Chemical Hygiene Plan

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Created By:

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Intro

The general intent of the **Chemical Hygiene Plan** is to protect employees from the hazards associated with the use of hazardous chemicals in schools and to assure that staff and students are not exposed to substances in excess of the permissible exposure limits established in 29 CFR 1910 Subpart Z and adopted by the New Jersey Public Employees Occupational Safety and Health Administration (PEOSHA).

This Plan has been reviewed and updated in accordance with 29 CFR 1910.1450, which has also been adopted by PEOSHA, together with "Prudent Practices for Handling Hazardous Chemicals in Laboratories", published by the National Research Council. It is not intended to be an all-inclusive guide for teachers. However, its purpose is to provide staff members with a quick reference for common situations that might occur in a school setting. If a staff member is confronted with a situation that he/she is uncomfortable or unfamiliar with, first seek out help and more information, before proceeding.

This Plan will be available to all School District Employees for review. A copy will be located in the following areas: Main Office and Buildings & Grounds Office

General Principles

Staff should seek information about potential hazards before using potentially dangerous materials. If such materials must be used, staff members should take all necessary precautions and follow all of the necessary safety procedures. If a procedure, piece of equipment or chemical is unfamiliar, the staff member should seek out the appropriate information before using it. Information regarding chemical hazards is found on the Safety Data Sheet (SDS) which is available from the chemical manufacturer. The SDS should be obtained from the Central File

and reviewed for hazards and proper storage requirements. Before an unfamiliar chemical is ordered, the SDS should be obtained from the manufacturer or distributor.

Staff members should be aware of potentially unsafe conditions and see that they are corrected when detected. This is especially true for electrical wiring, the gas supply, chemical usage and storage.

No staff members should work with hazardous materials while alone in the building.

Laboratories (*If Any*): Staff members should avoid working on any laboratory operations alone. Students should never be left alone during any laboratory operation. Science classrooms should never be left unattended or unlocked.

Because few laboratory chemicals are without hazards, it is prudent to minimize all chemical exposures. Avoid underestimation of risk, even for substances of no known significant hazard. Staff should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic. Skin contact with chemicals should be avoided as a cardinal rule.

All staff should be aware of the Permissible Exposure Limits (PELs), and Threshold Limit Values (TLVs) of the chemicals that they are using. The Permissible Exposure Limits of PEOSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists (ACGIH) should not be exceeded.

The Chemical Hygiene Officer has overall responsibility for chemical hygiene in the laboratories, ensuring that protective equipment is available, appropriate training has been provided, and that the Staff knows and follows the chemical hygiene rules. Responsibilities include formal and regular chemical hygiene and housekeeping inspections of the laboratory and associated emergency equipment.

The Laboratory Staff is responsible for planning and conducting each laboratory operation in accordance with institutional chemical hygiene procedures. Responsibilities include developing good, personal chemical hygiene habits.

Chemical Hygiene Plan

1. Basic Rules and Procedures

The Plan requires that all Staff know and follow its rules and procedures. The following "general" rules should be used for work with chemicals:

a) Accidents and Spills

- Determine the severity of the incident and call for custodial assistance
- If the severity of the incident demands it, evacuate the room or area and notify the Chemical Hygiene Officer, School Principal, and other School District officials
- Spills should be expeditiously cleaned up using appropriate protective apparel, equipment and proper disposal techniques; Guidance on cleanup for specific chemicals are available on the SDS for that chemical
- Always have a chemical hazard waste receptacle available for "emergencies"
- Never place acids, corrosives, flammables or other hazardous chemicals into the waste receptacle; Never mix different chemical wastes unless it has been determined that the chemicals will not react
- Make sure that custodial staff is aware of the potential hazards in the chemical hazard waste receptacle
- In the case of eye contact, promptly flush eyes with water for a minimum of fifteen (15) minutes and seek medical help
- In the case of ingestion, the victim should be encouraged to drink large amounts of water and seek medical help; consult the SDS for guidance; if the SDS is not readily available, the NJ Poison Control Center may be called at 1-800-222-1222
- For skin contact, the area should promptly be flushed with water and contaminated clothing should be removed. If symptoms persist, seek medical help

b) Avoidance of Routine Exposure

- Develop and encourage safe habits and strive to avoid unnecessary exposure to chemicals
- Do not smell, touch or taste chemicals
- Vent apparatus, such as vacuum pump and distillation columns, into local exhaust devices
- Safety equipment such as gloves and goggles should be inspected before use
- Gloves and lab coats should be worn when deemed necessary

- Be aware of the hazard potential of all chemicals being used; Ask for assistance before use of any substances of which you are unsure

c) Chemicals

- Use only those chemicals for which the quality of the available ventilation system is appropriate
- Chemicals should be stored in appropriate containers properly labeled, and placed in a locked storage room
- Chemicals should not be left in the laboratory; Once an experiment is completed, the chemicals should be returned to the storage room or the appropriate cabinet
- Students should not be allowed to handle chemicals without supervision
- When pipetting or siphoning liquids, mouth suction should never be used
- Students should be informed of the proper safety procedures when working with all chemicals, especially corrosive or flammable; biohazards; reactive or toxic chemicals; compressed gases
- All chemical waste needs to be disposed of properly and cannot be placed in the classroom laboratory trash can
- Students should not be allowed to mix chemicals unless directed to do so in the stipulated procedures
- The Chemical Hygiene Officer should be informed immediately if an accident involving a chemical spill occurs or if a substance comes in contact with skin or clothing

d) Eating and Food Storage

- Storage, consumption or handling of food or beverages in science storage areas is not permitted; Science refrigerators, glassware or utensils that are used for laboratory operations are not to be used for food
- Eating, drinking, gum chewing or the application of cosmetics in prep room areas where laboratory chemicals are present is not permitted
- Wash hands before eating, drinking or gum chewing, especially after working with chemicals

e) Equipment and Glassware

- All equipment should be checked to insure proper working order before use
- Use equipment for its designed purpose only
- Handle and store laboratory glassware with care to avoid damage
- Any damaged or malfunctioning equipment should be removed from the lab, repaired or disposed of; Do not use damaged glassware

- Check for broken, cracked or chipped glassware; Any glassware in this condition should be disposed of
- When using rubber or cork stoppers with glassware or glass tubing, the attachment should not be forced
- Glassware should be thoroughly washed after each use to eliminate the chance of contamination and unwanted reactions
- When heating material in glassware over a Bunsen burner or on a hot plate, always use Kimax or Pyrex; The glassware needs to be stamped with one of those two labels
- Shield or wrap flasks and other glass apparatus to contain chemicals and fragments should implosion occur

f) Exiting

- Wash areas of exposed skin before leaving the laboratory

g) Behavior

- Avoid practical jokes or other behavior which might confuse, startle or distract another staff member or a student
- Unsafe laboratory procedures and inappropriate behaviors will not be tolerated

h) Personal Apparel

- Long hair should be tied back, and loose clothing should be secured, before working in a lab
- Shoes should be worn at all times in laboratories; Do not wear sandals, perforated shoes, or sneakers

i) Housekeeping

- Keep the work area clean and uncluttered; clean up the work area on completion of an operation and at the end of each day
- Properly store and label all chemicals and equipment

j) Personal Protection

- Use any and all appropriate protective and emergency apparel and equipment
- Protective eye wear is required to protect Staff, Students and Visitors from splashing chemicals, flying objects and sharp instruments; Assure that appropriate eye protection is worn by all persons, including visitors, wherever chemicals are stored or handled; Staff and students wearing glasses must wear goggles
- Keep protective eye wear on until all chemicals and equipment are put away

- Goggles must "meet American National Standards Institute (ANSI Z87.1) standards"; multiple purpose goggles (impact, projectile and chemical protection) should meet the following criteria: fit comfortably, securely and have a pliable flange, which seals around the eyes for chemical splash protection
- Goggles need to be the appropriate size and shape of the face. If eyewear is too large or small, protection is limited
- When working with chemicals, contact lenses should be avoided and goggles are to be worn at all times; if contact lenses are worn, inform the Science Department Supervisor so that special precautions may be taken
- Wearers of contact lenses shall be required to wear appropriate eye covering and face protection devices in a hazardous environment; It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers
- Wear appropriate gloves when the potential for contact with chemicals exists
- Inspect gloves before each use; Gloves should be checked for punctures, tears or holes; Replace gloves periodically
- It is important to use the correct type of glove for the task; Gloves can protect hands from the absorption of hazardous materials and excess heat and absorb perspiration
- Wash gloves before removal
- Assure that air contaminant concentrations are adequately exhausted and air is not significantly restricted by engineering controls; If particulate matter is being produced, disposable dust masks can be worn. Respirators are prohibited from use
- Lab coast or aprons can be worn to protect clothing and skin from chemicals and other materials that may be spilled or splashed
- Remove laboratory coats immediately on significant contamination
- After working with chemicals, staff members and students should wash areas of exposed skin, particularly hands and arms

k) Planning

- Plan appropriate protective procedures and the proper positioning of equipment before beginning any new chemical operation
- Seek information and advice about hazards; Information on the hazards of specific chemicals is found on the Safety Data Sheets (SDS)
- Disposal plans should be included in the procedures (if and when necessary)

l) Unattended Operations

- Do not leave any chemical operation unattended

m) Use of Laboratory Hood

- Laboratory Hoods should be used for all experiments that might result in the release of toxic fumes, vapors, or dust
- Use the Laboratory Hood when working with any appreciably volatile substance with a TLV of less than 50 parts per million (ppm)
- Staff should confirm proper Laboratory Hood performance before use
- Keep the Laboratory Hood closed at all times during chemical operations except when adjustments within the Hood are being made and then the Hood should be opened only wide enough to perform the adjustment
- Do not block vents or air flow within the Laboratory Hood during chemical operations
- Do not store chemicals in the Laboratory Hood; After use, all chemicals and equipment should be removed from the hood and properly stored
- If toxic materials need to remain in the hood, the hood should be left on to prevent the build-up of toxic concentration in the air
- Laboratory Hoods should be regularly maintained to ensure peak performance; The Chemical Hygiene Officer will ensure the inspection of laboratory hoods for appropriate airflow and functioning
- The Laboratory Hood should be used to minimize waste and chemical volume; Boiling away small amounts of chemical solutions to dryness and the proper disposal of the solid wastes by a licensed disposal company shall be the standard operating procedure for the department
- When working with volatile or toxic materials, additional room ventilation should be used or do the entire activity in the hood

n) Vigilance

- Be alert to unsafe conditions and call the custodian to correct them when detected; Notify the Chemical Hygiene Officer and School Principal in writing of unsafe conditions detected

o) Working Alone

- Do not work alone in the laboratory if a chemical operation is being conducted

p) Chemical Waste Disposal

- Assure that the planning for each chemical operation includes procedures and training for chemical waste disposal
- Deposit chemical waste in appropriately labeled receptacles
- Do not discharge chemicals by any means to the sewer

- Chemicals are to be disposed of according to applicable Federal and State regulations; Notify the Chemical Hygiene Officer of any chemical waste
- Avoid the commingling of incompatible reagents in hazardous waste receptacles

2. Chemical Procurement, Distribution and Storage

a) Procurement

- Before a substance is received, information on proper handling, storage and disposal should be known to all those who will be involved in handling; This information is available on the Safety Data Sheets (SDS).
- Chemical reagents should be purchased in the smallest quantities possible; In the Science Department, a year's supply of most chemical reagents would constitute a satisfactory supply for most situations; Some chemicals that have a relatively long shelf life and are relatively non-reactive may be purchased in larger quantities; Quantities should not exceed a three-year need
- Science Department chemical orders will be monitored by the Chemical Hygiene Officer
- No container should be accepted without an adequate identifying label
- All chemicals will be checked and properly labeled before they are put in storage
- SDS and NJ HSFS will be located in the Main Office Central File and will be available to all Staff
- When unpacking chemicals, remove the SDS and give them to the Chemical Hygiene Officer and/or the Main Office and place them inside the SDS Binder in the Central File
- The NFPA HAZARD LABEL depicts information provided by the National Fire Protection Association concerning Health Hazard (H), Fire Hazard (F), Reactivity with other substances (R), and other (0) category; This system was designed to assist firefighters in dealing with chemical fires, and the information is valuable in recognizing chemical hazards; This information should be shared with students when appropriate; The NFPA hazard rating system should be used with care; The NFPA has not rated all items; For additional detailed information concerning chemicals, refer to the Merck Index
    - The HAZARD CLASS (H) provides information developed by the US Department of Transportation concerning safe transport of hazardous materials in commerce; The group includes: Explosives, Combustible Liquids, Compressed Gases, Corrosives, Flammable Gases, Flammable liquids, Flammable Solids and Poisons

NFPA Hazard Coding System

Signal #	Health Hazard	Flammability	Reactivity
4	Could cause death on short exposure	Rapid vaporizing at atmospheric pressure	Capable of explosive detonation
3	Short exposures can cause serious residual injury, even with prompt medical aid	Liquids, solids can be ignited under almost all ambient temps	with strong initial source – heat or pressure, can be explosive. Violent reaction with water
2	Upon intense or continual exposure, could cause temporary incapacitation	Must receive moderate heat before ignition will occur	Normally unstable, can undergo chemical change rapidly. Not explosive. Violent reaction with water
1	Exposure could cause irritation or minor injury if untreated	Must be preheated before ignition will occur	Normally stable but can become unstable at high temp. & pressure. May react with water, not violent
0	No more hazardous than Normally combustible Items	Will not burn	Normally stable even when exposed to fire, no reaction to water

b) Stockrooms/Storerooms

- Toxic substances should be clearly identified and segregated from other substances and stored with local exhaust ventilation
- Toxic and highly reactive chemicals, once opened, should be stored in unbreakable secondary containers; Plastic zip-lock bags should be used to enclose chemical bottles once opened

- Stored chemicals should be examined annually for replacement, deterioration and container integrity *(Note: Laboratory Staff are the primary persons responsible for this and should alert the Chemical Hygiene Officer of any problems)*

c) Distribution

- When chemicals are hand carried, the container should be placed in an outside container or bucket
- Elevators should not be used

d) Laboratory Storage

- Storage on bench tops and in hoods is not permitted
- Exposure to heat or direct sunlight is inadvisable
- Periodic inventories of stored chemicals should be conducted, with unneeded items being discarded using only approved methods of disposal

Table 1A
Suggested Shelf Storage Pattern – Inorganic

Inorganic 10 Sulfur, Phosphorus, Arsenic, Phosphorous Pentoxide	**Inorganic 7** Arsenates, Cyanides, Cyanates
Inorganic 2 Halides, Sulfates, Sulfites, Thiosulfates Phosphates, Halogens, Acetates	**Inorganic 5** Sulfides, Selenides, Phosphides Carbides, Nitrides
Inorganic 3 Amides, Nitrites, Azides, Nitrates (except Ammonium Nitrate)	**Inorganic 8** Morates, Chromates, Managenates, Permanganates
Inorganic 1 Metals, Halides (store away from water and store solids in flammable cabinet)	**Inorganic 6** Chlorates, Perchlorates, Chlorites, Perchloric acid, Peroxides (Hydrogen), Hypochlorites
Inorganic 4 Hydroxides, Oxides, Silicates, Carbonates, Carbon	**Miscellaneous**

Inorganic 9

Acids, except Nitric (store Nitric separately)

Table 1B

Suggested Shelf Storage Pattern – Organic

Organic 2

Alcohols, Glycols, Amines, Amides, Imines, Inides

Organic 8

Phenol, Cresols

Organic 3

Hydrocarbons, Esters, Aldehydes

Organic 6

Peroxides, Azides, Hydroperoxides

Organic 4

Ester, Ketones, Halogenated Hydrocarbons, Ethylene Oxide

Organic 1

Acids, Anhydrides, Peracids

Organic 5

Epoxy compounds, Isocyanates

Organic 7

Sulfides, Polysulfides

Miscellaneous

*Store flammable (including Organic 2 & 3) in cabinet

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e) Specific Storage Safety Regulations

- Dangerous chemicals, such as corrosives, should be stored as close to the floor as possible in a special vented cabinet
- Any chemicals that are stored at floor level should not be in the walking area
- Chemicals should **NOT** be kept in a work area for long periods of time; They should be returned to the proper storage area until needed
- Chemicals what react violently with each other should not be stored in close proximity; Dangerous combinations are: *glycerine and nitric acid; ammonia and bleach; cyanides and acids; peroxides; chlorates; nitrates; permanganates (oxidizing agents) and wood; paper and many organic compounds (easily oxidized)*

- White Phosphorus must be kept under water in a double container. The outer container should be metal. Direct sunlight and heat must be avoided. When possible, white phosphorus, sodium, potassium and lithium metals should be eliminated from the chemical inventory
- Sodium must be stored in kerosene as soon as the original container has been opened; Direct sunlight and heat could cause glass containers to break
- Potassium should not be kept at all
- Hydrofluoric acid in wax bottles should be stored under refrigeration
- Ethyl ether, once opened, should not be kept longer than three (3) months; The shelf life of ethyl ether is less than one year; If possible, it should not be stored at all and should be eliminated from the chemical inventory
- Glass tubing should be stored horizontally and supported the full length of the tubing
- All reagent bottles should be prominently and accurately labeled; This includes bottles, flasks, and tubes that contain materials, which are temporarily stored
- All chemicals should be dated upon receipt and clearly show that the Chemical Abstract Service (CAS) number is identified on the container
- Compressed gas cylinders should be stored in fire resistant, ventilated, dry, cool areas; Large cylinders should be securely strapped or chained to a frame built for the purpose and properly capped when not in use
- Flammable liquids such as alcohol, acetone, ethers, and other organic solvents should be stored in a metal storage cabinet; Gallon quantities should be ordered in metal or plastic containers; Such liquids should be dispensed to students in quart, liter, or smaller sizes
- All storage areas should be ventilated to remove toxic vapors
- Students must not have unsupervised and/or inappropriate access to the laboratory storerooms/prep rooms

3. Environmental Monitoring

Since the Science Department does not permit the use of allergens, embryotoxins, and chemicals of moderate chronic or high acute toxicity, regular instrumental monitoring of airborne concentrations is not justified or practical; Such monitoring will only be done upon the recommendation of the school administration

- Laboratory Hoods will be inspected annually to determine their efficiency

4. Housekeeping, Maintenance, and Inspections

a) Cleaning

- During the school year, floors in laboratory areas should be cleaned nightly

b) Inspections

- Formal housekeeping and chemical hygiene inspections will be made annually; Informal inspections will be continual

c) Maintenance

- Eye wash stations and showers will be inspected quarterly; If any problems arise during the school year, they should be brought to the attention of the Chemical Hygiene Officer
- Fire Extinguishers will be inspected annually by the service company that maintains them; After use, the fire extinguisher will be sent out to be refilled
- Laboratory hoods shall be inspected annually; The face velocity shall be determined using a Velometer; The average face velocity of the hood with the sash half closed should be between 60 and 100 feet per minute (FPM); A hood outside this parameter, or when any reading is greater than 125 FPM, should not be used as contaminated air from the hood may enter the laboratory either due to insufficient exhaust volume or turbulence caused by excessive velocity
- An annual report on the operational status of the safety equipment will be completed by independent third party (i.e Consultant) and provided to the Chemical Hygiene Officer and the Supervisor of Buildings and Grounds to review

d) Passageways

- Stairways and hallways should not be used as storage areas; Access to exits, emergency equipment and utility controls should never be blocked

5. Medical Program

- The School District shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention
- If an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be given an opportunity to receive an appropriate medical examination
- If the PEL level in a given laboratory exceeds PEOSHA standards, medical surveillance shall be established for the affected employee by the Chemical

Hygiene Officer *(Note: At this time, no experiments are allowed that would fit this category)*

- Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation by a physician
- The School District shall provide the following information to the physician:
    - The identity of the hazardous chemical(s)
    - A description of the conditions under which the exposure occurred
    - A description of the signs and symptoms of exposure that the employee is experiencing
- As stated in Item 4.c of this Plan, an annual report on the operational status of the safety equipment will be completed by independent third party (i.e., Consultant) and provided to the Chemical Hygiene Officer and the Supervisor of Buildings and Grounds to review
- The physician should provide the School District in writing the following items:
    - Recommendations for further medical follow-up
    - Results of the medical examination
    - Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk
- The School District shall establish and maintain for each employee that works in laboratory situations:
    - An accurate record of any measurements taken to monitor employee exposure
    - Any medical consultation or examination, including tests or written opinions, that are required; these records will be kept by the School District

6. Personal Protective Apparel and Equipment

Each laboratory should include protective apparel compatible with the required degree of protection for those chemicals being handled; The School District has determined that:

- Each Science laboratory will be equipped with the following:
    - Goggles and cabinet
    - Fire extinguisher
    - Fire blanket
    - First Aid kit
    - Eyewash fountain
- Each Chemistry laboratory will be equipped with the following:

- Goggles and cabinet
- Fire extinguisher
- Fire blanket
- First Aid kit
- Eyewash fountain
- Drench-type safety shower
- Laboratory Hood
- Gas shut off

Respiratory protection, fire alarm and telephone for emergency use should be available nearby

7. Records

- Accident records should be written and retained; These records will be maintained by the Chemical Hygiene Officer and School Nurse
- This Plan is updated yearly and is compatible with all current knowledge and regulations
- An inventory of hazardous chemicals shall be maintained and updated annually
- Medical records shall be retained by the School District in accordance with the requirements of State regulations
- The Main Office Central File shall contain all records mandated by NJAC, NJSA, PEOSHA, and any other programs responsible for maintaining and monitoring a safe and healthful workplace environment

8. Signs and Labels

The following items should have prominent signs and labels posted in the laboratories, storage rooms, and science offices:

- Emergency phone numbers
- Identity labels showing the contents of containers holding hazardous materials
- Location signs for safety showers, safety blankets and eye wash stations
- Areas where food and beverages may be stored
- Directions for exiting the facilities in emergencies
- Areas or equipment where unusual hazards exist

9. Spills and Accidents

The most important consideration is the safety of the personnel and students in the area. Evacuation of students and personnel and immediate application of appropriate first aid when needed should take priority. Be familiar with and follow the written Emergency Plan procedures for evacuation, medical care, reporting and drills.

- The Chemical Hygiene Officer, School Principal, and other School District officials should be alerted and efforts should be made to minimize physical damage to the facilities

- Once students and personnel have been evacuated to a safe area, then the chemicals can be confined and neutralized
- For a school laboratory there are two convenient confinement materials, sand and paper toweling
- Sodium Bicarbonate solutions are available in the laboratories and should be used to neutralize spills of acids and bases; SDS and NJ HSFS should be consulted following the containment of the material
- Staff who work with quantities of know hazardous materials larger than 1 liter of concentrated liquid or 100 grams of solid should prepare the appropriate neutralizer in advance
- While working with the containment of the spill, all available ventilation systems should be put into operation in order to minimize toxic vapors
- Appropriate and approved waste disposal techniques should be followed
- If an individual has been injured do not move the person unless they are in further danger by not being moved. Follow the recommended procedures for chemical and heat burns. If there is severe bleeding, control by compressing the wound with a cloth or other suitable material. Notify the School Nurse immediately and call 911

10. Training and Information (Annual Safety Meeting)

- All members of the Science Department will receive safety training. The intent of the training is to assure that all staff members who work in laboratory situations are adequately informed about the work in laboratory, its risks, and what to do if an accident occurs. The training shall be a regular, continuing activity
- Additional training, beyond the Hazard Communication Standard Hazardous Chemicals Training (formerly known as Right to Know Training), can be provided if the need arises
- Staff members should be aware of the information in the Plan, the location and proper use of protective equipment, chemical hazards, the handling of equipment, protective apparel, and relevant regulations
- A number of safety related materials will be maintained in the Science Department and will be updated on a regular basis. The staff will be made aware of the materials available

11. Waste Disposal

- In chemical use, storage and waste disposal, a basic rule of thumb to follow is “less is better”. Consequently, teachers are encouraged to micro-scale or mini-scale experiments when they have the same pedagogical impact as the more common macro-scale experiments. Teachers are also encouraged to consider “cooperative learning

techniques" that would lessen the number of laboratory groups or would allow groups to work on different segments of one laboratory activity

- Since each chemical presents its own special problem for disposal, SDS, NJ HSFS, or Prudent Practices for Disposal of Chemicals from Laboratories, should be consulted for the best methods of disposal. Disposal by recycling or chemical decontamination is the preferred method
- Before beginning any laboratory activity, the teacher should become familiar with the best technique for disposal of the chemicals and materials involved.
- In the chemistry laboratories, the solid chemical waste shall be disposed of in the receptacles labeled for such materials. These receptacles should be emptied on a regular basis.
- Used organic solvents shall be kept in a container designed for this purpose
- Bacterial waste from biological laboratory activities shall be autoclaved before disposal in the regular garbage
- Dissection materials shall be collected in plastic bags and given to the custodial staff for disposal
- Inorganic compounds that are insoluble should be disposed of in the solid chemical waste container. Soluble compounds that contain toxic ingredients should be precipitated and disposed of in the manner suggested by the Chemical Hygiene Officer and the procedures recommended in Prudent Practices for Disposal of Chemicals from Laboratories

General Procedures for Working with Chemicals

12. Allergens and Embryotoxins

The Science Department is not equipped to handle allergens and embryotoxins. Proper safeguards cannot be provided in our laboratories. Staff should not work with allergens or embryotoxins.

13. Chemicals of Moderate Chronic or High Toxicity

The Science Department is not equipped to handle moderate chronic or highly toxic materials. Proper safeguards cannot be provided in our laboratories. Staff should not work with chemicals of moderate chronic or high acute toxicity.

14. Chemicals of High Chronic Toxicity

The Science Department is not equipped to handle high chronic or highly toxic materials. Proper safeguards cannot be provided in our laboratories. Staff should not work with chemicals of high chronic of high acute toxicity.

15. Chemicals of High Chronic Toxicity Involving Animals and Plants

The Science Department is not equipped to handle highly toxic materials. Proper safeguards cannot be provided in our laboratories. Staff should not do animal work with chemicals of moderate or high chronic toxicity.

a) Animals and plants in the Classroom

- Before bringing plants or animals into the classroom, people with allergies need to be considered. People can have allergies to animal fur, bedding and plants that bear pollen
- If students who have allergies need to work with animals and plants, disposable dust masks should be worn
- Never taste/eat any plant material found in a classroom. There are a number of plant species that are poisonous
- If a classroom animal bites a teacher/student, the school nurse should be informed. (A tetanus shot may be required)
- Never bring wild animals into the classroom
- Always wash hands after handling animals
- The type of animal will determine its specific care. Things to consider are: type and size of cage, temperature, food and water requirements
- All culture growth practices must have a Hazardous Laboratory Work Permit (see Appendix C)
- Waste disposal of cultured growths must include sterilization

Control Measures to Reduce Employee Exposure to Lab Hazards

16. Safety Symbols

a) Electrical Safety

- All electrical equipment should be checked for worn cords or loose plugs before use
- Work areas around electrical equipment should be kept dry
- Do not overload electrical circuits
- Electrical outlets should be grounded and should accommodate a 3-pronged plug
- Outlets near sinks or other water sources should be ground fault circuit interrupter (GFCI) protected

b) Heating Safety

- Heat sources should not be left unattended
- Test tubes and other glassware should not be pointed towards an area where there are people
- When handling heated glassware or materials use tongs, test-tube holders or heat resistant gloves
- When using Bunsen burners, proper lighting procedures should be followed. Do not turn on the gas prior to gathering all of the necessary materials and spark source
- All glassware that may be heated should be marked with the Purex or Kimax label

c) Fire and Explosions

- In the event of a fire or explosion, evacuate the area quickly and notify the Chemical Hygiene Officer, School Principal and other School District officials immediately
- Do not attempt to fight any fire unless you have had formal instruction
- Make sure fire blankets and extinguishers are available
- Instruct students on the proper way to evacuate the room and building

17. Hazardous Chemicals Training (Annual Safety Meeting)

Annual Hazardous Chemicals Training will be provided to the Science Department instructional staff. Definitions will be discussed during the training and are listed below for reference:

- The NAME specifies, identifies chemicals, dyes and stains used in educational laboratory situations
- The STORAGE CATEGORY provides a listing of inorganic chemical groupings from 1 through 10 and organic chemical groupings from 1 through 8. Placing chemicals in these groups and storing them according to Tables 1A (Inorganics) and 1B (Organics), will help assure that chemical incompatibilities will be reduced if accidental spillage occurs on a single shelf or if a chemical leaks through to the shelf below. (See Tables on Pages 12 and 13 for Suggested Shelf Storage Pattern)

Explosives (Expl):

Class A: Liquids or gaseous are explosives which, in general, function by detonation. They include such devices as blasting caps, detonating primers, ammunition for a cannon, grenades, bombs, rockets, torpedoes, etc.

Class B: Are those explosives, which generally function by rapid combustion rather than detonation as in Class A. This class includes such items as special fireworks, flash powders, some pyrotechnic signal devices and liquid or solid propellant explosives.

Class C: Are certain types of manufactured articles, which contain Class A or Class B or both as components. They are in restricted quantities and in certain types of fireworks.

Combustible Liquids (Comb. Liq.):

Any liquid that has a flash point at or above 100° (37.8° C) and below 200° F (93.3° C). A flash point is the minimum temperature at which liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Compressed Gas (Comp. Gas):

Any material or mixture having an absolute pressure exceeding 40 pounds per square inch (psi) at 70° F having an absolute pressure exceeding 104 psi at 130° F (while in a container), or any flammable liquid material having a vapor pressure exceeding 40 psi at 100° F.

Corrosive (Corr):

A liquid or solid that causes visible destruction or alterations in human tissue at the site of contact, or in the case of leakage from packaging, a liquid that has a severe corrosion rate on steel.

Flammable Gas (Fl. Gas):

Any material that meets the definition of compressed gas outlined above, or meeting any of the following properties:

(1) A mixture of 13% or less (by volume) with air forms a flammable mixture or the flammable range with air is wider than 12% regardless of the lower limit
(2) There is any significant propagation of flame away from the ignition source
(3) There is any explosion of the vapor-air mixture in the drum

Flammable Liquid (Fl. Liq):

Any liquid having a flash point below 100° F (37.8° C).

Flammable Solid (Fl sol):

Any Solid material other than one classed as an explosive, which can cause fire through friction, retained from heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard (spontaneously combustible) including water-reactive materials.

Other Regulated Materials (ORM):

ORM-A: a material, which has an anesthetic, irritating, noxious, toxic property.

ORM-B: a material (including a solid when wet with water) the leakage of which could cause significant damage to the vehicle transporting it.

ORM-E: a material that is not included in the hazard class ORM-A or ORM-B as described in this document. A material which presents an environmental hazard if it enters natural water sources.

Poison A (Pois. A):

Poisonous gases or liquids of such a nature that a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life.

Poison B (Pois. B):

Those substances, liquids or solid (including pastes and semisolids), other than Class A poisons, or irritating materials, which are known to be so toxic to humans as to afford a hazard to health during transportation; or which, in the absence of adequate data on human toxicity, are presumed to be toxic to humans because they fall within any one of the following categories when tested on laboratory animals:

(1.) Oral Toxicity produces death within 48 hours of a group of 10 or more white laboratory rats weighing 200-300 grams at a single dose of 50 mg. or less per kg of body weight when administered orally.

(2.) Toxicity and inhalation produce death within 48 hours of more than half of a group of 10 or more white laboratory rats weighing 200-300 grams, when inhaled continuously for a period of one hour or less at a concentration of 2 mg or less per liter of vapor, mist or dust, provided such concentration is likely be to encountered by humans when the chemical product is used in any reasonably foreseeable manner.

(3.) Toxicity by Skin Absorption produces death within 48 hours in half or more of a group of 10 or more rabbits tested at a dosage of 200 mg or less per kg of body weight, when administered by continuous contact with the bare skin for 24 hours or less

- The EXPIRATION DATE refers to the manufacturer's suggested shelf expiration date. It is essential that all chemicals be removed from storage and used before this date is exceeded. By adhering to such dates, teachers can be assured that the substance meets the property specifications, which the manufacturer has stated on the container. After this expiration date, many substances begin to degrade and may not have the properties for which it was purchased. As a rule of thumb, it is recommended that not more than a one-year supply of chemicals is stored. This will help assure that items are not beyond their manufacturer's suggested shelf life and that harmful synergistic reactions involving excess quantities of dangerous substances are avoided.

- A SYMPTOMS list provides characteristic symptoms for specific chemicals. The list was compiled by the National Institute for Occupational Safety and Health (NIOSH) and the US Department of Labor Occupational safety and Health Administration (OSHA). Symptoms do not exist for all chemicals, nor are all possible symptoms listed. This category is provided as a reminder that working with chemicals can cause side effects. Chemicals may have more than one name and care should be exercised to assure that all necessary information for the identification of the chemicals in the stockroom and laboratory is collected.

- The QUANTITY category designates the amount of the chemical being stored. Every effort should be made to assure that all containers are accurately assessed and that each container is entered into the inventory separately.

- The STORAGE LOCATION (see Tables on Pages 12 and 13 for Suggested Shelf Storage Pattern) should be completed only after the storage classifications have been determined. Containers should be labeled and moved to their respective shelf according to the proper storage category. The location of the chemical should then be noted in shorthand: Rm. 132 – R3. This abbreviation would translate to read: room 132, right hand wall, shelf 3. (Shelves should be numbered from top to bottom: walls noted by how you enter the room – right, left, front, back)

<u>Labeling</u>

- Labels should be affixed to each container. Containers should then be placed on the properly labeled shelf (see Tables on pages 12 and 13 for suggested Shelf Storage Pattern) according to the chemical storage category. Below is a sample label.

Acetaldehyde H-2 F-4 R-2 O- Fl.liq Org. 3 Room 116 – R3 1/99

Specific Recommendations

Note: The following lists are not inclusive. For a specific chemical not listed check the SDS which must be provided with each chemical.

The following chemicals are listed as know or probable carcinogens and are NOT to be used by the members of the Science Department:

Table 2A

2-Acetylaminofluorine	Chromium (VI) Oxide
Acrolonitrile	3,3-Dichlorobenzidine
Alpha-Naphthylamine	4-Dimethylaminoazobenzene
4-Aminodipenyl	Ethylemeimine
Arsenic Powder	Formaldehyde
Arsenic Pentoxide	Lead Arsenate
Arsenic Trichloride	Sodium Arsenate
Arsenic Trioxide	Sodium Arsenite
Asbestos	Mercury
Benzine	Methyl Chloromethyl Ether
Benzidine	4,4-Methylenebis (2-dichloroaniline)
Cadmium Metal	Beta-Naphthylamine
Cadmium Chloride	Nickel Powder
Cadmium Sulfate	4-Nitrophyenyl
Carbon Tetrachloride	N-Nitrosodimethylamine
Bis-chloromethyl Ether	Beta-Propiolacetone
Chloroform Ethylene Oxide	O-Toluidine
Chromium Powder	Vinyl Chloride

The following chemicals are explosive and are NOT to be used by members of the Science Department:

Table 2B

Benxoyl Peroxide	Picric Acid
Carbon Disulfide	Perchloric Acid
Diisopropyl Ether	Potassium

The following chemicals have properties which are hazardous because they are either skin absorbent, have toxic vapors, are time sensitive, or are highly reactive. If they are used in the laboratory, special precautions recommended by the manufacturer should be followed:

Table 2C

Ammonium Dichromate	Hydrogen Sulfide
Ammonium Nitrate	Iodine
Bromine	Methyl Alcohol
Calcium Carbide	Phenylthiocarbimide (PTC)
Chlorine	Potassium Chlorate
Ethyl Ether	Sodium and any solvent with a flash point below 140° F (50° C)
Hydrogen Peroxide	

General Information

- The following operations will be carried out in a laboratory hood which has been tested for proper air flow: all single replacement reactions, all decomposition reactions, any reaction involving the release of gases, fumes, mists, fogs and aerosols*, all drying operations following any of the above, and temporary storage of reactions involving long term ventilation. *Note: Reactions marked with (*) require a Hazardous Laboratory Work Permit (see Appendix C)

- Appropriate Personal Protective Equipment (PPE) compatible with the required protection for the substance to be handled shall be used. The Chemical Hygiene Officer will insure the availability of and the instruction for the use of such PPE
- Employees responsible for science instruction will be instructed on the location, use, care and maintenance of eye wash and safety showers. Proper instruction will be made available to staff
- Appropriate personnel will be trained annually on the use of fire extinguishers and other fire protection devices available in the departmental areas

Maintenance of Laboratory Hoods and Protective Equipment

Note: All inspections by independent third party (i.e. Consultant) and test results will be filed in the Main Office Central File for employee review.

- Laboratory hoods will be inspected at the beginning of the school year
- Safety showers will be inspected at the beginning of the fall semester for proper water flow and coverage
- Eye wash stations will be tested for proper water pressure and efficiency at the beginning of the fall semester
- Fire blankets will be inspected for use and availability at the beginning of the fall semester for proper storage and availability
- Flammable, Acid, and Corrosive storage cabinets will be inspected and tested at the beginning of the fall semester for proper storage and availability

Employee Information and Training

All Science Department employees will be provided with information and training so that they will be appraised of the hazards inherent with working in the laboratories and associated classrooms in the School District science areas. This training will be given initially for all Science Department employees presently on staff. It will also be taught at the time of any new assignment or to any new employee within the first year of employment. Refresher training is required bi-annually thereafter, as part of the Hazard Communication Standard Training.

The training and information sessions shall include:

- The availability and location of the written Plan
- Signs and symptoms associated with exposure to hazardous chemicals
- Location of reference materials, including all SDS and NJ HSFS

- Methods used to detect the presence or release of hazardous chemicals i.e.: air monitoring, odor thresholds, etc.
- The physical and health hazards of chemicals listed on the Right-To-Know Survey for the School District
- The practices required to protect employees from these hazards i.e.: standard operating procedures (SOPs), work practices, emergency procedures, PPE, etc.

Training for the Science Department staff will be provided during the annual Hazard Communication Standard Training sessions.

Each staff member will sign an attendance form documenting that they have attended this training (see Appendix A).

Prior Approval for Specific Laboratory and Demonstration Operations

Certain chemical procedures and physical conditions which present a serious hazard shall require prior approval, in writing, by the Science Department Supervisor before any such activity takes place. This approval must be obtained at least one week prior to the actual work and must be submitted on a Hazardous Laboratory Work Permit form (see Appendix C). These procedures include: work with select suspect and known carcinogens, suspect and known teratogens, any chemical listed as a special hazard in the NJ Hazardous Substance List including specific chemicals listed in this written Plan (see Tables on pages 25 and 26).

Medical Attention

The School District shall provide medical attention including follow-up examination to any affected instructional or non-instructional staff members. A school physician will determine the route this attention will take.

- The Science Department Supervisor will provide a Chemical Incident Report Form (see Appendix B) to the physician. This form will contain the following information: identity of the hazardous chemical to which the employee has been exposed, a description of the conditions of the exposure including exposure date and concentration (if available), and a description of the signs or symptoms of exposure that the employee is manifesting (if any)

Responsibilities Under the Plan

Among the duties of the Chemical Hygiene Officer will be maintaining the Main Office Central File to include the following items: the Plan, all appendices listed in the Plan, copies of all forms

in quantity required by the Plan, a copy of the latest Right-To-Know (RTK) Survey, SDS, NJ HSFS, etc.

Additional Protection for Work with Chemicals Having High Acute Toxicity

When any chemicals of the type listed above are being contemplated, the following SOP will be adhered to: a Hazardous Laboratory Work Permit (see Appendix C) will be initiated, a designated work area will be allocated by the Chemical Hygiene Officer, the use of engineering controls is mandatory, the use of PPE is mandatory, waste disposal routines must be established, and decontamination procedures must be planned for.

Laboratory Standard Training Curricular Details

Occupational exposure to hazardous chemicals in laboratories 29 CFR 1910.1450:

- Content of the standard and appendices
- Locations and explanation of the Plan
- Location and reference materials and RTK materials, i.e. SDS and NJ HSFS

Physical Hazards:

- Corrosives, compressed gasses, explosives, flammables and select combustibles, organic peroxides, pyrophorics, unstable or reactive materials and water reactive materials

Health Hazards:

- Local: irritants and corrosives
- Systemic toxins: acute and chronic effects, central nervous system effects, respiratory system effects, reproductive system effects, and organ specific chemicals
- Sensitizers: personal susceptibility differences, identification of the aforementioned

Routes of Entry

- Inhalation, ingestion, skin contact and eye contact

Amount of Absorption

- Gasses and vapors: aerosols
- Particulates: dusts, mists and fumes

Dose Response

- Work practices, personal hygiene, weight, personal protective equipment, environmental controls, administrative controls, engineering controls, and good housekeeping

Duration and Limits Exposure

- PEL and TLV: definition, established by
- Short Term Exposure Limit (STEL): definition, established by
- Time Weighted Average (TWA): definition, established by
- NIOSH Guide to Chemical Hazards

Air Sampling

- As Required, e.g. carbon dioxide, ozone, etc.

Individual Response to Chemical Hazards

- Age, gender, body size and weight, individual's health status personal habits – hygiene

Employee Concerns

- Symptoms vs. causes, documentation of exposures, physician referrals, work refusal rights

18. Hazardous Chemicals Training Information (Annual Safety Meeting)

Instructional and non-instructional staff need to be aware of possible damage to health arising from the use of substances at work. Harmful effects are not always obvious and you will have to be alert to be able to respond to clues and ask the right questions. Signs of damage may appear only after lengthy periods of exposure, or a long time after contact with the substance. By then, it is often too late to prevent permanent damage. It may also be too late to link diseases to exposure which may have occurred long ago.

We now look at the different types of damage that toxic materials can cause, the different forms which materials can take, and the possible routes by which materials can enter the body. This should help you think more clearly about any problems that may be caused by toxic substances in your own workplace and assist you in planning a strategy for dealing with them.

For detailed information on the hazards of regulated substances you work with, review the NJ Department of Health and Senior Services Substance Fact Sheet (NJ HSFS).

What Are the Different Types of Toxic Materials?

The form of substance influences how it can get into the body and what damage it can cause. This form can change during the production process, so you should ask three basic questions when getting information about any substances.

- What is the basic form of the substance?
- Can this form change in use?
- How can the substance (in its various forms) get into the human body?

The seven main forms of toxic materials are:

Solids: Although solid materials are unlikely to be harmful, they can dangerous if their form changes while begin worked. For example, sanding wood purchases wood dust, and plastics can decompose into fumes and gases.

Dusts: Dusts are tiny particles of solids that may be breathed into the lungs. Dust may be created during many work processes, for example, grinding, sanding and mixing. The most dangerous dust particles are the very small ones, which remain in the lungs and cannot be expelled.

Fumes: These form whenever a solid material, usually a metal, is heated, volatilizes, then condenses in the air into extremely fine particles, usually less than 1.0 micron in diameter. A fume exposure is possible whenever metal or any other solid is melted, poured, cast, burned, welded or soldered. A solid must be heated above its melting point before it vaporizes, therefore, it is important to know to what temperature a solid is being heated. In most cases, the volatized solid reacts with oxygen in the air to form an oxide. An example is zinc oxide fumes from welding galvanized metals.

Liquids: Many hazardous substances are liquids at room temperature. Examples are acids and solvents. Many liquids give off vapors that may be breathed in. Some liquids can damage the skin, while others are able to pass through the skin.

Vapors: Vapor is the evaporated phase of a substance that is a liquid or solid at room temperature. Vapors are usually invisible and may be given off by solids that sublime or liquids that evaporate at room temperature.

Mist: Mist is actually tiny droplets of liquid suspended in air and is often invisible. The breaking up of a liquid can create a mist, by splashing, spraying, foaming or atomizing.

Gases: A gas is a formless fluid, which completely occupies any space at room temperature. Some gases are detectable by color or smell, while others can only be detected by special tests.

Routes of Entry into the Body

There are three ways in which toxic substances can enter the body. Often a substance can enter the body by more than one route. The routes of entry for specific products should be available on the Safety Data Sheet (SDS). It will also be necessary to know about "routes of entry" if adequate precautions are to be devised.

The three main routes of entry are:

Lungs: This is by far the most common way in which poisons are absorbed. Dusts, fumes, vapors, mists, and gases can all be inhaled. In the lungs, they may either irritate the lung itself or be absorbed into the blood stream and carried away to affect other organs. While a good deal of inhaled matter is breathed out again immediately, some parts of substances which do not dissolve in the blood may remain in the lungs to cause problems much later, such as asbestos. Because breathing is an-important route of contamination, having god ventilation is a vital part of the fight against health hazards.

Skin: Some substances (i.e. Acids) attack the skin directly. These are often called "corrosive" substances. Some irritate the skin and can cause dermatitis, skin allergies and possible skin cancer after prolonged exposure. Other substances easily penetrate the skin and enter the bloodstream. It would not be enough to measure airborne contamination from such substances. You would have to check skin contact as well. In addition, precautions would have to be taken to keep these substances off the skin.

Digestive System: This route is less common and often overlooked. Ingestion rarely takes place by deliberate swallowing of the toxic substances. Rather, dusts and fumes can collect on tables, in refrigerators and in lockers. Food, drink and cigarettes can be contaminated and harmful substances ingested when eating, drinking or smoking. Dust on hands, face and clothing can get into the mouth. Lastly, as the lungs clear out inhaled substances, they are brought up into the throat in phlegm, which may then be swallowed. Adequate washing facilities, clean laboratory benches, clean laboratory hoods, and refrigerators clearly labeled to not be used for food, are some of the precautions necessary to prevent ingestion. Some OSHA regulations, such as those for lead, lay down such precautions as a legal requirement.

Some substances have different effects depending on how they reach the body. For example, trichloroethylene (a common solvent) has more immediate and serious effects when swallowed

than when its vapor is inhaled. People need to consider the different ways in which a substance could get into the body and what precautions need to be taken to deal with these different routes of entry.

The Body's Reaction to Toxic Materials

Having established how something might be getting into the body, we next have to ask "What can it do to us?" The answer to this question depends on when an effect occurs, immediately, or sometime after exposure.

Acute effects: An acute effect is one that occurs in the body as an immediate response to exposure. Acute effects are usually immediately visible and the cause can often be traced without difficulty. Acute effects happen quickly and are followed by either recovery or permanent damage.

Chronic effects: Unlike an acute effect, a chronic effect may not be obvious. The onset of symptoms is gradual, and as a result the symptoms may go unnoticed, or may be explained away as the result of "being run down", "getting old", etc. It is much harder to trace the cause of a chronic effect, and by the time the link between exposure and symptoms has been identified, permanent damage may have occurred. In some cases, this could be 20 or 30 years after exposure. Obviously, it could then be very difficult for a doctor to diagnose such a disease as having been caused by a specific substance.

The distinction between acute and chronic effects is vital to an understanding of hazards from chemicals. Chronic and acute effects may be very different, and protecting against one effect only, may not control the substance fully. Here are some examples of ways in which acute and chronic effects can differ:

- The dose of some chemicals, like alcohol, needed to cause chronic effects is substantially more than those needed to create acute reactions. If you limit the dose to control immediate visible effects, you also eliminate chronic effects. However, this is not universal for all chemicals.
- Some chemicals have little or no acute effects. So there are no immediate adverse reactions. It may be years after exposure before chronic effects become visible, by then it is often too late to deal with the problem. Chlorine gas provides an example of this. Acute reactions are irritation of the eyes and respiratory passages. Chronic effects only emerge after years of use.
- Some chemicals including many which cause cancer (carcinogens) need only very low dose to produce chronic effects, while the acute effects occur only at much higher concentrations. Therefore, a level that eliminates immediate acute effects may still

expose people to more than enough of the chemical to produce long-range chronic effects. An example of this is vinyl chloride monomer (VCM). This is used to make PVC plastic. The acute effects of VCM were identified in the 1930's. It had a narcotic medical anesthetic. To prevent this narcotic effect from occurring in industrial uses, the limit for air contamination was set at 500 PPM. However, further research on animals showed the VCM affected the liver, bones and kidneys. Since then, the air contamination limit was radically reduced to 1 PPM

Types and Locations of Damage from Toxins

In addition to the timing of when the body reacts to a toxic substance, it is important to consider where in the body the damage may occur and the type of damage it may be. A summary of the types and locations of possible damage follows:

Poisoning: Some substances have a direct and destructive effect on human tissue functions. Poison can be absorbed into the body and attack internal organs, such as the liver, kidneys, brain, nerves, blood, lungs, and bone marrow. For example, carbon tetrachloride and chloroform, two common solvents, affect brain functioning and cause severe damage to the liver and kidneys. Another solvent, benzene, depresses the ability of bone marrow to make red blood cells. Some dusts cause thickening and hardening of the lungs.

Sensitization and allergies: Some substances do not cause harm when first used, but the body can develop a reaction to them so that they cause problems if used later. Allergic reactions can range from superficial skin rashes to serious lung reactions. For example, epoxy resins cause skin irritation characterized by itching, redness and swelling in sensitized workers.

Irritation: Some substances cause immediate pain or reddening of exposed areas whenever contact occurs. The most common exposed sites are the eyes, skin, throat and the breathing passages. The major danger of irritants is that they can cause scar tissue formation that may be permanent. Many solvent vapors cause mild irritation of the eyes, nose and throat. Ozone gas produced during welding causes irritation of the breathing passages, ranging from dryness of the throat, to choking, coughing and bleeding of the lungs.

Corrosion: Some substances cause rapid death of the body cells they contact. Exposure may cause pain, burning, bleeding and fluid loss. Acids and bases (caustics) are such corrosives.

Asphyxiation: Some gases can replace the normal oxygen that is in the air. Even if an asphyxiant is not inherently dangerous, if it is present in high enough concentration, it can cause suffocation. Carbon dioxide, acetylene, and argon are examples of such gases.

Asphyxiation can also be caused by substances which combines with the carrying sites on red blood cells, thereby reducing the available oxygen. Carbon monoxide and hydrogen cyanide gases are examples of such chemical asphyxiants.

Reproductive Hazards: There are several types of reproductive hazards. Some substances can decrease male or female fertility or sex drive by damaging the reproductive system, while others cause changes in the genetic material or reproductive cells. Substances called teratogens cause birth defects by damaging the developing fetus, especially during the early stages of pregnancy. Teratogens may also cause stillbirths and miscarriages.

Cancer: A number of substances can cause cancer, which is the uncontrolled growth of cells in some part of the body. Such substances are called carcinogens. In many cases, there is no known minimum dose that can remove all danger of cancer; therefore, any exposure increases risk. Cancer-causing effects of substances may be difficult to track, since in most cases they take years to develop.

Mutation: Mutagens are substances that cause a change in the genetic material (genes) in a body cell. Genes regulate the activity of the entire organism. A mutation may lead to cancer or, if the mutation is in reproductive cells (sperm cells in males and egg cells in females) to still births, miscarriages, and birth defects.

Fire and Explosions: Many chemicals and substances are flammable, particularly when present in gas, vapor or dust forms. This affects the precautions necessary during use, and teachers should seek information on this when inquiring about substances.

Additive Effects of Chemicals

It is an oversimplification to think in terms of the effects of individual substances on individual organs in the body. Employees may be exposed to not only one, but many different substances. Such exposure to two or more chemicals can result in:

- An additive effect or
- A greater than additive or synergistic effect

If the chemicals independently attack different parts of the body, their combined effect will probably be additive, the sum of the separate effects. However, when the same organs are attacked the effects are often synergistic, or much greater than the simple sum of the parts. An example is exposure to cigarette smoke plus exposure to asbestos, which can increase the risk of lung disease by 50 times or more.

Appendix A

Chemical Hygiene/RTK Training

Appendix B

Chemical Incident Report

Instructor's Name:_____ Date: _____

Room Number or Name: _____

Description of Incident:

Additional Personnel Involved:

Student Involved:

Medical Attention Required: _____ Yes _____ No

Nurse: _____ Physician: _____

First Aid Squad: _____ None: _____

Health Care Professional (HCP) Comments:

Follow-up Required: _____ Yes _____ No

HCP Signature: _____ Date: _____

Chemicals Involved:

Physician's Comments:

Waste Disposal Comments:

Science Department Supervisor Signature: _____ Date: _____

Appendix C

Hazardous Laboratory Work Permit

Instructor's Name: _____ Date: _____

Course Title: _____ Unit: _____

Laboratory Exercise: _____ Demonstration: _____

Description of work to be performed:

Chemicals:

Equipment:

PPE to be used:

Approved: _____ Yes _____ No

Science Department Supervisor Signature: _____ Date: _____

Follow-up Report:

Waste Disposal Procedures:

Comments: