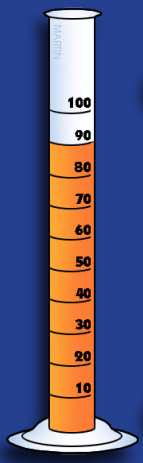
SCIENCE SAFETY



A GUIDE TO SAFE PRACTICES IN THE SCIENCE CLASSROOM

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WHY SCIENCE SAFETY?

As educators, student safety is the number one priority. There are many potential hazards in the science classroom, but if proper safety procedures are followed these potential hazards can be avoided. This safety handbook has been put together to ensure the safety of everyone who enters the classroom.

Included in this handbook are: rules and procedures that must be followed, chemical hygiene processes, as well as information on what to do when spills and accidents occur.

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RULES & PROCEDURES

Student Conduct

- Conduct yourself in a responsible manner at all times.
  - Frivolous activities, mischievous behavior, throwing items, and conducting pranks are prohibited.
- Lab and safety information and procedures must be read ahead of time.
  - All verbal and written instructions shall be followed in carrying out the activity or investigation.
- Eating, drinking, gum chewing, applying cosmetics, manipulating contact lenses, and other unsafe activities are not permitted in the laboratory.
- Working in the laboratory without the instructor present is prohibited.
- Unauthorized activities or investigations are prohibited.
  - Unsupervised work is not permitted.
- Entering preparation or chemical storage areas is prohibited at all times.
- Removing chemicals or equipment from the classroom or laboratory is prohibited unless authorized by the instructor.

Personal Safety (for students)

- Sanitized indirectly vented chemical splash goggles or safety glasses as appropriate (meeting the ANSI Z87.1 standard) shall be worn during activities or demonstrations in the classroom, laboratory, or field, including pre-laboratory work and clean-up, unless the instructor specifically states that the activity or demonstration does not require the use of eye protection. (See PPE on pg. 10)
- When an activity requires the use of laboratory aprons, the apron shall be appropriate to the size of the student and the hazard associated with the activity or investigation.
    - The apron shall remain tied throughout the activity or investigation.
- All accidents, chemical spills, and injuries must be reported immediately to the instructor.
    - Follow your instructor's directions for immediate treatment.
- Dress appropriately for laboratory work by protecting your body with clothing and shoes.
    - You should use hair ties to tie back long hair and tuck into the collar.
    - Do not wear loose or baggy clothing or dangling jewelry on laboratory days.
    - Acrylic nails are also a safety hazard near heat sources and should not be used.

Personal Safety (for students)

- Sandals or open-toed shoes are not to be worn during any lab activities.
- Know the location of all safety equipment in the room. This includes eye wash stations, the deluge shower, fire extinguishers, the fume hood, and the safety blanket.
- Know the location of emergency master electric and gas shut offs and exits.
- Certain classrooms may have living organisms including plants in aquaria or other containers. Students must not handle organisms without specific instructor authorization.
    - Wash your hands with soap and water after handling organisms and plants.
- When an activity or investigation requires the use of laboratory gloves for hand protection, the gloves shall be appropriate for the hazard and worn throughout the activity. (See PPE, pg 12)

Lab Safety Assessment for Students

- http://www.flinnsci.com/media/396492/safety_exam_hs.pdf

Chemical and Lab Equipment Safety

- Avoid inhaling in fumes that may be generated during an activity or investigation.
- Never fill pipettes by mouth suction. Always use the suction bulbs or pumps.
- Do not force glass tubing into rubber stoppers. Use glycerin as a lubricant and hold the tubing with a towel as you ease the glass into the stopper.
- Proper procedures shall be followed when using any heating or flame producing device especially gas burners. Never leave a flame unattended.
- Hot glass looks the same as cold glass. After heating, glass remains hot for a very long time. Determine if an object is hot by placing your hand close to the object but do not touch it.
- Should a fire drill, lockdown, or other emergency occur during an investigation or activity, make sure you turn off all gas burners and electrical equipment.
    - During an evacuation emergency, exit the room as directed. During a lockdown, move out of the line of sight from doors and windows if possible or as directed.
- Always read the reagent bottle labels twice before you use the reagent. Be certain the chemical you use is the correct one.
- Replace the top on any reagent bottle as soon as you have finished using it and return the reagent to the designated location.
- Do not return unused chemicals to the reagent container.
- Follow the instructor's directions for the storage or disposal of these materials.

Handling Glassware and Equipment

- Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken glass in the designated glass disposal container.
- Examine glassware before each use. Never use chipped, cracked, or dirty glassware.
- If you do not understand how to use a piece of equipment, ask the teacher for help!
- Do not immerse hot glassware in cold water. The glassware may shatter

Heating Substances

- Do not operate a hot plate by yourself. Take care that hair, clothing, and hands are a safe distance from the hot plate at all times. Use of hot plate is only allowed in the presence of the teacher.
- Heated glassware remain very hot for a long time. They should be set aside in a designated place to cool, and picked up with caution. Use tongs or heat protective gloves if necessary.
- Never look into a container that is being heated.
- Do not place hot apparatus directly on the laboratory desk. Always use an insulated pad. Allow plenty of time for hot apparatus to cool before touching it.

Fire/Electrical Safety

- Know the location and proper use of the fire blanket and fire extinguisher.
- Never directly touch something that might be hot. Use hot mitts or tongs.
- When heating, always point test tubes away from yourself and others.
- Never use electrical equipment near water or moisture.
- Extinguish all uncontrolled lames immediately.
- Make sure all flames and electrical equipment are turned off when not in use.
- If fire cannot be contained, call 9-1-1 and evacuate the building immediately. Follow school fire procedures.

Biological Safety

- Where protective gloves when handling biological specimens
- Dispose of all biological cultures or materials containing live cultures in proper biohazardous waste bags or containers
- Use knives and other sharp instruments with extreme care. Always cut an object after placing it on a suitable surface for cutting.
- Live specimens are to be handled in a humane manner. They are not to be released into the wild.

PPE

Protective eyewear, gloves, and lab coats/aprons are the basic PPE needed in the science lab.

Protective Eyewear

- Eye-protective devices shall be worn at any time the individual is engaged in an activity or is observing the use of hazardous substances likely to cause injury to the eyes. Such activity includes, but is not limited to, the following:
  - Working with hot metal.
  - Working with hot liquids or solids or with chemicals that are flammable, toxic, corrosive to living tissues, irritating, strongly sensitizing, or radioactive or that generate pressure through heat, decomposition, or other means.
  - Working with materials or equipment under stress, pressure, or force that might cause fragmentation, including the use of hand or power tools with such hard materials as stone or metal.

Use of Contact Lenses

- The use of contact lenses in science laboratory instruction is strongly discouraged because the capillary action of solutions causes rapid spreading of the solution under contact lenses and possibly delays the removal of the lenses.
- Quick removal of contact lenses is very difficult under adverse conditions.
- When laboratory activities are anticipated, prescription glasses should be worn unless a student cannot see without contact lenses. Contact lenses are also not to be worn when a dust or vapor hazard exists unless vapor-resistant goggles are available. It is essential to provide approved, nonvented protective goggles promptly to students, teachers, and visitors wearing contact lenses and to ensure that the goggles are worn regularly.
- If adequate eye protection cannot be provided, the student should be excused from the activity and assigned to another supervised room or area.

Gloves

When in the science lab, gloves should be worn when handling hazardous, corrosive or irritating materials, rough or sharp-edged objects, and very hot or cold materials.

Glove Type	Protection	Comments
Plastic disposable (Polyethylene)	Body fluids and small amounts of aqueous solutions.	Loose-fitting. Latex and powder free.
Latex (Natural Rubber)	Dilute acids, bases and irritating solutions. Not suitable for organic solvents.	Conforms to the hand and allows good finger dexterity. Be careful for latex sensitivities.
Neoprene (Synthetic Rubber)	Good for acids, bases, and most organic solvents.	More puncture resistant but may not provide good finger dexterity.
Nitrile	Best protection for acids, bases, and organic solvents. Great puncture resistance.	**Best all-around glove** for chemistry and biology labs.
Vinyl (PVC)	Suitable for washing dishes and reasonable protection against corrosive materials.	Not commonly found in laboratories. Not suitable for organic solvents.
Cloth cotton	Suitable for handling hot or cold items but they are not fire-proof.	Loose-fitting and only provides brief protection. Difficult to clean.
Silicone	Great for handling hot or cold items and are fire-resistant.	Best choice for handling hot materials in the lab. Hot vessel hand gripping devices are commonly made from silicone.

Student Safety Contract

I agree to follow the class science rules and procedures during any science course, investigation, or activity. By signing this form, I acknowledge that the science classroom, laboratory, or field sites can be an unsafe place to work and learn. The safety rules and regulations are developed to help prevent accidents and to ensure my own safety and the safety of my fellow students. I will follow any additional instructions given by my instructor. I understand that I may ask my instructor at any time about the rules and regulations if they are not clear to me. My failure to follow these science laboratory rules and regulations may result in disciplinary action.

Student Signature _____ Date____

Parent/Guardian Signature _____ Date____

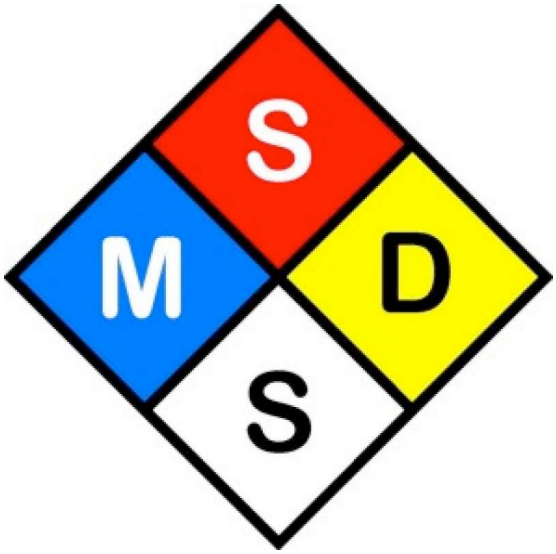
Mainting a Safe Lab Environment

- Backpacks and books are to remain in an area designated by the instructor and shall not be brought into the laboratory area.
- Never sit on laboratory tables.
- Work areas should be kept clean and neat at all times. Work surfaces are to be cleaned at the end of each laboratory or activity.
- Solid chemicals, metals, matches, filter papers, broken glass, and other materials designated by the instructor are to be deposited in the proper waste containers, not in the sink. Follow your instructor's directions for disposal of waste.
- Sinks are to be used for the disposal of water and those solutions designated by the instructor. Other solutions must be placed in the designated waste disposal containers.
- Glassware is to be washed with hot, soapy water and scrubbed with the appropriate type and sized brush, rinsed, dried, and returned to its original location.
- Goggles are to be worn during the activity or investigation, clean up, and through hand washing.
- Safety Data Sheets (SDSs) contain critical information about hazardous chemicals of which students need to be aware. Your instructor will review the salient points on the SDSs for the hazardous chemicals students will be working with and also post the SDSs in the lab for future reference.

CHEMICAL HYGIENE

Considerations for Purchasing

- Assess all hazards as well as chemical and physical properties using the MSDS
- Determine whether or not the hazards outway the educational benefits of using the chemical
- Determine if a safer chemical can be used
- Determine if the proper storage is available
- Determine how the product will need to be disposed and whether or not this is available
- Order no more than what is needed for one to two years
- Order no higher concentration than the highest needed concentration



Chemical Inventory Practices

- Keep an updated inventory for all chemicals, their amount, and location
- Examine all stored chemicals annually for replacement and chemical integrity
- Label all chemicals with date of purchase
- Develop a tracking system that includes the following information for each container of chemical being stored.
  - Chemical name as printed on original container
  - Molecular formula
  - Chemical Abstract Service (CAS) registry number
  - Date received
  - Source
  - Hazard classification
  - Required Storage conditions
  - Expiration or Use by date
  - Amount of chemical in container
  - Name of person who ordered or requested chemical
- All records of chemical storage and inventory need to be accurate and up to date

Proper Chemical Storage

- Keep all chemicals in a locked chemical prep and storage area!
- Chemicals used in the laboratory should be returned to the proper storage location at the end of the day's laboratory periods
- All shelving used for chemical storage must be secured to the floor or wall
- Storage area should be well ventilated
- All chemicals must be labeled. The label should include:
  - Chemical name or identity of contents
  - Concentration
  - Hazard information including target organs
  - Name of manufacturer or name of preparer
  - Date of expiration or date of preparation
- Do not store chemicals alphabetically! Chemicals must only be stored by compatibility. (Note: Within compatible groups chemicals can and should be stored alphabetically)
- Store acids in dedicated acid cabinet
  - Never store nitric acid with other acids unless acid cabinet has a compartment for nitric acid storage!
- Store corrosives in a corrosives cabinet
  - Do not store glacial acetic acid and nitric acid next to each other in the corrosives cabinet
  - Always transfer in plastic or rubber bottle carries

Proper Chemical Storage

- Store all flammable materials in an approved flammables storage cabinet
  - Keep flammable storage cool, between 55 and 80 degrees fahrenheit
  - Store all flammables away from ignition sources
  - All flammables must be stored away from all oxidiz ers
  - Storeroom with flammables should be equipped with an ABC fire extinguisher, fire blanket, and smoke de tector.
- Store toxic chemicals in a lockable poison cabinet that is labeled with a highly visible sign.
- Store water sensitive chemicals in a watertight cabinet in a cool and dry location
- Volatile chemicals should be stored in a ventilated cabi- net
- Only authorized personnel are allowed in the chemical storage area. Students are never allowed in this area!
- Chemical Storage Don’ts
  - Do not store chemicals under the fume hood.
  - Avoid storing chemicals above eye level
  - Do not store chemicals on the floor
  - Do not store chemicals above the work stations
  - Storage area should be well ventilated
  - Do not store items in the fume hood.
  - Avoid exposing chemicals to direct sunlight

Suggested Chemical Storage

Organics Shelf Storage

Alcohols, Amides, Amines, Imides, Imines, Glycols	Cresols, Phenol
Aldehydes, Esters, Hydrocarbons	Azides, Hydroperoxides, Peroxides
Ethers, Ethylene oxide, Halogenated Hydrocarbons, Ketones, Ketenes	Acids, Anhydrides, Peracids
Epoxy compounds, Isocyanates	Miscellaneous
Nitriles, Polysufides, Sulfides, Sulfoxides, etc.	Miscellaneous

Inorganics Shelf Storage

Arsenic, Phosphorous, Phosphorous Pentoxide, Sulfur	Arsenates, Cyanates, Cyanides
Halides, Halogens, Phosphates, Sulfates, Thiosulfates	Carbides, Nitrides, Phosphides, Selenides, Sulfides
Amides, Azides, Nitrates, Nitrites **EXCEPT Ammonium nitrite, must be stored away from all other substances**	Borates, Chromates, Manganates, Permanganates
Hydrides, Metals	Chlorates, Chlorites, Hypochlorites, Hydrogen Peroxide, Percholorates, Percholoric acid, Peroxides
Carbon, Carbonates, Hydroxides, Oxides, Silicates	Miscellaneous

Proper Handling of Chemicals

- Never smell chemicals directly; always waft the odors to your nose using your hand
- Wash hands thoroughly after any chemical exposure and before leaving the laboratory
- Do not pipet by mouth- always use a pipet bulb or other appropriate suction device
- Always add acid to water rather than adding water to acid

Proper Disposal of Chemicals

- All containers used for waste should be labeled with at least the following
  - Waste or Hazardous waste
  - Accumulation start date

ACCIDENT & INJURY PROCEDURES

First Aid

Burns

Because heat sources and corrosive chemicals are used in many laboratory science activities, there is the potential for burns to occur. If someone is burned, the following procedures are appropriate.

Chemical Burns of the Skin
(usually from strong acids or alkalies)

- Wash with large amounts of water
  - Use a shower or hose at low pressure (a forceful stream of water may further injure the burned skin) for at least 10 minutes.
- Remove clothing from the affected area while the skin is being flushed.
  - Clothing should be cut off, not pulled off, to avoid spreading the chemical over skin, face, and eyes.
- The label of some chemical containers may suggest other helpful first-aid measures that may be used for the particular chemical.
- Do not attempt to neutralize any chemical.
  - Never pour vinegar or citrus juice on alkali burns; never pour baking soda on acid burns.
  - Attempts at neutralization may cause further chemi cal reaction and more damage.
- Apply a nonocclusive (i.e., loose) dressing and call 9-1-1.

Nonchemical Burns of the Skin

- The degree or extent of burns and the percentage of skin surface involved usually determine the first-aid measures to be used.
- Adults who have suffered burns over 10 percent of their body surface (or a child with 2–10 percent burns) require hospitalization.
- Burns on the face suggest possible injury to the respiratory tract and may obstruct breathing as facial swelling increases.
    - Call 9-1-1, as prompt medical attention is urgent.

First-degree burns

- Minor burns, such as those resulting from overexposure to the sun or from light contact with a hot object.
- Redness or discoloration, together with mild swelling and pain.
- First-aid procedures:
    - Application of cool water or submersion of the burned area in cool water for no longer than 10 minutes to stop the burn
    - Follow with a dry dressing, if necessary

Second-degree burns

- May result from a very deep sunburn, contact with hot liquids, or flash burns from flammable products.
- Blisters are usually present.
- First-aid procedures:
  - Immerse the burned part in cool water (not in ice water) for a few minutes (water at room temperature or less is appropriate)
  - Apply dry, sterile gauze or a clean cloth as a protective bandage
  - Take precautions against breaking intact blisters or removing tissue
  - Avoid the use of an antiseptic preparation, ointment, spray, or home remedy
  - Keep affected arms or legs elevated
  - Seek medical evaluation

Third-degree burns

- May be caused by a flame, ignited clothing, immersion in hot water, grease scalds, contact with hot objects, or electricity.
- The temperature and duration of contact are important in determining the extent of tissue destruction.
- Characterized by deep tissue destruction; white, dark brown, mottled, or charred appearance (at first, the burn may resemble a second-degree burn); and complete destruction of all layers of the skin.
- First-aid procedures
    - Extinguish any smoldering clothing by applying water or by smothering with a fire blanket or any available clothing.
    - Do not attempt to remove clothing. Burnt clothing may be stuck or melted to the affected area.
    - Do not apply ointments, commercial preparations, grease, or other home remedies; those substances may cause further complications and interfere with treatment by the physician.
    - Do not attempt to administer any liquids or medicines orally to unconscious persons.
    - Cover the patient with a blanket.
    - If the hands are involved, keep them above the level of the heart.
    - Keep burned feet or legs elevated. (The victim should not be allowed to walk.)
    - Slightly elevate the head of a victim who has facial burns. Keep the person under continual observation for breathing difficulty. If respiratory problems develop, an open airway must be maintained.
    - Avoid immersing an extensively burned area or applying ice water over it; the cold may intensify the shock reaction. Cool water may be applied to the burned area to relieve pain and stop any further burning. Follow with the application of a dry, clean dressing or sheet.
    - Call 9-1-1 immediately and follow the serious injury or illness routine provided by the school district for emergency procedures.

Eye Injuries

Exposure to Chemicals—Acid Burns

- Begin first aid for acid burns of the eye as quickly as possible.
- Thoroughly wash the face, eyelid, and eye with tap water for at least 15 minutes, using the eyewash or eye/face-wash station if possible
    - If the victim is lying down, turn the head to the side; gently hold the eyelid open and, using the drench hose, apply water from the inner corner of the eye outward.
    - Make sure that the chemical does not wash into the other eye.
- Cover the eye with a dry, clean protective dressing (do not use cotton) and gently bandage in place.
- Caution the victim against rubbing the eye.
- Call 9-1-1.

Chemical Burns of the Eye—Alkali Burns

- Alkali burns of the eye are progressive injuries. An eye that at first appears to have only slight surface injuries may develop deep inflammation and tissue destruction, and the patient may lose eyesight.
- Follow Same steps for Acid Burns

Other Chemicals in the Eye

- Hold eyelids open; wash eyes immediately, using the eyewash or eyewash/facewash station, and continue to wash for at least 15 minutes.
- Make sure that the chemical does not wash into an unaffected eye.

Exposure to Poisons

Inhaled Poisons

- If possible, carry the victim immediately (do not let him or her walk) to fresh air. Open all doors and windows if the victim is too heavy to carry.
- Loosen clothing.
- Use appropriate CPR if the victim is not breathing. Do not stop until the patient breathes or help arrives.
- Have someone else call 9-1-1
- Monitor the victim for shock.

Ingested Poisons

- Call the poison control center at 1-800-222-1222, give the staff the necessary information, and follow the staff's instructions.
- Never induce vomiting in a stuporous or unconscious person.
- Take the victim to a doctor or medical facility for further evaluation and treatment.
    - The package or container of the ingested poison, with the intact label(s), as well as any vomited material, should also be taken to the doctor.
- Avoid self-contamination.

Poison (Chemicals) on Skin

- Remove any clothing that has come into contact with chemicals or poison and place the clothing in a plastic bag labeled with the name of the injured person.
    - Avoid self-contamination.
- Wash the skin with large quantities of cool, running water.
- Call the poison control center at 1-800-222-1222 to determine the need for additional treatment

POISON Help®

1-800-222-1222

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HIGH SCHOOL LABORATORY SAFETY COURSE

Certificate of Completion

Awarded to

Jennifer Davis

Kelly Walsh

on

December 1, 2015

for successfully completing seven hours of
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Flinn Scientific, Inc. Batavia, IL 60510

This certificate is valid until December 1, 2018.

FLINN SCIENTIFIC, INC

MIDDLE SCHOOL LABORATORY SAFETY COURSE

Certificate of Completion

Awarded to

Monica Harris

Dean Morgan Junior High

on

November 29, 2015

for successfully completing six hours of

Middle School Science Laboratory Safety Training

Flinn Scientific, Inc. Batavia, IL 60510

This certificate is valid until November 29, 2018.

FLINN SCIENTIFIC, INC

MIDDLE SCHOOL LABORATORY SAFETY COURSE

Certificate of Completion

Awarded to

Lauren Huntington

CY Middle School

on

December 2, 2015

for successfully completing six hours of

Middle School Science Laboratory Safety Training

Flinn Scientific, Inc. Batavia, IL 60510

RESOURCES

National Science Teachers Association. (2013) Safety in the Science Classroom, Laboratory, or Field Sites. Retrieved December 4, 2015, from https://www.nsta.org/docs/SafetyInTheScienceClassroomLabAndField.pdf

Mr. Thackwray's Lab Safety Rules. Retrieved December 4, 2015, from http://nobel.scas.bcit.ca/debeck_pt/science/safety.htm

Chemical Hygiene Plan Generic Plan for Schools. (2007). 9-15. Retrieved December 1,2015, from https://www.flinnsci.com/media/754740/chp.pdf

School Chemistry Laboratory Safety Guide. (2006). 17-23. Retrieved December 1, 2015, from http://www.cdc.gov/niosh/docs/2007-107/pdfs/2007-107.pdf

California Department of Education Sacramento (2014) Ward's Science.