

# 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.

<u>Item/Description:</u>	<u>Citation</u>	<u>Meets</u>	<u>Does Not Meet</u>	<u>N/A</u>
<b>1. FIRE EXTINGUISHERS.</b> 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 (15) 906.1			
<b>2. EGRESS AISLES.</b> Aisles serving work areas on two sides must be at least 36" wide; those serving work areas on one side must be 24".	MSFC (15) 1104.22.1			
<b>3. NUMBER OF EXITS.</b> 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 (15) 1015.1 MSFC (15) 1104.24			
<b>4. FIRE SEPARATIONS.</b> 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 (15) 1106.3			
<b>5. FIRE ALARM &amp; DETECTION.</b> 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 (15) 1103.7.2.2			



<b>6. ELECTRICAL SAFETY.</b> Damaged electrical wiring, receptacles, and fixtures must be repaired in accordance with the state electrical code. 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 (15) 605.7			
<b>7. EXTENSION CORDS.</b> 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 (15) 605.5			
<b>8. ELECTRICAL MULTI-PLUG ADAPTERS.</b> Relocatable power-taps (i.e. power strips) must be grounded and listed to UL 1363. Current-taps (multi-plug adapters without a power-cord) must be listed to UL 498A.	MSFC (15) 605.4			
<b>9. ELECTRICAL PANEL ACCESS.</b> 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 (15) 605.3			
<b>10. EMERGENCY PLANNING.</b> 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 (15) 5003.9.1			
<b>11. SPILL CONTROL.</b> Neutralizing chemicals, spill kits, dry sand, absorbents and other spill control methods must be readily available while the lab is in use.	MSFC (15) 5003.9.1			
<b>12. GAS SHUT-OFF VALVE.</b> 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 (15) 5003.2.2.1, item 3			
<b>13. FUME HOODS.</b> Fume/exhaust hoods must be listed or engineered for its intended use and maintained in proper operating condition.	MSFC (15) 5003.2			
<b>14. EYE PROTECTION.</b> 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			
<b>4. GAS PIPING SYSTEMS.</b> Gas piping systems must comply with nationally recognized standards.	MSFC (15) 5003.2.2			
<b>6. USE OF REFRIGERATORS.</b> Refrigerators, freezers and other cooling equipment used to store or cool flammable liquids must be specifically listed for such use.	MSFC (15) 605.7			

## Part 2: General safety *recommendations* for science labs

<p><b>1. SUPERVISION OF STUDENTS.</b> 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.</p>	<p>Recommendation NFPA 45 (15) 3.3.13</p>
<p><b>2. ELECTRICITY &amp; SPILLS.</b> Electrical receptacles, switches, and controls must be located so as not to be subject to liquid spills.</p>	<p>Recommendation NFPA 45 (15) 5.6</p>
<p><b>7. USE OF REFRIGERATORS.</b> Each refrigerator, freezer, or cooler should be prominently marked to indicate whether it meets the requirements for safe storage of flammable liquids.</p>	<p>Recommendation NFPA 45 (15) 11.3.2</p>
<p><b>8. EXPLOSIVE MATERIALS NOT ALLOWED.</b> It is recommended that due to the serious explosion hazard present, the following chemicals <b>not</b> be used in an instructional setting:</p> <ul style="list-style-type: none"> <li>Benzoyl Peroxide</li> <li>Carbon Disulfide</li> <li>Ethyl Ether</li> <li>Perchloric Acid</li> <li>Picric Acid</li> <li>Potassium metal</li> <li>Magnesium powdered metal</li> </ul>	<p>Recommendation</p>
<p><b>9. PERSONAL SAFETY.</b> 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.</p>	<p>Recommendation</p>
<p><b>10. HEAT SOURCES.</b> Heat sources should never be left unattended (e.g. gas burners, hot plates, heating mantles, etc.)</p>	<p>Recommendation</p>
<p><b>11. DANGEROUS RISK CHEMICALS.</b> See lists of chemical where risk exceeds the educational value or the chemicals should be used in limited quantities. (Tables 2 and 3)</p>	<p>Recommendation</p>
<p><b>12. VENTILATION.</b> Science labs and associated chemical storage areas should be equipped with a ventilation system having a minimum exhaust rate of 1.0 CFM/ft<sup>2</sup>. *Note: this is a requirement for newly constructed labs.</p>	<p>Recommendation MMC (15) 403.3</p>

## 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>
<b>1. FLAMMABLE/COMBUSTIBLE LIQUID QUANTITIES IN USE.</b> 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 2703.1.1)	MSFC (15) 5704.3.4.1			
<b>2. FLAMMABLE LIQUIDS CABINET.</b> 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 (15) 57043.4.4			
<b>3. FLAMMABLE/COMBUSTIBLE LIQUID QUANTITIES IN STORAGE.</b> 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 (15) 5003.1.1			
<b>4. HAZARDOUS MATERIALS – QUANTITIES IN STORAGE &amp; USE.</b> Quantities of hazardous materials being stored or used shall not exceed the amounts shown in Table 1 (adapted from MSFC Table 5003.1.1(1)).	MSFC (15) 5003.1.1			
<b>5. APPROVED CONTAINERS.</b> All chemicals must be stored in approved containers (if possible, chemicals should be stored in the original shipping package).	MSFC (15) 5003.2.1			
<b>6. FLAMMABLE/COMBUSTIBLE LIQUID CONTAINERS.</b> Class I, II and IIIA liquids must be stored in approved storage containers.	MSFC (15) 5704.3.1			
<b>7. REACTIVE MATERIALS.</b> 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 (15) 5704.3.3.2			
<b>8. GAS CYLINDERS.</b> Gas cylinders designed with protective devices such as caps, collars, or plugs shall have such devices in place when not in use.	MSFC (15) 5303.6			

<b>9. GAS CYLINDERS.</b> Gas cylinders must be secured in place to prevent falling.	MSFC (15) 5303.5.3			
<b>10. SDS AVAILABLE.</b> Safety Data Sheets (SDS) must be readily available on the premises for all hazardous chemicals.	MSFC (15) 5003.4			
<b>11. INCOMPATIBLE MATERIALS.</b> Incompatible materials shall be properly separated.	MSFC (15) 5003.9.8			
<b>12. DEFECTIVE CONTAINERS.</b> Defective containers must be removed and disposed of in a proper manner.	MSFC (15) 5003.2.6			
<b>13. CHEMICAL RELEASE.</b> 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 (15) 5003.3			
<b>14. SECURING STORAGE AREAS.</b> Areas used for storage, use or handling of hazardous materials must be secured against unauthorized entry.	MSFC (15) 5003.9.2			
<b>15. CONTAINER LABELING.</b> All containers must be properly labeled to identify their contents.	MSFC (15) 5003.5			
<b>16. TRANSFER OF FLAMMABLE LIQUIDS.</b> When transferring flammable liquids between containers, the containers must be properly bonded together. The practice of purchasing large containers and dispensing into smaller ones is discouraged.	MSFC (15) 5705.3.2			

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

<b>MATERIAL:</b>	<b>CLASS:</b>	<b>MAX. QUANTITY - STORAGE:</b>	<b>MAX. QUANTITY - USE:</b>
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.	1,000 lbs.
		500 gallons	100 gallons
		810 cu. ft.	
Cryogenic (flammable)	Flammable	45 gallons	10 gallons
Flammable Gas	Gaseous	1,000 cu. ft.	No specific limits
	Liquefied	30 gallons	
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)**

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

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

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

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

<b>Sodium Fluoroacetate:</b>	Poison
<b>Sodium Peroxide:</b>	Water reactive, fire and explosion risk
<b>Sodium Sulfide:</b>	Fire and explosion risk
<b>Strontium:</b>	Flammable, water reactive (store under naphtha)
<b>Tetrahydrofuran:</b>	Flammable forms peroxides
<b>Thioacetamide:</b>	Carcinogen, combustible, toxic
<b>Thionyl Chloride:</b>	Corrosive
<b>Thiourea:</b>	Carcinogen
<b>Titanium Trichloride:</b>	Flammable
<b>Triethylamine:</b>	Flammable, irritant, toxic
<b>Trinitrobenzene:</b>	Explosive, disposal by bomb squad
<b>Trinitrophenol:</b>	Explosive, disposal by bomb squad
<b>Trinitrotoluene:</b>	Explosive, disposal by bomb squad
<b>Uranium/Uranyl Compounds:</b>	Radioactive

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

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

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