CHEMISTRY LABORATORIES

2023

Chemistry laboratories are inherently dangerous places as chemicals, glassware, fire, and electrical equipment regularly interface in restricted spaces. Maintaining safe conditions in a chemistry laboratory, prep room, and storage area requires knowledge and vigilance on the part of the chemistry teacher. It requires care in ordering, storing, using, and disposing of chemicals. While chemical safety is the responsibility of everyone who uses the classroom laboratory, safe management of the chemistry laboratory and chemical stock begins with the teacher who orders and uses these products. Careful attention to the following guidelines will prevent the majority of accidents and incidents commonly seen in high school chemistry labs.

Complete the Waste Disposal Form for removal of all waste (chemicals and broken glass) at the end of each semester. The Science/STEM Coordinator (Dr. Chaundra Creekmur; creekch@boe.richmond.k12.ga.us) will facilitate removal.

CHM 1: Required Materials for the High School Chemistry Lab

1. Broken Glass Container
2. Fire Extinguisher
3. Safety Shower and Eye Wash
4. Fume Hood
5. Spill Kit
6. First Aid Kit
7. MSDS Notebook
8. Chemical Waste Disposal Containers

CHM 2: Eye Protection

Teachers owe their students a duty of care. A teacher must reasonably address all foreseeable dangers inherent in any laboratory experiment or demonstration that will be performed in the science laboratory or classroom. A teacher must also instruct and ensure that students demonstrate the proper use of protective equipment.

CHM 2.1 What is your obligation?

An important obligation of science teachers is to provide students with appropriate eye protection. **Provision and Maintenance of PPE - 29 CFR §1910.132(d) Personal**

Protective Equipment, General Requirements Standard requires a hazard assessment to determine PPE needs and teachers must be trained in use and care of goggles.

CHM 2.2 What circumstances require eye protection?

Eye protection is a must in any hazardous laboratory activity or demonstration in science. Protection of the eyes is essential in any laboratory activity. Eye protection is required (but not limited to):

1. When chemicals, glassware, or a heating source is being used
2. When working with solid materials or equipment under stress, pressure, or force that might cause fragmentation or flying particles
3. When an activity generates projectiles, or uses elastic materials under stress, or causes collisions
4. When dust or fumes are present
5. When using preserved specimens

CHM 2.3 Choosing the best eye protection

Only safety goggles provide the level of protection needed for your laboratory activities when dealing with hazardous liquids or solids. A safety goggle fits the face surrounding the eyes; it should have a soft pliable flange, which seals around the eyes snugly to protect the eyes. In addition, safety goggles, with side shields or without side shields, provide adequate protection for laboratory activities involving use of solids such as meter sticks, projectiles, etc. Safety goggles should also be the standard for eye protection when chemicals, glassware, a heating source, or preserved specimens are being used.

CHM 2.4 Disinfecting Goggles

1. When using the safety goggle cabinet, the ultraviolet light timer should be set for a minimum of ten (10) minutes. Sanitation of goggles is accomplished best by usage of a UV cabinet. Treatment with UV light will destroy the goggles over several years.
2. Hot soapy water and thorough drying between uses of shared goggles is also recommended by the ACS.

3. Chemical Disinfection: After student use, wash the goggles in soapy water followed by a ten (10) minute rinse in five percent bleach solution (10:1 ratio - 10 parts water to 1 part bleach). The goggles should be allowed to air dry.

CHM 2.5 What is the current recommendation for wearing contact lenses?

1. The American Chemical Society Committee on Chemical Safety states that contact lenses can be worn in the laboratory provided that approved eye protection is worn as required of others in the laboratory.
2. The National Institute for Occupational Health and Safety (NIOSH) recommends that workers be permitted to wear contact lenses when handling hazardous chemicals provided adequate face and eye protection is worn.
3. The Council of State Science Supervisors states that contact lenses can be worn provided "specially marked, non-vented safety goggles are available to contact lens wearers".
4. The Occupational Safety and Health Administration (OSHA) believes that contact lenses do not pose additional hazards to the wearer and has determined that additional regulation addressing the use of contact lenses is unnecessary.
    a. The agency wants to make it clear, however, that contact lenses are not eye protection devices. If eye hazards are present, appropriate eye protection must be worn instead of, or in conjunction with, contact lenses."
    b. Regulations (Preamble to Final Rules) Personal Protective Equipment for General Industry (Amended Final Rule, April 1994) Section 3- III Summary and Explanation of the Final Rule 1910.133, p.16343.

CHM 3: Glassware

CHM 3.1 Injuries from Glassware

Glassware is the number one source of injury in the laboratory setting. More students are cut by damaged glassware and burned by heated glassware that are harmed by any other object or circumstance in the lab. To ensure the safety of students in the middle school laboratory, substitute plastic lab ware for glassware where possible. New plastics like polycarbonate (Lexan®) have been successfully used for laboratory containers. While not useful for heating, the plastic is clear and extremely hard and can be used for almost all water soluble compounds. Beakers, flasks, graduated cylinders, and thermometers now are available in plastic. Check with your science supply company.

CHM 3.2 General Cautions

CHM 3.2.1 Broken Glass

1. Use glassware that is without defect and has smooth edges.
2. One of the most important ways to prevent glassware related injuries is to check the pieces for chips or cracks. Any damaged glassware should be disposed of in the appropriate container.
3. Glassware should have no cracks, chips, or scratches. In particular, be wary of "star cracks" that can form on the bottom of beakers and flasks. Any glassware with such cracks should be properly disposed of immediately.
4. All glass tubing should be fire-polished.

CHM 3.2.2. "Frozen" Glass

Be careful with glassware that is "frozen." Only teachers, wearing goggles and gloves, should try to release the "frozen" glassware. If this fails, discard the glassware. Some common cases of "frozen" glassware are:

1. nested beakers that have been jammed together.
2. stoppers that cannot be removed from bottles.
3. stopcocks that cannot be moved.

CHM 3.2.3 Hot Glass

1. Use only Kimax® or Pyrex® brand glassware when heating substances. Common glass can break or shatter, causing serious injuries in the lab.
2. Use care when working with hot glass. Hot glass looks exactly the same as room temperature glass.
3. Do not leave hot glassware unattended, and allow ample time for the glass to cool before touching.
4. Check the temperature of the glassware by placing your hand near, but not touching, the potentially hot glass.
5. Have hot pads, thick gloves, or beaker tongs available for grasping hot glassware.
6. Never set hot glassware on cold surfaces or in any way change its temperature suddenly. Even a Pyrex® or Kimax® beaker will break if cold water is poured into a hot beaker.

CHM 3.2.4 Glass Tubing

1. Make sure that the tubing is without chips or cracks.
2. Use the appropriate diameter tubing for the task.
3. Make sure the ends of the tubing are fire polished.
4. When breaking tubing:
    a. Use gloves or towels to protect hands when breaking glass tubing. Use goggles to protect the eyes.
    b. Scratch the glass once with a file or score. Wrap the glass in a towel.
    c. Place the thumbs together opposite the scratch. Pull and bend in one quick motion.
    d. Fire polish the broken ends: hold the glass so that the sharp end is in the top of the flame of a gas burner. Rotate the tube so all sides are heated evenly, causing the sharp edges to melt and become smooth.
    e. Place the glass on insulating material to cool.

CHM 3.2.5 Bending

Bending glass tubing is often necessary. Follow these procedures:

1. Place a wing-top attachment on a gas burner and heat the area of the glass to be bent while holding it with one hand on each end, rotating to ensure even heating.
2. When the glass is soft and pliable, remove it from the flame and quickly bend to the desired shape.
3. Place on insulating material until cool.

CHM 3.3 Types and Appropriate Use of Glassware

To prevent glassware related injuries always use the correct type of glass for the task you are doing. For example, a graduated cylinder should be used to measure the volume of a liquid, not as a container in which to run chemical reactions. Likewise, a watch glass should not be used to mix chemical compounds, but as a cover over a heated reaction vessel.

CHM 3.3.1 Proper Use

Each type of glassware has its proper use and should be used only for its intended purpose.

1. **For measuring volume**:

   pipets burets graduated cylinders

   dropper pipets volumetric flasks

2. **For storing solids and liquids:**

   bottles vials

3. **For containing reactive chemicals during experiments:**

   beakers flasks test tubes

   crucibles watch glasses test plates

4. **For transferring liquids and gases**:

   glass tubing funnels pipets

5. **For measuring temperature:**

   digital thermometers alcohol thermometers

CHM 3.5 Cleaning

1. Clean glassware immediately after use. The longer glassware sits, the harder it is to clean.
2. Use laboratory-grade detergents or liquid dishwashing detergent such as Dawn® for cleaning glassware.
3. When using brushes, make sure to use the appropriate size brush; make sure the metal part of the brush does not scratch the glass.
   Rinse glassware with deionized water.
4. Allow glassware to air dry on paper towels, drying pads, or drying racks.

CHM 3.6 Disposal

1. Use a dustpan and brush to pick up broken glass. Never pick up broken glass you're your bare hands.
2. Defective glassware should be disposed of correctly.
3. Glassware should be disposed of in a separate container from normal trash. Such container should be clearly labeled **BROKEN GLASSWARE ONLY**

CHM 4: Special Concerns

CHM 4.1 Heating Procedures

Often it is necessary to heat liquids and solids in physics experiments and demonstrations. It is safer to use water baths and hot plates than to heat directly with open flames such as with Bunsen burners. Below are guidelines for heating and handling hot objects.

1. Any glass apparatus that is to be heated should be made of Pyrex® brand or Kimax® brand. It must be free of chips and cracks.
2. Never heat a closed container if there is no means of pressure relief.
3. Many substances, especially glass, remain hot for a long time after they are removed from the heat source.
4. Always check objects by bringing the back of the hand near them before attempting to pick them up without tongs, hot pads, or gloves.
5. Never set hot glassware on cold surfaces or in any other way change its temperature suddenly, because uneven contraction may cause breakage

CHM 4.2 Chromatography

1. Chemical splash safety goggles and aprons should be worn.
2. Only Pyrex or comparable glass tubes should be used.
3. Dissolving and developing solvents give off toxic vapors. They must be stored in closed containers and the room
4. Solvents are highly flammable and must not be used near an open flame.
5. Avoid skin contact when spraying the developing solvents.
6. Use a fume hood when appropriate.
7. Consider the solvent and pigment mixture to be hazardous waste. Store and dispose of appropriately.

CHM 4.3 Spectroscopic Analysis Using Flame Tests

The most common chemicals used when performing nichrome wire flame tests are recognized as toxic, and adequate precautions should be taken to ensure good ventilation of the experimental area. When large numbers of students are performing flame tests, the potential exists for individual acute toxicity exposure or instructor chronic toxicity exposure.

CHM 4.3.1 Chemicals Often Used in Flame Tests

Table CHM 4.3.1.1

Health	Safety	Compound
1	0	Sodium Chloride (NaC1)
2	1	Strontium Chloride ($SrCl_2$)
3	1	Lithium Chloride (LiC1)
3	1	Copper Chloride ($CuCl_2$)
4	1	Barium Chloride ($BaC1_2$)

1. The higher the health/safety number, the greater the health hazard.

CHM 4.3.1.2 Precautions

1. Goggles and lab aprons are required.
2. In poorly ventilated or confined laboratories, flame tests should be performed in a fume hood.
3. The general nature of an unknown compound should be ascertained before performing a flame test.
4. When performing flame tests, the nichrome wire or paper clip that is used should be held in a well-insulated holder or long-handled pliers.
5. The wire and holding device should be placed on an insulated mat and allowed to cool thoroughly before handling.
6. An overloaded wire causes splattering and material can fall into the burner jets, causing blockage.
7. Unknown chemicals should not be placed in the flame.

8. It is recommended that teachers use spectrum tubes to show the properties of spectrum analysis.
9. These spectrum tubes are safe and can be used in any classroom setting. Care should be used when changing tubes as they can get hot when used for a few minutes.

CHM 5: Electrical Hazards

CHM 5.1 Burns and Shock

1. Many electrical devices become quite hot while in use.
   a. In addition, "shorted" dry cells and batteries can produce very high temperatures.
   b. Students should never grasp a recently operated device or wiring without first checking for excess heat.
2. Students must be warned of the high death potential present even when the voltage is low.
   a. The severity of an electrical shock depends primarily on the amount of current to which a person is exposed.
   b. Since the current is related to the resistance and voltage, these two factors, as well as the part of the body involved and the duration of the contact, determine the extent of injuries to the victim.
   c. If the skin is wet or the surface broken, the resistance drops off rapidly, permitting the current to flow readily through the bloodstream and body tissues.

CHM 5.2 Electrical Apparatus

CHM 5.2.1 Batteries

1. A battery is an unregulated source of current capable of producing large currents when resistance is low.
   a. When short-circuited, connecting wires can become very hot, raising the risk of burns. Short-circuited mercury batteries may even explode.
   b. Chemical leakage from batteries is a potential hazard, especially in the case of wet cells that contain caustic chemicals such as sulfuric acid.
2. Certain types of batteries are rechargeable while others are not.
   a. Carbon-zinc and nickel-cadmium type batteries can be recharged.
   b. Do not, however, attempt to recharge a completely dead carbon-zinc battery, a leaking or corroded battery, or any battery that carries a warning against recharging.

c. Such batteries can cause damage to the charger and may explode, causing personal injury. Lead-acid batteries can be recharged but produce explosive hydrogen gas during the process.
d. They should only be recharged in a well-ventilated area with an appropriate charger.

3. Do not discard any battery in the trash.
   a. Contact Facilities and Maintenance for pick-up and disposal. Document the date of the request and the date the pick-up occurred.

CHM 5.2.2 Circuit Loads

1. Most school laboratory electrical circuits have a maximum power rating of 1,500 watts (if fuses are 15 amp) or 2,000 watts (if fuses are 20 amp).
2. The total power load on a circuit should not exceed these values.
3. The total load is the sum of the power ratings of all apparatus plugged into that circuit.
4. The individual power rating is usually found printed on a plate somewhere on the apparatus.

CHM 5.2.3 Extension Cords.

1. Use extension cords only when there is no convenient way to connect equipment directly to a receptacle.
2. If an extension cord must be used, it should be checked for damage, proper grounding, and electrical capacity.
3. An extension cord should be marked with its capacity in amperes and watts and the total load should not exceed these values.
4. If the cord is unmarked, assume that it is 9 amperes or 1,125 watts.
5. If an extension cord becomes very warm to the touch, it should be disconnected and checked for proper size.
6. In general, science laboratories should be equipped with sufficient receptacles to minimize extension cord use.

CHM 5.2.4 Fuses/Circuit Breakers.

1. Replace blown equipment fuses with fuses of the same amperage.
2. Replace fuses with the equipment unplugged.
3. Failure to use the correct fuse can cause damage to equipment and overheating.
4. Frequent blowing of circuit fuses or tripping of circuit breakers usually indicates that the circuit is overloaded or a short exists.
5. Circuit breakers and fuses that are tripped or blown should be turned on or replaced only after the cause of the short or overload is removed from the circuit.

CHM 5.2.5 Grounding

1. Use grounded 3-prong plugs when available.
2. If the outlet is 2-prong, use an adapter and secure the ground wire to the cover-plate screw on the outlet.
3. Any apparatus with a metallic case or exposed metal parts should be checked to make sure that the case is grounded.
4. Such ungrounded appliances should be retrofitted with a ground wire and three-pronged plug.
5. The use of ground-fault interrupters should be considered.

CHM 5.2.6 Power Cords

1. Any power cord should be inspected periodically and replaced immediately if frayed or damaged.
2. Apparatus should be located to keep power cords away from student traffic paths.
3. When removing the cord from an outlet, the plug should be pulled, not the power cord.
4. Wet hands and floors present a hazard when connecting or disconnecting electrical apparatus.

CHM 6: Fire Hazards

Fire is a real danger in any laboratory setting, and all teachers need to be aware of how to prevent fires. In the vent a fire does occur, teachers need to know how to respond appropriately. The following information is provided as guidance in preventing or combatting fires in the science laboratory.

CHM 6.1 Preventing Burns and Fires

CHM 6.1.1 When planning to heat materials or use open flames

1. Instruct students on STOP DROP AND ROLL in the event clothing catches fire
2. Make sure students know how to evacuate the classroom in the event of a large fire
3. Know the location of the nearest fire extinguisher and know how to use it.
4. Have a bucket of sand or a fire blanket nearby in the event that the nearest fire extinguisher too far outside of the classroom.

CHM 6.1.2 When heating materials

1. **DO NOT USE ALCOHOL BURNERS! T**hey are extremely hazardous. Safer alternatives to alcohol burners include candles and hot plates.
2. **DO NOT USE STERNO HEATERS!**
3. Make sure that the area surrounding a heat source is clean and has no combustible materials nearby.
4. Do not allow students to work with hot materials, such as very hot water.
5. Do not use household glass. Use only borosilicate laboratory glassware, such as Kimax™ or Pyrex™ when heating substances.
6. Do not heat common household liquids, such as alcohol or oil; these are flammable and should not be heated. Heat only water or water solutions.
7. Handle all hot materials using the appropriate type of tongs or heat resistant gloves (those made of asbestos or thick silicon rubber).

CHM 6.1.3 When using Hot Plates

1. Do not use hotplates designed for use in home kitchens. Use only laboratory type hot plates. These are sealed against minor spills.
2. Do not place the hot plate on paper or wooden surfaces.
3. Place the hot plate in a location where a student cannot pull it off the worktop or trip over the power cord.
4. Never leave the room while the hot plate is plugged in, whether or not it is in use.
5. Keep students away from hot plates that are in use or still hot, unless you are right beside the students and have given them specific instructions.
6. Make sure that the hotplate is both unplugged and cool before handling a hotplate. You can check to see if a hot plate is still too hot by placing a few drops of water on the surface. If the water does not evaporate, it should be cool enough to touch.

CHM 6.1.4 When using open flames

1. Use only safety matches. Make sure the matches are stored in a secure place between uses.
2. Closely supervise students when they use matches. Make sure students are dressed properly (baggy clothes are tucked in, long sleeves are rolled up, smocks/aprons are properly tied) and have long hair/braids tied up.
3. Closely supervise students when they use candles. Make sure students are dressed properly (baggy clothes are tucked in, long sleeves are rolled up, smocks/aprons are properly tied) and have long hair/braids tied up.
4. Use tea candles that are short and wide, and cannot be knocked over in normal use.
5. Place all candles in a “drip pan,” such as an aluminum pie plate, that is large enough to contain the candle if it is knocked over.
6. Never leave the room while a flame is lit or other heat source is in use.

CHM 6.2 In the event of a large, uncontainable fire

1. Evacuate the classroom immediately.
2. Locate and pull the nearest fire alarm.
3. Notify public safety and/or administration about the fire. Make sure you include the location and source (chemical, paper, petroleum) of the fire.

CHM 6.3 In the event of a small, containable fire

1. Identify the type of fire. The table below lists the four classes of fires and methods for extinguishing them:

Class	To Fight Fires Involving	Method to Extinguish
A	wood, paper, cloth	Use water or dry chemical extinguisher.
B	gasoline, alcohol, paint, oil, or other flammable liquids	Smother by using carbon dioxide or dry chemical extinguisher.
C	fires in live electrical equipment	Cut off power to electrical equipment. Use ABC or carbon dioxide fire extinguisher.
D	metals (Na, K, Mg, etc.)	Scoop dry sand onto fire.

2. Use the appropriate method to extinguish the fire.
3. File an incident report.

CHM 6.4 In the event a student's clothes catch fire

1. Roll the child on the floor to smother the fire. Use a fire blanket if one is available. Do not direct a carbon dioxide (CO_2) fire extinguisher at an individual because such extinguishers produce dry ice that can cause frostbite.
2. **DO NOT ATTEMPT TO ADMINISTER FIRST AID TO ANY BURNS THE CHILD MAY HAVE SUSTAINED!** Immediately notify the school administrator, school nurse, and public safety.

CHM 7: Physical Management of Chemical Stock

All teachers should be familiar with the RCSS Chemical Management policy that addresses how chemicals should be properly stored, labeled, and secured, as well as who should have access to these chemicals and chemical storage locations. The following guidelines are provided for teachers in order to reduce the risk of chemical accidents and ensure that chemicals and products in their schools are stored and handled safely.

CHM 7.1 Procurement of Chemicals

1. Prior to ordering, determine whether the chemical is in stock.
2. Order only quantities that are necessary for the project. Remember: **"Less is better**".
3. Upon receipt of the chemical, make sure the date received and the owner's initials are on the label.

CHM 7.2 Chemical Inventory

An important part of responsible chemical management is the creation of an accurate chemical inventory. A chemical inventory identifies the quantities and physical locations of, as well as the potential hazards associated with, all of the chemicals used and stored in a school. It also serves as a reference for school and emergency personnel (e.g., local fire department) in the event of an emergency. Furthermore, a chemical inventory, when used to guide necessary purchases, can reduce the costs and management needs associated with excess chemicals.

According to the Hazard Communication standard (29 CFR 1910.1200) and **O.C.G.A 45-22-2– Public Employee Hazardous Chemical Protection and Right to Know Act of 1988**, chemical inventories should be conducted and updated annually. The following guidelines are provided to schools and administrators by the Georgia Department of Labor and should be used for conducting a chemical inventory:

1. **Conduct pre-screening, inventory and removal while students are NOT in school.**
2. If the pre-screening establishes that it is safe to conduct an inventory, ensure that the inventory team is properly equipped with personal protective equipment and emergency response supplies as well as chemical management and safety knowledge. Ensure that

chemical storage areas are properly ventilated and that potential sources of ignition are turned off.

3. Conduct an inventory of all of the chemicals and products containing chemicals (e.g., mercury thermometers) stored on-site covering all sections of the school including maintenance rooms and closets, storage sheds, greenhouses, and all classrooms.
4. Review the **RCSS Laboratory Management and Safety Manual** to ensure that chemicals are consistently being managed, stored, handled, and disposed of properly.
5. Review the **Approved Chemicals and Products List** in the **RCSS Laboratory Management and Safety Manual**. Chemicals and products not on this list should be removed and properly disposed of or recycled according to applicable federal, state, and local laws.
6. The inventory must be updated when new chemicals or products are added to the list and when chemicals or products are used or disposed.
7. When complete, provide the following with a copy of the inventory:
   Dr. Chaundra Creekmur, Science/STEM Curriculum Coordinator (creekch@boe.richmond.k12.ga.us)
8. In addition, a copy should be made available in the front office and in every chemical storage area on campus.

CHM 7.3 Clean-outs

1. Conduct periodic cleanouts by identifying and removing unnecessary hazardous materials and expired chemicals through appropriate recycling and/or disposal methods.
2. Chemical inventories should be conducted prior to cleaning out chemicals from schools.
3. Contact your local state agency, college or university, industry partner, or chemical supplier, or someone with technical qualifications to identify potentially dangerous situations (i.e., school staff should not move very old chemicals because of the extreme hazard they may present) and properly handle the chemicals during a chemical cleanout.

CHM 7.4 Material Safety Data Sheets (MSDS)

1. There must be an MSDS on file for every chemical compound in use in the lab.
2. At a minimum, MSDS information should be located in all chemical storage rooms and cabinets and in a central place within the school (away from the chemicals), as well as a central location for the school district.
3. A copy must be kept in an area that is accessible to all individuals during periods of building operations.
4. If no MSDS is available for a product because 1) the manufacturer no longer exists; or 2) the manufacturer cannot be identified from the label that material should be considered hazardous waste and disposed of in a manner consistent with federal and state regulations.

CHM 7.5 Equipment

1. All emergency equipment (e.g., eyewash stations and safety showers), fume hoods, and ventilation systems/exhaust fans must be inspected and tested on an annual basis.
2. Chemical fume hoods must be recalibrated annually by appropriately trained individuals to ensure proper function. Documentation of annual recalibration should be assessable to all building occupants.
3. Engage maintenance staff in these inspections if safety equipment is in need of updates or repair.
4. Protocols for the upkeep of emergency equipment and the associated maintenance records must be established and maintained by school administrators.

CHM 7.6 Chemical Storeroom Ventilation and Temperature

1. Rooms that are designated for use as chemical storage areas must have a functioning exhaust ventilation system that operates continuously to remove fugitive chemical vapors.
2. The local exhaust system should be ducted to the outdoors independent of the general ventilation system.
3. Each room must also have an appropriate source of transfer (or make-up) air allowing for exhaust vents to operate efficiently.

4. Such chemical storage ventilation systems must be in conformance with the applicable fire and building codes.
5. Chemical storeroom exhaust vents must be inspected annually by appropriately trained individuals to ensure proper function.
6. Chemical storerooms should be kept within 70 to 75 degrees Fahrenheit.

CHM 7.7 Shelving

1. Shelving must be constructed of appropriate materials that will resist corrosion resulting from leaking materials stored on or around the shelves.
2. The shelving must be able to support the weight of stored materials.
3. Guardrails should be installed along the edge of shelving to prevent accidental slippage.
4. Shelving should not be installed within a 30 inch margin from the ceiling.
5. Shelves should be appropriately labeled with the chemical type and storage code (ex: Halide Compounds, I-2).

CHM 7.8 Chemical Fume Hoods

Chemical fume hoods are intended to remove vapors, gases, and dusts of toxic, flammable, corrosive or otherwise dangerous materials. With the sash lowered, laboratory fume hoods can also afford workers protection from such hazards as chemical splashes or sprays and fires. However, they are not designed to withstand explosions. Before performing hazardous operations, make simple checks to determine that the hood is working (e.g., a small piece of paper held at the face of the hood will be sucked inward).

1. When work is being conducted within the hood, position the sash so that protection from splashes, flying debris, etc., is provided.
    a. Normally, this is a 12-16 inch work opening.
    b. Experimental procedures should be conducted well inside the hood.
    c. Moving an apparatus 5-10 cm back from the front edge into the hood can reduce the vapor concentration at the face by 90%.
2. Hoods are not intended for the storage of chemicals.
    a. Materials stored in them should be kept to a minimum and in a manner that will not interfere with airflow.

3. Hoods should be considered as backup safety devices that can contain and exhaust toxic, offensive, or flammable materials.
    a. They should not be regarded as a means of disposing of chemicals.

CHM 7.9 Inspections

1. Annual inspections of classrooms, janitorial closets, and chemical store rooms and cabinets should be conducted in your school to ensure the integrity of chemicals and storage structures. Spot inspections may be performed periodically throughout the school year.
2. Engage maintenance staff in these inspections if storage shelving or locks are in need of updates or repair.
3. Create and maintain an up-to-date map of the location and storage pattern of chemical storage rooms and cabinets in your school.

CHM 8: Chemical Storage

CHM 8.1 Container Labeling

1. Each container must be labeled with the **chemical name** of the material stored within (not chemical formula solely).
2. Chemical names must be consistent with the **State of Georgia's Public Employee Hazardous Chemical Protection and Right to Know Act of 1988 (O.C.G.A 45-22-2**), **OSHA Standard 29 CFR 1910**,and **National Fire Protection Association (NFPA) 45: Standard on Fire Protection for Laboratories Using Chemicals**, in order to facilitate the identification of the chemical(s) in case of a spill.

CHM 8.1.1 Labeling of Chemical Containers

1. No unlabeled substance should be present in the laboratory at any time!
2. Use labels with good adhesive.
3. Use a permanent marker (waterproof and fade resistant) or laser (not inkjet) printer.
4. Print clearly and visibly.
5. Replace damaged, faded, or semi-attached labels.

CHM 8.1.2 Commercially Packaged Chemicals

1. Verify that the label contains the following information:
    a. Chemical name (as it appears on the MSDS)
    b. Name of chemical manufacturer
    c. Necessary handling and hazard information
        1. Add:
    a. Date received
    b. Date first opened
    c. Expiration or —use by date (if one is not present)

CHM 8.1.3 Secondary Containers and Prepared Solutions

1. When a material is transferred from the original manufacturer's container to other vessels, these vessels are referred to as ―secondary containers.
2. Label all containers used for storage with the following:
    a. Chemical name (as it appears on the MSDS)
    b. Name of the chemical manufacturer or person who prepared the solution
    c. Necessary handling and hazard information
    d. Concentration or purity
    e. Date prepared
    f. Expiration or ―use by date

CHM 8.1.4 Containers in Immediate Use

1. These chemicals are to be used within a work shift or laboratory session.
2. Label all containers in immediate use with the following:
3. Chemical name (as it appears on the MSDS)
4. Necessary handling and hazard information

CHM 8.1.5 Chemical Waste

All containers used for chemical waste should be labeled with the following:

1. HAZARDOUS WASTE
2. Chemical name (as it appears on the MSDS)
3. Accumulation start date
4. Hazard(s) associated with the chemical waste
5. Date generated

Complete the Waste Disposal Form for removal of all waste (chemicals and broken glass) at the end of each semester. The Science/STEM Coordinator (Dr. Chaundra Creekmur; creekch@boe.richmond.k12.ga.us) will facilitate removal.

CHM 8.2 Proper Chemical Storage

Guidelines for chemical storage must follow **O.C.G.A 45-22-2, O.C.G.A. 25-2, OSHA Standard 29 CFR 1910, and NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals** and **NFPA 30: Flammable and Combustible Liquids Code.**

1. Create and maintain an up-to-date map of the location and storage pattern of chemical storage rooms and cabinets in your school.
2. Hazardous chemicals in schools should be stored in accordance with MSDS specifications
3. Chemicals should not be stored in areas that are occupied by or accessible to students, such as classrooms or restrooms; they should preferably be stored in a central, secure location.
4. Organize chemicals first by **COMPATIBILITY**—not alphabetic succession (refer to section entitled Shelf Storage Pattern). Store alphabetically within compatible groups.

CHM 8.4 Other Considerations

Additional consideration must be paid to toxics, peroxides, oxidants, poisons, fuming corrosives, etc. to see where they fit into the basic flammability/reactivity categories. Chemicals that belong in the same storage area but are incompatible with each other, such as acids and bases, should be separated as much as possible.

1. Once separated into hazard classes, chemicals may be stored alphabetically.
    a. Keep all containers well sealed to avoid vaporization and spills. Caps constructed of plastic wrap aluminum foil, corks, or glass stoppers are not adequate.
    b. Use FM or UL approved storage containers and safety cans for flammable liquids. No container of a flammable liquid may exceed a capacity of 2 gallons.
    c. Use spill trays under containers of strong reagents.
2. Store corrosives in non-metallic or stainless steel safety cans on lowest shelves.
3. Store containers of inorganic hydroxides and hydrofluoric acid in polyethylene containers.
4. Segregate acids from bases and active metals such as sodium, potassium, or magnesium.

5. Segregate acids from chemicals which could generate toxic gases upon contact such as sodium cyanide, iron sulfide, etc.
6. Segregate oxidizing acids from inorganic acids and flammable and combustible materials.
7. Keep oxidizers, such as bromine and sulfuric acid, away from reducing agents such as zinc, formic acid, and alkali and alkaline earth metals.
8. Do not store liquids above eye level. All shelves should have a protective edge guard to prevent containers from sliding off shelves.
9. Do not store containers, full or empty, in walkways.
10. Store chemicals, particularly acids and water-reactives, in areas protected from water leaks and flooding, e.g., no storage under sinks.
11. Always store chemicals of high acute and moderate or high chronic toxicity in unbreakable secondary containers.
12. Nitric acid is incompatible with almost all other chemicals. It should be stored in a tub or basin in a storage cabinet.

CHM 8.2.1 Storage Compatibility Chart

Inorganics

I-1. Metals, Hydrides
I-2. Halides, Halogens, Phosphates, Sulfates, Sulfites, Thiosulfates
I-3. Amides, Nitrates (except Ammonium nitrate*), Nitrites, Nitric acid
I-4. Carbon, Carbonates, Hydroxides, Oxides, Silicates
I-5. Carbides, Nitrides, Phosphides, Selenides, Sulfides
I-6. Chlorates, Chlorites, Hydrogen Peroxide (< 10%), Hypochlorites, Perchlorates*, Perchloric acid*
I-7. Arsenates*, Cyanates*, Cyanides*
I-8. Borates, Chromates, Manganates, Permanganates
I-9. Acids (except Nitric acid)
I-10. Arsenic, Phosphorous*, Phosphorous Pentoxide*, Sulfur

Organics
O-1. Acids, Anhydrides*, Peracids
O-2. Alcohols, Amides, Amines, Glycols, Imides, Imines
O-3. Ethers*, Ethylene oxide, Halogenated hydrocarbons*, Ketenes, Ketones
O-4. Epoxy compounds, Isocyanates*
O-5. Azides, Hydroperoxides, Peroxides

* Not allowed in RCSS labs.

CHM 8.2.2 Shelf Storage Pattern for Organics

ORGANIC #2 Alcohols Imides Amides Imines Amines Glycols **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC #8** Cresols Phenol	**POISON STORAGE CABINET** Toxic substances
ORGANIC #3 Aldehydes Esters Hydrocarbons **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC #6** Azides Hydroperoxides Peroxides	**FLAMMABLE ORGANIC #1** **Red Diamond Rating = 1** Alcohols Glycols.
ORGANIC #4 Ethers Ketenes Ketones Ethylene oxide Halogenated Hydrocarbons **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC #1** Acids Anhydrides Peracids **STORE CERTAIN ORGANIC ACIDS IN ACID CABINET**	**FLAMMABLE ORGANIC #2** **Red Diamond Rating = 2** Alcohols Glycols Acetone
ORGANIC #5 Epoxides Isocyanates	**MISCELLANEOUS**	**FLAMMABLE ORGANIC #3** **Red Diamond Rating = 3** Methanol Other compounds allowed only with written permission

ORGANIC #7		MISCELLANEOUS	FLAMMABLE ORGANIC #4. Red Diamond Rating =4 Not allowed.
Nitriles Sulfides	Polysulfides Sulfoxides		

Note:

RCSS labs may NOT have Class IA, Class IB, and Class IC Flammable Organics in storage! Check the NFPA rating!

RCSS labs may NOT have Class IA, Class IB, and Class IC Combustible Organics in storage! Check the NFPA rating!

CHM 8.2.2 Shelf Storage Pattern for Inorganics

INORGANIC #10		INORGANIC #7	
Arsenic Phosphorous	Phosphorous Pentoxide Sulfur	Arsenates Cyanides	Cyanates
		STORE AWAY FROM WATER	
INORGANIC #2		**INORGANIC #5**	
Halides Halogens Phosphates	Sulfates Sulfites Thiosulfates	Carbides Nitrides Phosphides	Selenides Sulfides
INORGANIC #3		**INORGANIC #8**	
Amides Azides	Nitrates Nitrites	Borates Chromates	Manganates Permanganates
EXCEPT AMMONIUM NITRATE - STORE AMMONIUM NITRATE AWAY FROM ALL OTHER SUBSTANCES			

INORGANIC #1		INORGANIC #6	
Hydrides	Metals	Chlorates Chlorites Hypochlorites Hydrogen Peroxide	Perchlorates Perchloric acid Peroxides
STORE AWAY FROM WATER. STORE ANY FLAMMABLE SOLIDS IN DEDICATED CABINET			
INORGANIC #4		**MISCELLANEOUS**	
Carbon Carbonates Hydroxides	Oxides Silicates		

CHM 8.2.3 Incompatible Chemicals

It is important to avoid storing incompatible chemicals together. In the list below, do not store chemicals in the left column together with chemicals in the right column.

This chemical is . . .	**incompatible with this chemical:**
I. acids	bases
A. nitric acid	metals, acetic acid sulfuric acid, sulfides, nitrites and other reducing agents, chromic acid and chromate, permanganates, flammable liquids.
B. oxalic acid	silver, mercury
C. sulfuric acid	metals, chlorates, perchlorates, permanganate, nitric acid
II. alkali and alkaline earth metals and their carbides, hydrides, hydroxides, oxides, peroxides	water, acids, halogenated organics oxidizing agents
III. ammonia	halogens, silver, mercury, sodium hypochlorite (bleach)
IV. carbon, activated	oxidizing agents*
V. hydrogen peroxide	metals and their salts
VI. inorganic azides	acids, heavy metals and their salts, oxidizing agents*
VII. inorganic cyanides	acids, strong bases
VIII. inorganic nitrates	acids, metals, nitrites, sulfur
IX. inorganic nitrites	acids, oxidizing agents*
X. inorganic sulfides	acids
XI. organic compounds	oxidizing agents*
A. acetylene and monosubstituted acetylenes (R-CCH)	halogens, Group 11 and 12 metals and their salts
B. organic acyl halides	bases, organic hydroxy compounds

C. organic anhydrides	bases, organic hydroxy compounds
D. organic halogen compounds	aluminum metal
E. organic nitro compounds	strong bases
XII. phosphorus (yellow)	oxygen, oxidizing agents*, strong bases
XIII. phosphorus pentoxide	water
XIV. powdered metals	acids, oxidizing agents*

* Oxidizing agents include chromates, dichromates, chromium (VI) oxide, halogens, hydrogen peroxide and peroxides, nitric acid, nitrates, perchlorates and chlorates, permanganates, and persulfates.

CHM 8.3 Flammable and Combustible Materials

CHM 8.3.1 Classification of Flammable and Combustible Materials

Flammable Liquid: A liquid having a flash point (the minimum temperature at which a liquid gives off a vapor in sufficient concentrations to ignite) below 100°F (37.8°C). There are three classes of flammable liquids:

Class	Flashpoint	Boiling Point	NFPA 704 Red Diamond Rating
Class 1A (IA)	< 73°F (22.8°C)	boiling point < 100°F (37.8°C)	4
Class 1B (IB)	< 73°F (22.8°C)	≥ 100°F (37.8°C)	3
Class 1C (IC)	≥ 73°F (22.8°C) and < 100°F (37.8°C)		3

Combustible Liquid: A liquid having a flash point at or above 100°F (37.8°C). There are three classes of combustible liquids:

Class	Flashpoint	Boiling Point	NFPA 704 Red Diamond Rating
Class 2 (II)	≥ 100°F (37.8°C) and < 140°F (60.0°C)		2
Class 3A (IIIA)	≥ 140°F (60.0°C) and < 200°F (93.3°C)		2
Class 3B (IIIB)	≥ 200°F (93.3°C)		2

CHM 8.3.2 Storage Guidelines

1. **RCSS labs may NOT have Class IA, Class IB, and Class IC Flammable Organics in storage! Check the NFPA rating!**
2. **RCSS labs may NOT have Class IA, Class IB, and Class IC Combustible Organics in storage! Check the NFPA rating!**

3. Guidelines for flammable storage must follow **O.C.G.A. 25-2, O.C.G.A. 45-22-2, OSHA Standard 29 CFR 1910**, and **NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals** and **NFPA 30: Flammable and Combustible Liquids Code.**
4. All cabinets for storage of flammable materials must follow statutes, regulations and local ordinances promulgated pursuant to **O.C.G.A. Title 25, Chapter 2, OSHA Standard 29 CFR 1910, and NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals**.
5. In addition, all flameproof cabinets must meet the design and installation criteria set forth in the **NFPA's latest version of NFPA 30: Flammable and Combustible Liquids Code.**
6. The maximum allowable quantity for flammable liquid storage in any size lab is not to exceed 480 liters.
7. Regarding flammable liquid storage outside of approved flammable storage cabinets: there may be a maximum of 40 liters of flammable liquids in original containers and an additional 100 liters in approved safety cans may not to exceed 8 liter size (**NFPA 45**).
8. NFPA specified safety cabinets MUST be used for storage of flammable liquids.
9. **High schools should not be in possession of any flammable liquid that requires storage in explosion-proof refrigerators and/or freezers**.
10. All flammables must be stored by compatibility.

CHM 8.4 Acids

1. Acids and bases should not be stored together.
2. Acids must be stored in a cabinet that is constructed from corrosion-resistant materials (**OSHA Standard 29 CFR 1910** and **OSHA Standard 29 CFR 1200**).
3. Each acid cabinet should be vented to reduce acid vapor accumulation.
4. To properly store acids
   a. Segregate acids from bases.
   b. Segregate acids from reactive metals such as sodium, potassium, and magnesium.

c. Segregate oxidizing acids from organic acids, and flammable and combustible materials.
d. Segregate acids from chemicals that could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide and calcium carbide.
e. Store inorganic acids in corrosive or acid storage cabinets.
    - Their interiors and hardware (door hinges and shelf brackets) are corrosion resistant. Corrosive storage cabinets can be located under fume hoods or exist as separate units.
    - **FLAMMABLE STORAGE CABINETS ARE NOT CORROSION RESISTANT AND MUST NOT BE USED FOR ACID STORAGE.**
f. Store acids and bases in sealed, air-impermeable containers with tight-fitting caps as opposed to loose-fitting lids or glass stoppers.
    - An exception to this is mixtures that may produce gases that can pressurize the container.
g. Store nitric and in its own secondary containment tray.
    - Nitric acid can combine with other acids to form nitrogen oxides and nitrosyl halide gases.

CHM 8.5 Bases

1. Acids and bases should not be stored together.
2. **Ammonium hydroxide is flammable and must be stored in a dedicated Flammables Cabinet.**
3. Bases in pellet or powder form should be stored on a dedicated shelf in chemical storage room.
4. Bases in liquid form should be stored in appropriate containers with proper labels and tight-fitting lids. They may be stored adjacent to bases in pellet/powder form on the same shelf in the chemical storage room.

CHM 8.4 Care of Compressed Cylinders

CHM 8.4.1 Labels

1. Make sure the contents of the compressed gas cylinder are clearly stenciled or stamped on the cylinder or on a durable label.
2. Do not identify a gas cylinder by the manufacturer's color code.
3. Never use cylinders with missing or unreadable labels.
4. Label empty cylinders ―EMPTY‖ or ―MT‖ and date the tag; treat in the same manner that you would if it were full.

CHM 8.4.2 Operations

1. Check all cylinders for damage before use.
2. Be familiar with the properties and hazards of the gas in the cylinder before using.
3. Wear appropriate protective eyewear when handling or using compressed gases.
4. Use the proper regulator for each gas cylinder.
5. Do not tamper with or attempt to repair a gas cylinder regulator.
6. Never lubricate, modify, or force cylinder valves.
7. Open valves slowly using only wrenches or tools provided by the cylinder supplier directing the cylinder opening away from people.
8. Check for leaks around the valve and handle using a soap solution, ―snoop‖ liquid, or an electronic leak detector.
9. Close valves and relieve pressure on cylinder regulators when cylinders are not in use.

CHM 8.4.3 Transport

1. Always attach valve safety caps when storing or moving cylinders.
2. Transport cylinders with an approved cart with a safety chain; never move or roll gas cylinders by hand.

CHM 8.4.4 Storage

1. Securely attach all gas cylinders (empty or full) to a wall or laboratory bench with a clamp or chain, or secure in a metal base in an upright position.
2. Store cylinders by gas type, separating oxidizing gases from flammable gases by either 20 feet or a 30-minute firewall that is 5 feet high.
3. Store gas cylinders in cool, dry, well-ventilated areas away from incompatible materials and ignition sources.
4. Do not subject any part of a cylinder to a temperature higher than 125 °F or below 50 °F.
5. Store empty cylinders separately from full cylinders.

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CHM 9: Chemical Waste Storage and Disposal

CHM 9.1 Definition of Chemical and Hazardous Wastes

1. Any chemical discarded or intended to be discarded is defined by the EPA as chemical waste. HAZARDOUS chemical waste as designated by the EPA or the Georgia Environmental Protection Division is waste that presents a danger to human health and/or the environment.
2. According to EPA regulations, the following four characteristics define a waste as hazardous:
   a. Ignitability
   b. Corrosiveness
   c. Reactivity
   d. Toxicity
3. Management and disposal of laboratory waste in containers are regulated under RCRA regulations.
4. These laboratory waste streams include used chemicals, residues from experiments, spill cleanup, expired or off-spec chemicals and other chemical waste.

Complete the Waste Disposal Form for removal of all waste (chemicals and broken glass) at the end of each semester. The Science/STEM Coordinator (Dr. Chaundra Creekmur; creekch@boe.richmond.k12.ga.us) will facilitate removal.

CHM 9.2 Regulation of Waste

While the federal Occupational Safety and Health Administration (OSHA) does not have jurisdiction over state and local government employees, including those in public schools, the federal Environmental Protection Agency (EPA) has the authority to enforce certain OSHA standards, such as Hazardous Waste Operations (**29 CFR 1910.1200** - see Appendix C) or relevant EPA standards in public schools.

Some chemicals purchased by schools may need to be managed as hazardous wastes and may ultimately require disposal as such. Hazardous wastes need to be managed from their initial

point of generation until their ultimate point of disposal, known as “cradle to grave.” The **Resource Conservation and Recovery Act** (RCRA) gives the EPA the authority to control the generation, transportation, treatment, storage, and disposal of hazardous waste. The **Toxic Substances Control Act** (TSCA) addresses the manufacturing, processing, distribution, use, and disposal of commercial and industrial chemicals. The **Pollution Prevention Act** (PPA) establishes pollution prevention as the national policy for controlling industrial pollution at its source. The Department of Transportation’s Pipeline and Hazardous Materials Safety Administration regulates the transport of hazardous materials.

CHM 9.3 Liability

1. It is the school's responsibility to make a hazardous waste determination.
    a. This includes spent chemicals used in the lab, expired or unwanted chemicals, contaminated gloves, and any spill cleanup debris.
    b. Schools must ensure that a RCRA hazardous waste is safely accumulated and transported off-site for proper disposal.
    c. Depending on the quantity of waste generated by a school, additional requirements for storage, handling and emergency response may apply.
2. Any school that generates hazardous wastes must notify their state environmental agency and obtain an EPA Identification (ID) Number.
    a. This EPA ID Number must be put on all manifests for tracking disposal of school wastes and must be site specific for the address given.
3. School liability does not end when the wastes leave the school, and school administrators must make sure they receive a copy of the shipping manifest stating that their wastes arrived at their destination (e.g., treatment, storage, or disposal facility).

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CHM 9.4 Proper Storage and Disposal of Chemical Waste

The following guidelines are provided to schools and administrators and should be used for storing and disposing of hazardous waste:

CHM 9.4.1. Segregation of Waste

Separate waste containers are required to properly segregate waste for disposal. The following waste categories should be used.

- Chlorinated Solvents
- Cyanides
- Hexavalent Chrome
- High Ph Solutions
- Hydrofluoric Acid
- Low Ph Solutions
- Nitric Acid
- Non-Chlorinated Solvents
- Oxidizers
- Palladium
- Reducing Agents
- Sulfides

CHM 9.4.2 Storage of Waste

1. Chemicals that are stored for disposal off-site should be placed in suitable closed containers and should be clearly marked with the contents.
2. If the chemicals are a RCRA hazardous waste, the school must ensure that they are transported offsite for proper disposal.
3. Store all waste in containers that are in good condition and are compatible with their contents.
4. Avoid using metal containers; certain chemicals can cause the metal to corrode and the container to leak.
5. Clearly and permanently label each container as to its contents and label as hazardous waste.
6. Store waste in a designated area away from normal laboratory operations and to prevent unauthorized access.
7. Store waste bottles away from sinks and floor drains.
8. Do not completely fill waste bottles; leave several inches of space at the top of each waste container. Securely cap all waste bottles.

CHM 9.5 Disposal of Hazardous Waste

1. **The use of sinks for the disposal of chemicals is strictly prohibited!**
   a. When rinsing glassware that contained chemical, discard the first rinse volume into the appropriate waste container.
   b. Subsequent rinses can be discarded to the sink.
2. Water/air reactive wastes are restricted by waste disposal companies and must be deactivated prior to disposal.
   a. This is particularly true of materials which ignite or release gases on contact with air or water.
3. Dispose of chemically contaminated paper and disposable clothing in approved solid waste containers.

4. Do not treat hazardous waste on-site. Exception: Acids may be neutralized with sodium bicarbonate in a 50-50 ratio by weight.
5. Contact Facilities and Maintenance for pick-up and disposal. Document the date pick-up was requested and the date that it occurred.

Complete the Waste Disposal Form for removal of all waste (chemicals and broken glass) at the end of each semester. The Science/STEM Coordinator (Dr. Chaundra Creekmur; creekch@boe.richmond.k12.ga.us) will facilitate removal.

CHM 9.6 Record Keeping

1. Reassigned samples must be re-labeled with the new custodian's name and the date the waste was generated and stored.
2. A waste management log must be maintained and should indicate how and when the waste was generated, how and when it was isolated and stored, by whom it was generated and stored, and date and method in which it was disposed.

CHM 10: Chemical Spills

CHM 10.1 RCSS Chemical Spill Response Plan

Chemical spills and accidents need to be minimized as much as possible. If a chemical spill should occur, a quick response with a stocked chemical spill kit will help minimize potential harm to personnel, equipment and laboratory space. The majority of chemical spills can be prevented or minimized by:

1. Maintaining a neat and organized work area.
2. Performing a laboratory procedure review prior to conducting new experimental procedures.
3. Storing liquid chemicals in secondary containment bins.
4. Keeping reagent chemical containers sealed or closed at all times, except when removing contents.
5. Ordering reagent chemicals in plastic or plastic coated glass containers whenever possible.
6. Using secondary containment to store and move chemicals.

Cleanup of any spill, release or discharge is the responsibility of the school. Spill clean- up debris may be a hazardous waste subject to RCRA regulations. It is the school's responsibility to conduct a hazardous waste determination on waste generated from spill cleanup to confirm whether or not the material meets the definition of hazardous waste and must be managed in accordance with RCRA regulations.

Schools should have a chemical inventory and an emergency response plan to ensure the safety of building occupants and emergency responders. The elements of the emergency response plan should include the following topics:

1. Procedures for evacuation of the building in the case of a spill that may to result in exposure to building occupants.
2. District personnel contact numbers and emergency contact numbers.

   MAKE SURE THAT ALL EMERGENCY CONTACT NUMBERS ARE POSTED IN YOUR STORAGE AREAS, BESIDE THE CLASSROOM DOOR, AND OUTSIDE THE STORAGE DOOR.

3. Emergency procedures to contain the material in the location of the spill.
4. Contact information for remediation services
5. Procedures for proper disposal of hazardous material in compliance with federal, state, and local regulations.

Training is MANDATORY for any personnel who might use the Chemical Spill Response Kit. The procedures noted in this manual were developed to give guidance to knowledgeable laboratory personnel, maintenance staff and custodians, public safety officers, and administrators on the safe and effective ways in which to clean-up small chemical spills. If you have any questions or concerns about the spill clean-up process, please contact Dr. Chaundra Creekmur at creekch@boe.richmond.k12.ga.us (Science/STEM Coordinator).

CHM 10. 2 RCSS Chemical Spill Clean-Up Procedures

CHM 10.2.1 General Precautions

In the event of a solid or liquid spill, LARGE OR SMALL

1. Keep students or other individuals away from the spill. Evacuate the lab if toxic or flammable vapor is present.
2. Extinguish all flames and turn off electrical equipment that may produce a spark in order to avoid ignition of flammable vapor.
3. Attend to any students or other individuals splashed by the spill. Find out what was spilled, flush affected parts of the body with water, and get medical attention, if necessary.
4. If the spill is large or releases dangerous quantities of toxic or flammable vapors, evacuate the area and call your local fire department for advice.

5. If the floor is wet after cleanup, warn students to avoid the area to minimize the danger of slipping.

CHM 10.2.2 Types of Spills that Can Be Handled by Laboratory Personnel

1. In the event of a chemical spill, first decide if you are trained, knowledgeable and equipped to handle the incident.
2. Immediately evacuate the lab and notify administration and/or public safety if there is a possibility of an acute respiratory hazard present or if you need assistance to clean up the spill.
3. Never proceed to clean up a spill if you do not know the hazards associated with the chemical or if you are unsure of how to clean up the spill.
4. If anyone is injured or contaminated, immediately notify administration and/or public safety and begin decontamination measures or first aid, if trained.
5. Precautions must be taken to minimize exposure to the spilled chemical.
    a. Wear the appropriate PPE when cleaning up a spill.
    b. Be careful not to step in the spilled material and track it around.
    c. Contact emergency personnel, your principal, and Dawn Phillips if exposure to a chemical occurs.

Chemical Class	Example
Weak Acids or Diluted Strong Acid Solutions (< 1.0M) Any acid that is dilute enough to not create fumes or gases	dilute acetic acid dilute hydrochloric acid 0.5M sulfuric acid
Weak Bases or Diluted Strong Base Solutions (<1.0M) Any base that is dilute enough to not emit vapors	dilute sodium hydroxide dilute ammonium hydroxide
Solid Chemical Compounds, Non-oxidative	sodium sulfate aluminum chloride
Solid Chemical Compounds: Class 1 Oxidizers	potassium dichromate potassium nitrate
Solid Chemical Compounds: Class 2 Oxidizers	calcium chlorate calcium hypochlorite (50% or less by weight)

Class 1 Flammables: **Combustible if heated**	isopropyl alcohol ethanol
Class 2 Flammables: **Liquids and Solids** **Flashpoint/Ignition between 100º and 200ºF.**	acetone sulfur, granulated solid

6. If the spill is fairly small, it can be cleaned up using the guidelines given below.
    a. When cleaning up any spill, make sure the proper protective clothing is worn - gloves, lab coat and safety glasses or goggles. For spills of more hazardous substances or for large spills, rubber boots, a face shield or a respirator may be needed.
    b. Make sure that all forms of local exhaust, i.e. fume hoods, are operating. It is normally not advisable to open the windows.
    c. If broken glass is involved, do not pick it up with your gloved hands. Use the scoop or tongs to place it in the bag, then place the bag in a strong cardboard box or plastic container.
7. All spill debris and associated paper towels, glassware, gloves, and shoe covers should be placed into a polyethylene waste bag and sealed.
8. The bag should be labeled with the following information:
    a. Date
    b. School and Classroom Number
    c. Person responsible for Clean-up
    d. Content
    e. Approximate Amount of Material
9. Contact Facilities and Maintenance for pick-up and disposal. Document the date that pick-up was requested and the date pick-up occurred.

CHM 10.2.3 Types of Spills that MUST NOT Be Handled by Laboratory Personnel

If the spill is too large for you to handle, involves more than 500 ml of any hazardous material, involves materials listed in the table below; is a threat to personnel, students or the public; involves radioactive material; involves an infectious agent; or involves a corrosive, highly toxic, or reactive chemical, call for assistance.

Chemical Class	Example
Strong Acids - Any acid that is concentrated enough to fume or emit acid gases	Fuming Sulfuric Acid Red Nitric Acid
Strong Bases - Any base that is concentrated enough to emit vapors	ammonium hydroxide
Poison by Inhalation - Any chemical that readily emits vapors / gases at normal temperature and pressure that are extremely toxic by inhalation	**NOT ALLOWED IN RCSS LABS**
Reactive - Any chemical that is sensitive to air, water, shock, friction and/or temperature	dry picric acid sodium borohydride organic peroxides
Mercury - Any mercury compound	**NOT ALLOWED IN RCSS LABS**
Extremely Toxic - Any chemical that is readily absorbed through the skin and is extremely toxic at small concentrations	**NOT ALLOWED IN RCSS LABS**
Solid Chemical Compounds: Class 3 Oxidizers	potassium bromate potassium chlorate
Solid Chemical Compounds: Class 4 Oxidizers	hydrogen peroxide (greater than 91% by weight) perchloric acid solutions (greater than 72.5% by weight)
Class 3 Flammables: **Easily ignitable; high risk of explosion**	methanol
Class 4 Flammables	**NOT ALLOWED IN RCSS LABS**

CHM 10. 2.4 Specific Clean-up Procedures

CHM 10.2.4.1 Solid Spills

1. Use a plastic scoop to place the spilled material into the polyethylene bag. Care should be taken so as not to create dust or cause the contaminated powder to become airborne.
2. Broken glass contaminated with a hazardous solid requiring special disposal should be placed into a cardboard box or plastic container appropriately labeled "BROKEN GLASS" and placed with the spilled solid for disposal.
3. After the bulk of the material is cleaned up, wet a spill pad (paper towel) and wipe the area down. Place the towels into the polyethylene bag.
4. Wipe the area down with another wet paper towel. Dispose of paper towel with the waste generated from the spill clean-up.
5. All spill debris and associated paper towels, glassware, gloves, and shoe covers should be placed into a polyethylene waste bag and sealed.
6. The bag should be labeled with the following information:
   a. Date
   b. School and Classroom Number
   c. Person responsible for Clean-up
   d. Content
   e. Approximate Amount of Material
7. Contact Facilities and Maintenance for pick-up and disposal. Document the date that pick-up was requested and the date pick-up occurred.

CHM 10.2.4.1 Liquid Spills

Liquid spills can be harder to deal with than solid spills because liquids may spread over a wider area, may emit toxic or flammable vapors and can make the floor very slippery. Liquid spills can be dealt with by absorption onto a solid absorbent, such as diatomaceous earth, or by neutralization, depending on the chemical spilled and the spill situation.

CHM 10.2.4.1.1 Organic Solvent and Flammable Liquid Spills

1. Alert people in the immediate area of the spill.
2. Determine chemical nature of the spill. Check the MSDS (Material Safety Data Sheet). If the material spilled is highly hazardous, treat it as a major spill, and call the 911.
3. If a volatile, toxic or flammable material is spilled, immediately warn everyone nearby to extinguish flames and turn off all electrical and spark producing equipment.
4. Wear the proper protective equipment; at a minimum, gloves and safety goggles.
5. Dike the spill by surrounding the area with absorbents, such as vermiculite or sand for organic liquids. Clean up the spill using the same materials. **Do not use paper towels, as these will increase the rate of evaporation and will cause higher concentrations of vapor, which may be toxic or flammable, to enter the air.**
6. When the liquid has been absorbed, shovel the absorbent or pillows into a container for disposal. Remember that although the liquid has been absorbed, it still has the same hazardous properties and must be disposed of appropriately.
7. Wash the surfaces with soap and water and clean up by ordinary means.
8. After cleanup, all materials used in the cleanup, including paper towels, must be disposed of as wastes and placed in the disposal bags. Double bag the waste as needed. Label the bags to indicate the chemicals inside.
9. The bag should be labeled with the following information:
    a. Date
    b. School and Classroom Number
    c. Person responsible for Clean-up
    d. Content
    e. Approximate Amount of Material

11. Contact Facilities and Maintenance for pick-up and disposal. Document the date that pick-up was requested and the date pick-up occurred.

CHM 10.2.4.1.2 Acid Spill

1. Absorb the spill by sprinkling it with the absorbent kitty litter.
2. Neutralize an acid spill by sprinkling the absorbed liquid with sodium bicarbonate (baking soda).
3. When fizzing (evolution of CO_2) stops, enough neutralizing agent has been added.
4. The spill should be swept up with a brush into a dustpan or mopped and placed into a sturdy container.
5. Add additional sodium bicarbonate to ensure that all of the acid is neutralized.
6. If broken glass is present in the spill, pick it up with tongs and rinse it in the sink before disposal in the broken glass container.
7. If the floor is wet after cleanup, warn students to avoid the area to minimize the danger of slipping.
8. After cleanup, all materials used in the cleanup, including paper towels, must be disposed of as wastes and placed in the disposal bags. Double bag the waste as needed. Label the bags to indicate the chemicals inside.
9. The bag should be labeled with the following information:
    a. Date
    b. School and Classroom Number
    c. Person responsible for Clean-up
    d. Content
    e. Approximate Amount of Material
10. Contact Facilities and Maintenance for pick-up and disposal. Document the date that pick-up was requested and the date pick-up occurred.

CHM 10.2.4.1.3 Base Spill

1. Absorb the spill by sprinkling it with the absorbent kitty litter.
2. Neutralize base spill by sprinkling the absorbed liquid with boric acid.
3. Use pH paper to determine whether the material has been neutralized.
4. The spill should be swept up with a brush into a dustpan or mopped and placed into a sturdy container.
5. Add additional boric acid to ensure that all of the acid is neutralized.
6. If broken glass is present in the spill, pick it up with tongs and rinse it in the sink before disposal in the broken glass container.
7. If the floor is wet after cleanup, warn students to avoid the area to minimize the danger of slipping.
8. After cleanup, all materials used in the cleanup, including paper towels, must be disposed of as wastes and placed in the disposal bags. Double bag the waste as needed. Label the bags to indicate the chemicals inside.
9. The bag should be labeled with the following information:
    a. Date
    b. School and Classroom Number
    c. Person responsible for Clean-up
    d. Content
    e. Approximate Amount of Material
10. Contact Facilities and Maintenance for pick-up and disposal. Document the date that pick-up was requested and the date pick-up occurred.