

Appendix D

Fire Marshal Laboratory Safety Checklist

Minnesota Department of Public Safety State Fire Marshal Division

School Science Lab Safety Checklist

School: _____ Room number: _____ Date: _____

Person completing report: _____ Title: _____

Part 1: General safety requirements for science labs

Description

A school science laboratory is defined as a classroom where demonstrations and/or laboratory instructions are provided for individual or group experiments in which hazardous chemicals or gases are used. These areas may include chemistry classrooms, rooms used for student experiments, and prep areas. This form is to be completed for each school science laboratory in accordance with Minnesota Statutes, §121A.31.

<u>Item/Description:</u>	<u>Citation</u>	<u>Meets</u>	<u>Does Not Meet</u>	<u>N/A</u>
1. FIRE EXTINGUISHERS. At least one 2A:20B:C rated (or larger) portable fire extinguisher must be provided for each 3,000 feet of laboratory. Travel distance must not exceed 50 feet from anywhere in the lab.	MSFC (20) 906.1	☐	☐	☐
2. EGRESS AISLES. Aisles serving work areas on two sides must be at least 36" wide; those serving work areas on one side must be 24".	MSFC (20) 1104.23	☐	☐	☐
3. NUMBER OF EXITS. At least 2 remotely located egress doorways must be provided for <i>newly constructed</i> labs containing hazardous materials that exceed 500 square feet in area. At least 2 remotely located egress doorways are required for <i>existing</i> labs exceeding 1,000 square feet in area.	MSFC (20) 1006.2.2.7 MSFC (20) 1104.25.4	☐	☐	☐
4. FIRE SEPARATIONS. Labs must be separated from other portions of the building by not less than a one-hour fire barrier. *Note: A fire separation is not required for labs equipped with fire sprinkler protection.	MSFC (20) 1105.3	☐	☐	☐
5. FIRE ALARM & DETECTION. Labs must be equipped with automatic fire detection interconnected with the building's fire alarm system. *Note: Labs protected by an approved and supervised fire sprinkler system do not require automatic fire detection.	MSFC (20) 1103.7.2.2	☐	☐	☐



6. ELECTRICAL SAFETY. Electrical wiring, devices, appliances and other equipment that is modified or damaged and constitutes an electrical shock or fire hazard shall not be used. Wiring junctions shall be enclosed in approved junction boxes and provided with cover plates. Appliances requiring a ground connection must be connected to a grounded receptacle.	MSFC (20) 604.1	☐	☐	☐
7. EXTENSION CORDS. Extension cords must not be used as a substitute for permanent wiring, but may be used temporarily with portable appliances. Cords must be in good condition and properly rated for the appliance.	MSFC (20) 604.5	☐	☐	☐
8. ELECTRICAL MULTI-PLUG ADAPTERS. Relocatable power-taps (power strips with cords) must be grounded and listed to UL 1363. Current-taps (multi-plug devices without a cord) must be listed to UL 498A.	MSFC (20) 604.4	☐	☐	☐
9. ELECTRICAL PANEL ACCESS. A working space of not less than 30" in width, 36" in depth and to a height of 72" shall be maintained in front of electrical panels.	MSFC (20) 604.3	☐	☐	☐
10. EMERGENCY PLANNING. Persons responsible for each lab must be familiar with the chemical nature of the materials present in the lab and the appropriate mitigating actions to be taken in case of fire, leak or spill.	MSFC (20) 5003.9.1	☐	☐	☐
11. SPILL CONTROL. Neutralizing chemicals, spill kits, dry sand, absorbents and other spill control methods must be readily available while the lab is in use.	MSFC (20) 5003.9.1	☐	☐	☐
12. GAS SHUT-OFF VALVE. Clearly labeled and readily accessible manual or remotely activated automatic shutoff valves are required at the source of gas piping systems and at each point of use.	MSFC (20) 5003.2.2.1, item 3	☐	☐	☐
13. FUME HOODS. Fume/exhaust hoods must be listed or engineered for its intended use and maintained in proper operating condition.	MSFC (20) 5003.2	☐	☐	☐
14. EYE PROTECTION. Industrial quality eye protection meeting ANSI standards shall be provided and utilized for any activity that is potentially hazardous to the eye.	MN Statute 121A.32	☐	☐	☐
4. GAS PIPING SYSTEMS. Gas piping systems must comply with nationally recognized standards.	MSFC (20) 5003.2.2	☐	☐	☐
6. USE OF REFRIGERATORS. Refrigerators, freezers and other cooling equipment used to store or cool flammable liquids must be specifically listed for such use.	MSFC (20) 604.7	☐	☐	☐

Part 2: General safety *recommendations* for science labs

1. SUPERVISION OF STUDENTS. Students must be under the direct supervision of a faculty member or an assistant at all times. In most cases it is recommended that direct supervision means direct eye contact. It is recommended that no more than two students be assigned to a lab station.	Recommendation NFPA 45 (19) 3.3.13
2. ELECTRICITY & SPILLS. Electrical receptacles, switches, and controls must be located so as not to be subject to liquid spills.	Recommendation NFPA 45 (19) 5.5.1
7. USE OF REFRIGERATORS. Each refrigerator, freezer, or cooler should be prominently marked to indicate whether it meets the requirements for safe storage of flammable liquids.	Recommendation NFPA 45 (19) 11.3.2
8. EXPLOSIVE MATERIALS NOT ALLOWED. It is recommended that due to the serious explosion hazard present, the following chemicals <u>not</u> be used in an instructional setting: Benzoyl Peroxide Carbon Disulfide Ethyl Ether Perchloric Acid Picric Acid Potassium metal Magnesium powdered metal	Recommendation
9. PERSONAL SAFETY. Loose clothing (e.g. sleeves, full cut blouses, neckties, etc.) and long hair should be properly restrained. Also, some laboratory activities could be dangerous to persons wearing contact lenses.	Recommendation
10. HEAT SOURCES. Heat sources should never be left unattended (e.g. gas burners, hot plates, heating mantles, etc.)	Recommendation
11. DANGEROUS RISK CHEMICALS. See lists of chemical where risk exceeds the educational value or the chemicals should be used in limited quantities. (Tables 2 and 3)	Recommendation
12. VENTILATION. Science labs and associated chemical storage areas should be equipped with a ventilation system per the MN Mechanical Code having a minimum exhaust rate of 1.0 CFM/ft ² . *Note: this is a requirement for newly constructed labs.	Required for new Recommendation for existing MMC (20) 403.3.1.1

Part 3: Science chemical storage requirements

<u>Item/Description:</u>	<u>Citation</u>	<u>Meets</u>	<u>Does Not Meet</u>	<u>N/A</u>
1. FLAMMABLE/COMBUSTIBLE LIQUID QUANTITIES IN USE. Quantities of flammable and combustible liquids shall not exceed the amounts necessary for demonstration, treatment, laboratory work, maintenance purposes or operation of equipment. See limits in "Use" column of Table 1 below (adapted from MSFC Table 5003.1.1)	MSFC (20) 5704.3.4.2, item #3	☐	☐	☐
2. FLAMMABLE LIQUIDS CABINET. Quantities of flammable and combustible liquid in excess of 10 gallons must be stored in a flammable liquids cabinet. Quantities not exceeding ten gallons must be stored in an approved location.	MSFC (20) 5704.3.4.4	☐	☐	☐
3. FLAMMABLE/COMBUSTIBLE LIQUID QUANTITIES IN STORAGE. The maximum quantity of flammable and combustible liquids in storage and use in a lab must not exceed 120 gallons. *Note: These quantities may be doubled if stored in approved storage cabinets or in sprinklered buildings. (both increases apply)	MSFC (20) 5003.1.1	☐	☐	☐
4. HAZARDOUS MATERIALS – QUANTITIES IN STORAGE & USE. Quantities of hazardous materials being stored or used shall not exceed the amounts shown in Table 1 (adapted from MSFC Table 5003.1.1).	MSFC (20) 5003.1.1	☐	☐	☐
5. APPROVED CONTAINERS. All chemicals must be stored in approved containers (if possible, chemicals should be stored in the original shipping package).	MSFC (20) 5003.2.1	☐	☐	☐
6. FLAMMABLE/COMBUSTIBLE LIQUID CONTAINERS. Class I, II and IIIA liquids must be stored in approved storage containers.	MSFC (20) 5704.3.1	☐	☐	☐
7. REACTIVE MATERIALS. Materials that will react with water or other liquids to produce a hazard shall not be stored in the same room or area with flammable/combustible liquids -or- such materials must be isolated within an approved hazardous materials storage cabinet.	MSFC (20) 5704.3.3.2	☐	☐	☐
8. GAS CYLINDERS. Gas cylinders designed with protective devices such as caps, collars, or plugs shall have such devices in place when not in use.	MSFC (20) 5303.6	☐	☐	☐

9. GAS CYLINDERS. Gas cylinders must be secured in place to prevent falling.	MSFC (20) 5303.5.3	☐	☐	☐
10. SDS AVAILABLE. Safety Data Sheets (SDS) must be readily available on the premises for all hazardous chemicals.	MSFC (20) 5003.4	☐	☐	☐
11. INCOMPATIBLE MATERIALS. Incompatible materials shall be properly separated.	MSFC (20) 5003.9.8	☐	☐	☐
12. DEFECTIVE CONTAINERS. Defective containers must be removed and disposed of in a proper manner.	MSFC (20) 5003.2.6	☐	☐	☐
13. CHEMICAL RELEASE. Hazardous Materials shall not be released into a sewer, storm drain, ditch, drainage canal, lake, river or tidal waterway, or upon the ground, street, sidewalk, street or highway or into the atmosphere.	MSFC (20) 5003.3	☐	☐	☐
14. SECURING STORAGE AREAS. Areas used for storage, use or handling of hazardous materials must be secured against unauthorized entry.	MSFC (20) 5003.9.2	☐	☐	☐
15. CONTAINER LABELING. All containers must be properly labeled to identify their contents.	MSFC (20) 5003.5	☐	☐	☐
16. TRANSFER OF FLAMMABLE LIQUIDS. When transferring flammable (Class I) liquids between containers or when transferring liquids handled at or above their flash points, the containers must be properly bonded together. The practice of dispensing from large containers into smaller containers is discouraged.	MSFC (20) 5705.3.2	☐	☐	☐

Table 1: Quantities of materials allowed in a single room or area

MATERIAL:	CLASS:	MAX. QUANTITY - STORAGE:	MAX. QUANTITY - USE:
Combustible Liquids	II	120 gallons	30 gallons
	III-A	330 gallons	80 gallons
	III-B	13,200 gallons	3,300 gallons
Corrosives & Acids		5,000 lbs. 500 gallons 810 cu. ft.	1,000 lbs. 100 gallons
Cryogenic (flammable)	Flammable	45 gallons	10 gallons
Flammable Gas	Gaseous Liquefied	1,000 cu. ft. 30 gallons	No specific limits
Flammable Liquids	I-A	30 gallons	10 gallons
	I-B	120 gallons	30 gallons
	I-C	120 gallons	30 gallons
Organic Peroxides	I	5 lbs or 5 cu. ft.	1 lb or 1 cu. ft.
	II	50 lbs or 50 cu. ft.	10 lbs or 10 cu. ft.
	III	125 lbs or 125 cu. ft.	25 lbs or 25 cu. ft.
	IV	no limits	no limits
	V	no limits	no limits
Oxidizers	4	1 lb or 1 gallon	1/4 lb. or 1 quart
	3	10 lbs or 10 gallons	2 lbs or 2 gallons
	2	250 lbs or 250 gallons	50 lbs or 50 gallons
	1	4,000 lbs or 4,000 gallons	1,000 lbs or 1,000 gallons
Note: These quantities can be doubled if all materials are stored or kept in storage cabinets.			
Note: These quantities can also be doubled if the building is protected with a fire sprinkler system.			

Table 2: Examples of excessive risk chemicals (risk exceeds educational value)

Acetic Anhydride:	Explosive potential, corrosive
Acetyl Chloride:	Corrosive, fire risk, reacts violently with water and alcohol
Acrylamide:	Toxic by absorption, suspected carcinogen
Acrylonitrile:	Flammable, poison
Adipoyl Chloride:	Corrosive, absorbs through skin, lachrymator (causes eyes to tear)
Aluminum Chloride:	Corrosive, water reactive
Ammonia, gas:	Corrosive, lachrymator (causes eyes to tear)
Ammonium Bifluoride:	Reacts with water, forms Hydrofluoric Acid
Ammonium Bichromate:	May explode upon contact with organics, suspected carcinogen
Ammonium Chromate:	Poison, oxidizer, may explode when heated
Ammonium Dichromate:	Reactive, may cause fire and explosion
Ammonium Perchlorate:	Explosive, highly reactive
Ammonium Sulfide:	Corrosive, poison, reacts with water and acids

Aniline:	Absorbs through skin, carcinogen, toxic
Aniline Hydrochloride:	Poison
Antimony Oxide:	Health hazard
Antimony Powder:	Flammable solid, health hazard
Antimony Trichloride:	Corrosive, emits Hydrogen Chloride gas if moistened
Arsenic compounds:	Carcinogen, poison
Asbestos, Friable:	Carcinogen, health hazard (inhalation)
Azide compounds:	Extremely reactive, explosive in contact with metals, highly toxic
Barium Chromate:	Poison
Benzene:	Carcinogen, flammable
Benzoyl Peroxide:	Flammable, organic peroxide, oxidizer
Beryllium & its compounds:	Carcinogen, poison; dust is highly toxic
Bromine:	Corrosive, oxidizer, volatile liquid
Cadmium compounds:	Carcinogen, toxic, heavy metal
Calcium Fluoride (Fluorspar):	Toxic fumes when heated, damage to fetus or embryo
Carbon Disulfide:	Flammable, toxic
Carbon Tetrachloride:	Carcinogen, toxic
Chloral Hydrate:	Sedative, hypnotic drug, DEA controlled substance
Chlorine – gas:	Corrosive, poison
Chlorobenzene:	Explosive, toxic by inhalation
Chloroform:	Carcinogen, can form phosgene gas (if old)
Chorosulfonic Acid:	Toxic (aka Sulfuric Chlorohydrin)
Chromic Acid:	Strong oxidizer, poison
Collodion:	Flammable, explosive when dry, nitrocellulose compound
Cuprous Cyanide:	Toxic
Cyanogen Bromide:	Poison, irritant to skin and eyes
Cyclohexene:	Flammable, forms peroxides
Dichlorobenzene:	Toxic
Dichloroethane:	Flammable, toxic
Dinitro Phenol:	Explosive, disposal by bomb squad
Dinitrophenyl Hydrazine:	Severe explosion and fire risk

Dioxane:	Flammable, forms peroxides
Ether, Anhydrous:	Flammable, forms peroxides
Ether, Ethyl:	Flammable, forms peroxides
Ether, Isopropyl:	Flammable, forms peroxides
Ethylene Dichloride:	Contact hazard, toxic, fire risk, explosive in air (6-16%)
Ethyl Nitrate:	Explosive, disposal by bomb squad
Ethyleneimine:	Flammable
Ferrous Sulfide:	Spontaneously ignites if wet
Formaldehyde (Formalin):	Carcinogen, sensitizer, toxic
Gunpowder:	Explosive
Hydrazine:	Carcinogen, corrosive, flammable, absorbs through skin
Hydriodic Acid:	Corrosive, toxic
Hydrobromic Acid:	Corrosive, poison
Hydrofluoric Acid:	Corrosive, poison
Hydrogen:	Flammable
Hydrogen Sulfide, gas:	Poison, forms Sulfuric Acid with water
Lithium Aluminum Hydride:	Flammable, reacts with air, water, and organics
Lithium Metal:	Water reactive
Mercaptoethanol:	Corrosive, flammable
Mercury compounds:	Poison, heavy metal
Mercury, liquid:	Carcinogen, toxic, heavy metal
Methylene Chloride:	Carcinogen, narcotic, toxic
Methyl Ethyl Ketone (MEK):	Flammable, toxic
Methyl Isocyanate:	Flammable, toxic
Methyl Isopropyl Ketone:	Toxic
Methyl Methacrylate:	Flammable, vapors cause explosive mixture in air
Naphthylamine, a-:	Carcinogen, combustible, toxic
Nickel Oxide:	Carcinogen, toxic, flammable as a dust
Nitrilotriacetic Acid:	Corrosive
Nitrobenzene:	Highly toxic
Nitrocellulose:	Explosive, flammable

Nitrogen Triiodide:	Explosive, disposal by bomb squad
Nitroglycerine:	Explosive, disposal by bomb squad
Osmium Tetraoxide	
(Osmic Acid):	Highly toxic
Pentachlorophenol:	Extremely toxic
Perchloric Acid:	Strong oxidizer, reactive
Phosphorus Pentasulfide:	Water reactive, toxic, incompatible with air & moisture
Phosphorus Pentoxide:	Oxidizer, toxic
Phosphorus, Red:	Flammable solid
Phosphorus,	
Yellow or White:	Reactive with air, poison
Picric Acid	
(Trinitrophenol):	Explosive when dry
Potassium Cyanide:	Poison, extremely hazardous
Potassium Perchlorate:	Powerful oxidizer, reactive
Potassium Sulfide:	Flammable, spontaneously ignites
Potassium, metal:	Reactive with water, forms peroxides
Pyridine:	Flammable, toxic, vapors cause explosive mixture in air
Selenium:	Toxic
Silver Oxide:	Poison
Silver Cyanide:	Extremely toxic
Sodium metal:	Corrosive, water reactive, spontaneously ignites
Sodium Arsenate:	Carcinogen, toxic
Sodium Arsenite:	Carcinogen, toxic
Sodium Azide:	Reacts explosively with metal, poison
Sodium Borohydride:	Flammable solid, water reactive
Sodium Cyanide:	Poison
Sodium Fluoride	
(Bifluoride):	Toxic by ingestion & inhalation, skin irritant
Sodium Fluoroacetate:	Poison
Sodium Peroxide:	Water reactive, fire and explosion risk
Sodium Sulfide:	Fire and explosion risk
Strontium:	Flammable, water reactive (store under naphtha)

Tetrahydrofuran:	Flammable forms peroxides
Thioacetamide:	Carcinogen, combustible, toxic
Thionyl Chloride:	Corrosive
Thiourea:	Carcinogen
Titanium Trichloride:	Flammable
Triethylamine:	Flammable, irritant, toxic
Trinitrobenzene:	Explosive, disposal by bomb squad
Trinitrophenol:	Explosive, disposal by bomb squad
Trinitrotoluene:	Explosive, disposal by bomb squad
Uranium/Uranyl Compounds:	Radioactive

Table 3: High-risk chemicals — use very limited amounts

Acetamide:	Carcinogen
Ammonium Nitrate:	Powerful oxidizer, reactive
Barium Peroxide:	Fire & explosion risk with organics; oxidizer, toxic
Butyric Acid:	Corrosive
Cadmium Sulfide:	Carcinogen, highly toxic
Calcium Carbide:	Flammable, water reactive
Chromium Trioxide:	Oxidizer, poison
Ethidium Bromide:	Mutagen
Hexamethylenediamine:	Corrosive, absorbs through skin, lachrymator (causes eyes to tear)
Hexanediamine, 1-6:	Corrosive, absorbs through skin, lachrymator (causes eyes to tear)
Hydrogen Peroxide, >29%:	Corrosive to tissue, powerful oxidizer
Lead compounds:	Highly toxic
Lead Nitrate:	Oxidizer, toxic, heavy metal
Magnesium, powder:	Flammable
Mercury Thermometers:	Corrosive, toxic, heavy metal
Phenol:	Poison
Potassium Chlorate:	Reactive, powerful oxidizer
Potassium Chromate:	Oxidizer, toxic
Potassium Dichromate:	Carcinogen, powerful oxidizer

Radioactive Materials:	Radioactive
Sebacoyl Chloride:	Corrosive, irritant, lachrymator (causes eyes to tear)
Silver compounds:	Toxic
Sodium Chlorate:	Powerful Oxidizer
Sodium Chromate:	Oxidizer
Sodium Dichromate:	Reactive, fire & explosion risk
Sodium, metal (small chips):	Corrosive, water reactive
Strontium Nitrate:	Oxidizer, may explode when heated
Thermite:	Flammable solid
Toluene:	Flammable, toxic
Wood's Metal:	Poison
Xylene:	Flammable, toxic