents and overexposure to vapors can lead to loss of muscular coordination, collapse, unconsciousness.</p> <p>Benzene is toxic to bone marrow and can cause leukemia.</p> <p>ALCOHOLS: vapors moderately narcotic</p> <p>ETHERS: exhibit strong narcotic properties and for most part are only moderately toxic.</p> <p>ESTERS: vapors irritate eyes, nose and upper respiratory tract.</p> <p>KETONES: systemic toxicity is not generally high.</p>	<p>Provide medical responders with the name of chemical and provide a copy of MSDS.</p> <p>INHALATION: remove from contaminated area if safe to do so. Get medical attention and do not leave unattended.</p> <p>INGESTION: remove person from source of contamination. Get medical attention. DO NOT induce vomiting.</p> <p>SKIN CONTACT: Remove from source of contamination. Remove clothing, jewelry, shoes from affected areas. Flush with water for at least 15 minutes and get medical attention.</p> <p>EYE CONTACT: Remove from source of contamination. Flush the eyes with water for at least 15 minutes. Get medical attention.</p>	<ul style="list-style-type: none"> -Always use fume hood - Nitrile and neoprene gloves are effective against most flammables. - Wear non-flammable lab coat to provide a barrier to skin. - Chemical goggles

OXIDIZERS

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<ul style="list-style-type: none"> - Present fire and explosion hazards on contact with combustible materials. Depending on class, an oxidizing material may increase burning rate of combustibles, cause the spontaneous ignition of combustibles with which it comes into contact with, or undergo an explosive reaction when exposed to heat, shock or friction. - Are generally corrosive. - Anhydrous perchloric acid is unstable at room temperature and can decompose spontaneously with a severe explosion. Will explode in contact with wood or other organic materials - Perchloric acid – oxidizing power increases with an increase in concentration and with an increase in temperature. Cold, 70% perchloric is a strong, non-oxidizing corrosive. At 72% at an elevated temperature it is a strong oxidizing agent. A 85% perchloric acid solution is a strong oxidizer at room temperature. <p>Peroxides Nitrates Chlorates Hypochlorite Permanganate Nitrates Perchlorates Chlorite Dichromate Persulfate</p>	<ul style="list-style-type: none"> - Store away from flammables, organic compounds and combustible materials. - Strong oxidizing agents, such as chromic acid, should be stored in glass or some other inert container, preferably unbreakable. Do not use corks or rubber stoppers. - Reaction vessels containing appreciable amount of oxidizing agent should not be heated in oil baths. Use heating mantle or sand bath. <p>PERCHLORIC ACID:</p> <ul style="list-style-type: none"> - Do not heat perchloric acid unless you have a perchloric fume hood. - Substitute a less hazardous chemical. - Store in perchloric fume hood or on metal shelf/metal cabinet away from organic/flammables. - Do not allow contact with Sulfuric acid or other strong dehydrating agents → explosion! 	<ul style="list-style-type: none"> - In general, are corrosive and many are highly toxic. <p>ACUTE HEALTH HAZARDS:</p> <ul style="list-style-type: none"> - fumes act as irritant and can cause inflammation in surface layer of tissues . Can also irritate upper airways, conjunctiva and throat - Some can cause severe burns of skin and mucous membranes (fluorine) - Chlorine trifluoride is extremely toxic and can cause severe burns - Nitrogen trioxide very damaging to tissue – can cause fatal pulmonary edema. <p>CHRONIC HEALTH HAZARDS:</p> <p>Nitrobenzene and chromium compounds can cause hematological and neurological changes.</p> <p>Chromium / manganese compounds can cause liver and kidney disease.</p> <p>Chromium VI have been associated with lung cancer.</p>	<p>Provide medical responders with the name of chemical and provide a copy of MSDS.</p> <ul style="list-style-type: none"> - Remove from source of contamination if safe to do so - Summon medical help immediately <p>SKIN / EYE CONTACT Remove from source of contamination. Remove clothing, jewelry, shoes from affected areas. Flush with water for at least 15 minutes and get medical attention.</p> <p>EYE CONTACT: Remove from source of contamination. Flush the eyes with water for at least 15 minutes. Get medical attention.</p>	<ul style="list-style-type: none"> - Neoprene, polyvinyl chloride (PVC) or nitrile gloves. Check glove compatibility chart or call Risk Management. - Chemical splash goggles - Always use these materials in a fumehood. - Compressed gases must be kept in ventilated cabinet.

CORROSIVES

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<ul style="list-style-type: none"> - Most commonly acids and alkalis, but other materials can also be severely damaging to living tissue. - Can cause visible destruction or irreversible alterations at site of contact. Particularly damaging to eyes and skin. - Some substances considered to be non-corrosive in dry state are corrosive when wet, such as when in contact with moist skin or mucus membranes. (lithium chloride, halogen fluorides and allyl iodide) - Sulfuric acid is very strong dehydrating agent and nitric is strong oxidizing agent. Can cause severe burns to eyes due to their affinity to water. <p>Sulfuric Acid Ammonium bifluoride Chromic Acid Bromine Stannic chloride Ammonium hydroxide</p>	<ul style="list-style-type: none"> - Always store acids separately from bases. - Store acids away from flammables. - Do not work with corrosives unless and emergency shower and continuous flow eye wash are available. - Always add acid to water to prevent splashing from the acid due to generation of excessive heat as the two substances mix. - Never store corrosives above eye level. Store on low shelf or cabinet. - Good practice to store corrosives in a tray or bucket to contain any leakage. - When possible purchase corrosives in containers that are coated with protective plastic film that will minimize the danger if container is dropped. - Store corrosives in a wooden cabinet or one that has a corrosion resistant lining. Corrosives stored in metal cabinet will quickly damage it and supports could corrode. <p>HYDROFLUORIC ACID:</p> <ul style="list-style-type: none"> - Extremely hazardous. Can cause severe burns and inhalation of anhydrous hydrogen fluoride can be fatal. HF readily penetrates the skin, damaging underlying tissues, fluoride ions can cause destruction of soft tissues and decalcification of the bones. - Always use fume hood and wear personal protective clothing! - Do not store in glass containers. - Store separately 	<ul style="list-style-type: none"> - All have property of being severely damaging to living tissues and also attack other materials such as metal. - Skin contact with alkali metal hydroxides (sodium hydroxide and potassium hydroxide) is more dangerous than with strong acids. Causes deeper tissue damage because there is less pain than with an acid exposure. Person may not wash off thoroughly or may not seek prompt medical attention. Acids on contact with skin generally form a protein layer which prevents further penetration and is painful, while alkali metal hydroxides do not. - All hydrogen halides are acids that are serious respiratory irritants and also can cause severe burns. - HF – at low concentrations does not show immediate signs or symptoms upon contact with skin. May take several hours- by this time permanent damage/scarring can result. <p>ACUTE HEALTH EFFECTS:</p> <p>Inhalation – irritation of mucous membranes, difficulty breathing, fits of coughing, pulmonary edema</p> <p>Ingestion – irritation and burning sensation of lips, mouth and throat; pain in swallowing; swelling of the throat, painful abdominal cramps; vomiting ; shock; risk perforation of stomach</p> <p>Skin Contact: burning, redness and swelling, painful blisters, profound damage to tissues and, with alkalis: a slippery soapy feeling.</p> <p>Eye Contact- stinging, watering, swelling of eyelids, intense pain, ulceration of eyes, loss of eye / eyesight</p> <p>CHRONIC HEALTH EFFECTS: Symptoms are depending on chemical. HCl – damage to teeth, HF in creased bone density, fluorosis and anemia</p>	<p>Provide medical responders with the name of chemical and provide a copy of MSDS.</p> <p>INHALATION: remove from contaminated area if safe to do so. Get medical attention and do not leave unattended.</p> <p>INGESTION: remove person from source of contamination. Get medical attention. DO NOT induce vomiting.</p> <p>SKIN CONTACT: Remove from source of contamination. Remove clothing, jewelery, shoes from affected areas. Flush with water for at least 15 minutes and get medical attention.</p> <p>EYE CONTACT: Remove from source of contamination. Flush the eyes with water for at least 15 minutes. Get medical attention. Have person rotate eyes up/down/side to side while flushing with water. Do not let person rub eyes or keep tightly shut.</p>	<ul style="list-style-type: none"> - Neoprene and nitrile gloves are effective for most acids/bases. PVC is effective for most acids - Rubber coated apron - Goggles - If potential for splash wear a face shield over goggles. - Always use a fume hood.

REACTIVES

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<p>Polymerization Reactions: Reactions in which two or more molecules of substance combine to form repeating structural units of original molecule. Can result in extremely high/uncontrolled release of energy.</p> <p>Water Reactive: -When contact water can: liberate heat which may cause ignition of chemical itself if flammable or ignition of flammables near by; release of flammable, toxic, or strong oxidizing gas; release of metal oxide fumes; formation of corrosive acids. -Examples: alkali metals, silanes, sodium, potassium, alkylaluminums, magnesium, zinc, aluminum.</p> <p>Pyrophorics: - Can ignite spontaneously ignite in presence of air. - Examples: diethylzinc, triethylaluminum, many organometallic compounds.</p> <p>Peroxide-Forming Materials: - Unstable. React with air, moisture or impurities to form organic peroxides. Formation is greatly increased by evaporation or distillation. - Organic peroxides are extremely sensitive to shock, sparks, heat, friction, impact, light. - Examples: Isopropyl ether, sodium amide, dioxane, THF, butadiene, acrylonitrile, styrene, diethyl ether, vinyl ethers,</p> <p>Other Shock Sensitive Materials: - Are explosive and are sensitive to heat/shock. Examples: fulminates, hydrogen peroxide>30%, ammonium perchlorate, chemicals with nitro group, chems with functional groups : acetylide, azide, diazo, halamine, nitroso, ozonide.</p>	<ul style="list-style-type: none"> - Minimize amount of material used - Substitute less hazardous substance. <p>Water Reactive:</p> <ul style="list-style-type: none"> - Store in isolated area/clearly marked cabinet , away from ANY water sources. <p>Pyrophorics:</p> <ul style="list-style-type: none"> - Store in isolated area in clearly marked cabinet. Routinely check integrity of container. Contact Risk management is container is corroded/damaged. <p>Peroxide Forming Materials:</p> <ul style="list-style-type: none"> - Do not open container if peroxide formation may have occurred. Visually liquid for crystals or unusual viscosity before opening. - Bottles should be dated when received and stabilized with BHT prior to disposal. Check expected shelf life (isopropyl ether 3 months, THF 1 yr.) - Store away from heat, light and sources of ignition. - Secure lids to discourage evaporation/concentration of chemicals. Do not store in glass containers with screw cap lids or glass stoppers. Avoid friction/grinding. - Can test for presence of peroxides in ethers. Call Risk Management if a problem is suspected. <p>Other Shock Sensitive Materials:</p> <ul style="list-style-type: none"> - Store separately from other chemicals in a clearly labeled cabinet. - Do not allow picric acid to dry out-extremely explosive! 	<ul style="list-style-type: none"> - Grouped together due to their safety hazards associated with storage and use. - For specific health hazards consult MSDS, manufacturer, or Risk Management. <p>Common hazards:</p> <ul style="list-style-type: none"> - heat / flames - hearing loss - respiratory injuries due to inhalation of fumes, vapors and reaction products - Flying debris!!! 	<ul style="list-style-type: none"> - If someone is seriously injured, contact Campus Police as quickly as possible - For severe bleeding apply sterile dressing, clean cloth or handkerchief to wound. Wear gloves, use universal precautions. Apply direct pressure to wound. Keep person calm. - If person is on fire, have them immediately drop to floor and roll. If fire blanket is available put it over them. Emergency shower can also be used to douse flames. - If person is going into shock, have lie on back if it is safe to do so. Raise feet about one foot above floor. 	<ul style="list-style-type: none"> - Wear appropriate PPE. May include: - Impact resistant chemical splash goggles, faceshield, gloves, lab coat and shield. - Conduct work in chemical fumehood and pull sash down as far as is practical. Keep sash closed when experiment does not require you to reach into fumehood.

TOXINS

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<ul style="list-style-type: none"> - Any chemical at the right dose could be toxic. Some chemicals are known to be hazardous at very low concentrations, over short exposure time or after repeated exposures. - Toxins, poisons and carcinogens. - Toxin may be mutagenic and cause a heritable change in gene structure or may be teratogenic and cause a malformation of an embryo. Pregnant women and persons in their child bearing years should not work with or, at a minimum, use extreme caution while handling these materials. - Toxicity is due to ability to interfere with the metabolism of living tissue. An acute toxin can cause an adverse effect after single or short duration exposure. A chronic toxin causes and adverse effect after repeated exposures, after long duration single exposure or after a long latency period. Carcinogens are examples of chronic toxins that have a long latency period before the effects of exposure are observed. - Examples of acute toxins: -hydrogen cyanide, diisopropyl fluorophosphate, hydrogen sulfide, hydrofluoric acid, nitrogen dioxide, phosgene. - Examples of chronic toxins: - all carcinogens, many metals and their compounds 	<ul style="list-style-type: none"> - Minimize exposure by substituting a less hazardous chemical, decrease exposure time, wearing PPE, practice safe techniques, using fumehoods, sfety cabinets etc. - Do not eat, drink, smoke or apply cosmetics where toxic chemicals are used or stored or without washing hands after use. - Thoroughly wash hands and arm before leaving work area. - Store toxins in pans, trays or other secondary containers to minimize hazards if container breaks or contents spilled. - Ue absorbent paper on work surface to contain spills. - Restrict access where toxins are used / stored. - Store toxic chemicals separately in a clearly labeled cabinet. - Do not allow personnel to work with toxins until properly trained in hazards, use, storage, proper handling. 	<ul style="list-style-type: none"> - Varies greatly. - For specific information contact Risk Management, MSDS or manufacturer. 	<ul style="list-style-type: none"> - Remove person from source of contamination if safe to do so. - Get medical attention immediately. - - Provide medical responders with the name of chemical and provide a copy of MSDS. - 	<ul style="list-style-type: none"> - Use fumehood! - Gloves, goggles, lab coats, aprons.

COMPRESSED GAS CYLINDERS

General Characteristics	Use and Storage	Health Hazards	1 st Aid	PPE
<ul style="list-style-type: none"> - Can pose chemical and physical hazard. - If valve is broken off a cylinder, force could propel cylinder through a brick wall. - Replaces oxygen – asphyxiant. - 	<ul style="list-style-type: none"> - Use toxic, flammable or reactive gases in fumehood or other ventilated enclosure. - Always use appropriate regulator. If regulator will not fit cylinder’s valve replace cylinder. Do not Attempt to modify or adapt a regulator to fit a cylinder it was not designed for. Regulators are designed to fit only specific cylinder valves to avoid improper use. - Inspect regulators, pressure relief devices, valves, connections, hose/line for damage. - Never transfer gases from one cylinder to another – may be incompatible with cylinder material construction or residual gas remaining in cylinder. - Close main valve when cylinder is not in use. - Always secure cylinders, whether empty or full to prevent from falling. Secure by chaining or strapping to wall, bench or other support. - Clearly mark empties and store separately. 	<ul style="list-style-type: none"> - Varies greatly 	<ul style="list-style-type: none"> - Remove person from source of contamination if safe to do so. - Get medical attention immediately. - - Provide medical responders with the name of chemical and provide a copy of MSDS. - 	