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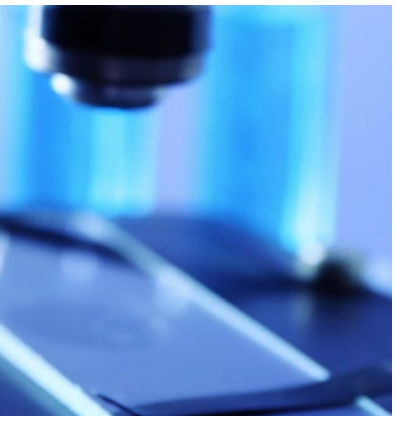
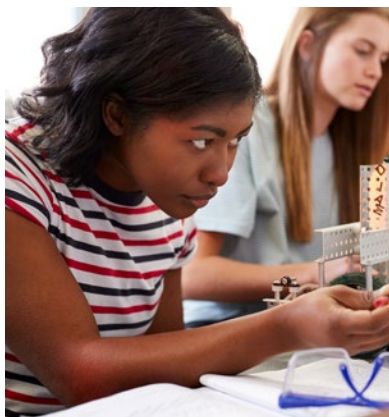





Science SAFETY MANUAL

GRADES 6–12



NYC Department of Education

Greg Borman
Director of Science

Ingrid Buntschuh
Citywide Instructional Lead, High School Science

Sasha Ban
Senior Program Manager, Citywide Science Programs

Additional Contributors
Denise McNamara, former Director of Science
Office of Curriculum, Instruction, & Professional Learning

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52 Chambers Street
New York, NY 10007
schools.nyc.gov

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The project coordinator was Sasha Ban, Senior Program Manager of Citywide Science Programs in the Office of Curriculum, Instruction, and Professional Learning. Denise McNamara, former Director of Science, and Thomas Evangelist, Assistant Principal of Physical Science at Brooklyn Technical High School, contributed information and resources to the initial draft of this document.

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Appendices

Introduction

Science education has undergone significant changes since the New York City Department of Education *Science Safety Manual* was last published in 2008. The Next Generation Science Standards' and New York State P–12 Science Learning Standards' emphasis on three-dimensional learning weaves together disciplinary core ideas, science and engineering practices, and cross-cutting concepts, and highlights the importance of doing science, rather than simply learning about science. Scientific investigations, engineering design challenges, and place-based learning experiences play critical roles in this updated approach to science teaching and learning. However, these kinds of learning experiences present a set of risks that need to be anticipated and proactively managed.

This manual is intended for use by secondary school administrators and other individuals who are responsible for implementing a laboratory program, a science research program, or other type of hands-on or place-based science or STEM program in their school. **The first section of this safety manual addresses the individual responsibilities** of the school administrators, and primarily focuses on the principal and assistant principal overseeing science. This section of the manual also outlines responsibilities of the science teacher, laboratory specialist, custodian, and student.

Scientific investigations, engineering design challenges, and place-based learning experiences play critical roles in this updated approach to science teaching and learning.

The next section of the manual provides guidelines for safe laboratory procedures, including general safety and use of equipment and appliances. Life science resources include guidance around humane and ethical treatment of animals, planning dissection activities, and responsible investigations with microbes and other potential biohazards. Physical science sections include guidance around safe operation of light and heat sources, and safe practices with materials and equipment used in physics and earth science. This section also contains detailed guidance around safety in chemistry, including chemical storage and inventory maintenance, use of chemicals in laboratory activities, handling chemical spills, and proper disposal of chemicals.

The third section of this manual includes changes to the National Fire Protection Association Codes and Standards (2015) and the Fire Department of New York City's Safety Rules and Regulations (2016).

The revised manual contains information about safety on field trips, fieldwork, and other off-site activities. Finally, **a new section provides information for students** interested in participating in science research fairs, journals, or other public events, and outlines NYCDOE Institutional Review Board guidelines for students conducting behavioral science research that involves human test subjects.

The manual's appendix includes relevant forms, contracts, reference documents, and links to relevant resources. While this manual will be updated if key policies or guidance changes, it is essential that administration and staff who are involved with their school's science program keep up with the latest technology, chemical advances, and safety procedures. Our choice of chemicals, demonstrations, and class activities must reflect current knowledge of toxic substances; additional guidance can be found in the *Green Chemistry* section on page 81. For information concerning removal of substances/hazardous wastes, refer to the *Hazardous Waste Management* section on page 234.

Included in this manual is a brief discussion of the *New York State Safety and Health Regulations*, which form the foundation upon which school science safety is based. The *Federal OSHA (Occupational Safety and Health Act)* guidelines that pertain to laboratory safety include:

1. OSHA (29 CFR 1910.1200) Hazard Communication Standard (5/2012)
2. OSHA (29 CFR 1910.1450) Laboratory Standard (8/2011)
3. OSHA (29 CFR 1910.132) Personal Protective Equipment Standard (6/2011)
4. OSHA (29 CFR 1910.1030) Bloodborne Pathogens Standard (4/2012)

Schools must comply with the New York State Safety and Health Regulations, which were added to the New York State Public Employees Safety and Health Act (PESH) in the 1980s, and with New York State Education Law Section 305, Subdivision 19. These include The Toxic Substances Act and The Hazard Communication Standard, which were mandated by federal law under 051-IA guidelines for public employees.

The texts of these laws and regulations can be found in the following Department of Education publications, copies of which must be available in every school for reference.

- *The New York City Department of Education Chemical Hygiene Plan*
- *The New York City Department of Education Hazard Communication Plan*
- *The New York City Department of Education Bloodborne Pathogens Exposure Control Plan*

Updated versions of these plans can be found on the New York City Department of Education Employee Safety and Health page (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) of the NYCDOE website.

Schools must also comply with:

- Environmental Protection Agency regulations for waste disposal and hazardous substance reporting: Superfund Amendments and Reauthorization Act (SARA) and RCRA Title III
- New York City Fire Rules §2706-01 Non-Production Laboratories
- Ongoing NYC Department of Education directives concerning health and safety issues

Adherence to safety rules and regulations should be standard operating procedure for all science instructors and their students. This safety manual is designed as a guide for use in classrooms, science laboratories, and on class field trips. All science staff members are required to review this manual annually and file a signed statement that they have read the material and agree to follow all regulations and guidance contained wherein.

Adherence to safety rules and regulations should be standard operating procedure for all science instructors and their students.

The science team in the NYCDOE's Office of Curriculum, Instruction, and Professional Learning wishes you and your students a wealth of engaging, interactive, safe and responsible science teaching and learning experiences! Should you have questions about this document, please contact us at STEM@schools.nyc.gov.

Who Is Responsible for Safety in the Secondary (6–12) Setting:

Stakeholders and Responsibilities

Science safety is a team effort, and multiple stakeholders in a school or building contribute to making sure that all scientific activities are not only engaging and enlightening, but also safe and ethical. Below are some guidelines around general science safety, and a chart that identifies and briefly outlines responsibilities for each stakeholder in a school or building. More detailed descriptions of each stakeholder's responsibilities are below the chart. Please be aware that if any of these stakeholders is absent from a building, someone else must be assigned their responsibilities. For more information, refer to the Checklist in part 1g of the *Appendix*.

Stakeholder: Principal

1. Ensures that students and staff are under the direct supervision of a principal or designated representative at all times.
2. Assigns staff to safety roles, including:
   - RTK/Site Safety Officer
   - Chemical Hygiene Officer
   - Bloodborne Pathogens Site Employee Safety Administrator (SESA)
   - Certificate of Fitness Holder

   The principal must also ensure that staff members in these safety roles are upholding all responsibilities.
3. Communicates building safety conditions and potential hazards to staff.
4. Communicates laboratory emergency safety plans to staff.
5. Designates and informs staff of location for keeping of SDS (Safety Data Sheet) forms and chemical safety information.
6. Ensures compliance with all required safety and health training for school staff.
7. Assigns a staff member to coordinate purchasing of scientific equipment and supplies; principal has final approval of all purchasing decisions.
8. If applicable, appoints school-level Institutional Review Board point of contact.

Stakeholder(s): Assistant Principal(s)

1. Provide direct supervision of staff and ensure that students are appropriately supervised by a science teacher or licensed pedagogue.
2. Conducts safety conferences at the start of each term with science teachers and other relevant staff on appropriate safety procedures, including use of ABC fire extinguishers, fire blankets, eyewash stations, and safety showers.
3. Ensures that all science safety equipment, including ABC fire extinguishers, fire blankets, eyewash stations, and safety showers, are all in good working condition. This should be done via periodic inspection and consultation with the custodian.
4. Is familiar with the locations of the SDS (Safety Data Sheet) forms and chemical safety and inventory information.
5. Provides Right-to-Know (RTK) and Bloodborne Pathogen (BBP) training to all staff; keeps attendance record of trainings on file.
6. Confirms that all staff have signed off on reading this manual.

Stakeholders: Science Teachers and Other Teachers in Science Classrooms and Laboratories

1. Educates students about laboratory safety requirements at the beginning of each term and prior to the first laboratory activity. Safety reminders and information specific to certain laboratory procedures should be provided prior to each subsequent lab.
2. Provides, collects, and maintains contracts for students and their parents/guardians to sign to show they are aware of safety rules.
3. Provides close supervision of students during laboratory activities and use of scientific equipment, and models safe use of scientific equipment and safe laboratory procedures at all times.
4. Tests laboratory activities in advance to ensure that all components of laboratory experiments and demonstrations are safe prior to doing them with students and makes sure that specific safety instructions for a given activity are communicated to students in advance.
5. Is familiar with the locations of the SDS (Safety Data Sheet) forms and chemical safety information.
6. Attends annual Right-to-Know and Bloodborne Pathogen trainings.
7. Adheres to all Legal Responsibilities for Secondary School Science Teachers.
8. Reviews and is familiar with all components of this manual.

Stakeholders: Administrator or Designee (Lab Specialist if one is on site)

1. Is familiar with the locations of the SDS (Safety Data Sheet) forms and chemical safety information and ensures all SDS sheets for newly ordered chemicals are added to binder of SDS forms.
2. Inspects all laboratory safety equipment (eyewash stations, safety showers, fire blankets, fume hoods, fire extinguishers) to make sure they are in good condition and in compliance with all safety regulations and standards.
3. Collaborates with teachers to ensure safe preparation of laboratory activities, including equipment setup; solution preparation; dispensing of appropriate amounts of chemicals, reagents, or materials; and safe transport of scientific equipment from preparation rooms to classrooms or demonstration rooms.
4. Inspects laboratory and demonstration/prep rooms regularly to ensure safe storage of chemicals, materials, and equipment and that all safety equipment is present and operational. If gas lines are present, ensures that they are in good working order. Inspects laboratory classrooms regularly to ensure that safety equipment is present and in good working order.
5. With custodian, coordinates a hazardous chemical removal program to ensure that hazardous chemicals are identified and removed from NYCDOE facilities.
6. Reports all hazardous situations to their supervisor.

Stakeholder: Custodian

1. Maintains ventilation and illumination of all rooms where laboratory activities take place and where chemicals, materials, or equipment are stored.
2. Inspects and maintains all fire extinguishers and other science safety equipment and ensures compliance with maintenance/inspection schedules.
3. Coordinates repair or replacement of safety equipment (e.g., eyewash stations) that are damaged, obsolete, or not working.
4. With lab specialist, coordinates a hazardous chemical removal program to ensure that hazardous chemicals are identified and removed from NYCDOE facilities; submits relevant Work Orders.
5. Escorts FDNY inspectors to laboratories and hazardous materials storage areas at times when laboratory personnel are not available.
6. During emergency situations, directs FDNY first responders to laboratories or hazardous materials storage areas.

Stakeholders: All Staff (Administration, Science, and Non-Science Staff)

1. Is familiar with employee rights, employer responsibilities, and health and safety hazards associated with the use of chemicals and other substances.

Stakeholders: Students and Parents/Guardians

1. Provides written confirmation that the student has reviewed and agreed to uphold science safety measures related to the student safety contract.
2. Practices safe and responsible practices in laboratory settings at all times, including at school and at home, as outlined in the student safety contract.

General Directions for

School Principals in Grades 6–12

- Provide direct supervision of staff and ensure that students are appropriately supervised by a science teacher or licensed pedagogue: Students in school must be under the direct supervision of the principal or his/her representative at all times, as required by the By-Laws of the Department of Education.
- The principal is responsible for the administration of the Occupational and Safety Health Program, which includes the Hazard Communication and Right-to-Know (RTK) Program and the Bloodborne Pathogens Program (BBP). These plans can be found at https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health.
- The principal is responsible for certifying any SH 900.1 forms for accidents that occur. For more information, see https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health/sh-900-annual-report.
- The principal is responsible for assigning staff to the required safety roles. Their specific responsibilities are outlined in more detail below. Principals can also refer to guidance on the NYCDOE Infohub Employee Safety and Health page (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) for additional information about the safety roles listed below.

Right-to-Know/Site Safety Officer

The **Right-to-Know/Site Safety Officer**'s responsibilities include, but are not limited to:

- Informing and training all staff members regarding safety in the workplace when there is potential for exposure to hazardous chemicals
- Ensuring that personal protective equipment and adequate engineering controls are provided
- Ensuring that the school completes and maintains a chemical inventory
- Acquiring and maintaining material **Safety Data Sheets (SDSs)** for chemicals on inventory
- Making sure chemicals are properly labeled and act as the first point of contact to the staff regarding RTK issues in the workplace
- Maintaining and sharing health and safety information as outlined on the NYCDOE Employee Safety and Health webpage (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health).

- Completing and maintaining records of annual Right-to-Know training. See the *Right-to-Know* resources on page 173 of the *Appendix* for more information.
- Completing **Hazard Communication Plan and Chemical Hygiene Plan** on an annual basis, and keeping completed plans on file. Templates for both of these plans should be available on the DOE's Employee Safety and Health webpage (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health).
- Ensuring that Right-to-Know posters (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) are prominently displayed to inform the staff of the names of the **Site Safety Officer** and location of SDS and RTK information

More information about the Right-to-Know/Site Safety Officer's responsibilities can be found on the NYCDOE Occupational Safety & Health page on the InfoHub (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health). This page includes the most up-to-date copy of the **NYC Department of Education's Hazard Communication Plan**.

Chemical Hygiene Officer

The principal must appoint a Chemical Hygiene Officer (CHO) to ensure that the policies and procedures outlined herein are effectively carried out and to maintain records related to this program. The CHO must be an employee who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan (preferably the assistant principal of science or a senior science teacher).

The duties of the Chemical Hygiene Officer include but are not limited to training all science teachers and lab specialists in safe laboratory practices when using chemicals. More information about the Chemical Hygiene Officer's responsibilities can be found in the NYC Department of Education's Chemical Hygiene Plan, which can be found on the NYCDOE Employee Safety & Health page on the InfoHub (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) and on the New York State Education Department's School Chemical Management and Storage Guidelines (http://www.nysed.gov/curriculum-instruction/school-chemical-management-and-storage-guidelines) page.

Bloodborne Pathogens Site Employee Safety Administrator (SESA)

The SESA's duties include but are not limited to training designated employees to utilize Universal Precautions, guidelines for using personal protective equipment when there is potential exposure risk and what to do if there is exposure to bloodborne pathogens. The SESA also coordinates the Hepatitis B vaccination program for employees who choose to participate, and completes and maintains the NYC Department of Education's Bloodborne Pathogens Compliance tool (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) for the school or building.

More information about the Bloodborne Pathogens SESA's responsibilities can be found in the NYC Department of Education's Bloodborne Pathogen Guidance for Principals and SESAs (https://infohub.nyced.org/docs/default-source/default-document-library/bbpct-guidance.pdf).

Certificate of Fitness Holder

All science teachers that oversee (supervise) laboratory operations where hazardous materials are handled and used are required to obtain a D-14 certificate of fitness. The holder of a D-14 certificate of fitness only needs to be present in a laboratory when laboratory operations are taking place.

Likewise, all laboratory specialists that oversee (supervise) prep room and stockroom operations where hazardous materials are stored and handled for laboratory use are required to obtain a D-15 certificate of fitness. The holder of a D-15 certificate of fitness only needs to be present in the prep room or stock room when hazardous materials are being handled.

In schools where there are no lab specialists, a science teacher shall obtain the required D-15 Certificate of Fitness **only if hazardous materials are handled and stored**. A science teacher can hold both a D-14 and D-15 certificate of fitness.

In some schools, teachers and lab specialists obtained the C-14 certificate of fitness prior to the creation of the D-15 certificate. The C-14 certificate has been in existence since 1985, and was only required for college, medical, and industrial labs prior to 2014. The C-14 certificate covers both laboratory and prep room/stock room operations and therefore is the equivalent of holding both "D" certificates.

Note: *In schools where there are no prep rooms or stock rooms, there is no need for a D-15 certificate of fitness holder. Principals may recommend science teachers supervising laboratory operations with hazardous chemicals to acquire a D-14 certificate of fitness. However, if that teacher does not obtain a D-14 certificate of fitness, hazardous chemicals cannot be part of their laboratory instruction. Instead, consider eliminating or substituting hazardous chemicals by integrating green chemistry in lab activities.*

As per FDNY regulations, teachers/laboratory specialists who use laboratories with hazardous chemicals in NYC 6–12 schools require a Certificate of Fitness holder to supervise the handling and use of hazardous chemicals in NYC K–12 School Laboratories (D-14). For more information regarding D-14 certification, go to: https://www1.nyc.gov/site/fdny/business/all-certifications/cof-d14.page.

New York City Department of Education science teachers and/or lab specialists can obtain D-14 certification by using the alternative Certificate of Fitness issuance procedure found at: https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d14-aip.pdf.

For more information on the D-15 Certificate of Fitness for supervising the handling and storage of hazardous chemicals in NYC K–12 school laboratories, go to: https://www1.nyc.gov/site/fdny/business/all-certifications/cof-d15.page.

New York City Department of Education science teachers and/or lab specialists can obtain D-15 certification by using the alternative Certificate of Fitness issuance procedure found at: https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d15-aip.pdf.

For more information on possible scenarios for which staff members can hold a D-14 or D-15 Certificates of Fitness, see the Certificates of Fitness Scenarios on page 157 in the *Appendix*.

The Principal's Responsibilities Regarding Communicating Safety Measures and Roles

- The principal should communicate to faculty and staff the status of safety precautions and potential hazards in the school building that that may exist, or that have been eliminated.
- If a modernization or construction is to be undertaken, the principal should be sure that students and staff are informed about and protected from any resulting construction hazards or unsafe conditions.
- Particular attention should be given to means of hazard prevention, including reasonable class size to prevent overcrowding in violation of occupancy load codes (NYC Building Code §[C26-601.2] 27-358 Occupant load: "Occupancy load for non-production laboratory facilities shall be 50 feet per occupant").
- The principal is responsible for ensuring that all building staff are informed of who is fulfilling each of these science safety rules. **Science teachers cannot be obligated to obtain a DoF Certificate of Fitness (CoF). However, without a D-14 CoF they cannot handle hazardous materials. Requiring people to fulfill those responsibilities should be a shared decision at the school level.** The principal is also responsible for ensuring that the school is in compliance with FDNY safety regulations, including D-14 and D-15 certificate of fitness requirements for schools using and/or storing hazardous chemicals.

Laboratory Emergency Plan

Documented plans for laboratory emergencies shall be established for all new and existing laboratories. The plan should be specific and can be added to the addendum section of the School Safety Plan.

6.5.3 Emergency Plans (taken from the NFPA, 2015)

6.5.3.1
Provisions Within the Emergency Action Plan

Documented plans for laboratory emergencies shall be established for all new and existing laboratories. The Laboratory Emergency Plan shall include the procedures to be followed in the event of a fire, chemical emergency, or explosion, as follows:

Note: *The plan should be specific and can be added to the addendum section of the School Safety Plan.*

1. Procedures for sounding the alarm
2. Procedures for notifying and coordinating with the fire department, governmental agencies, or other emergency responders or contacts, as required
3. Procedures for evacuating and accounting for personnel, as applicable
4. Procedures for establishing requirements for rescue and medical duties for those requiring or performing these duties
5. Procedures and schedules for conducting drills
6. Procedures for shutting down and isolating equipment under emergency conditions, to include the assignment of personnel responsible for maintaining critical functions or for shutdown of process operations
7. Appointment and training of personnel to carry out assigned duties, including steps to be taken at the time of initial assignment, as responsibilities or response actions change, and at the time anticipated duties change
8. Alternative measures for occupant safety, when applicable
9. Aisles designated as necessary for movement of personnel and emergency response
10. Maintenance of fire protection equipment
11. Safe procedures for startup to be taken following the abatement of an emergency

6.5.3.2
Procedures for extinguishing clothing fires shall be established for all new and existing laboratories

6.5.3.3
All laboratory users, including, but not limited to, instructors and students, shall be trained prior to laboratory use and at least annually thereafter on the emergency plan

A.6.5.3
An emergency response plan should be prepared and updated. The plan should be available for inspection by the Authority Having Jurisiction (AHJ), upon reasonable notice. The following information should be included in the emergency plan:

1. The type of emergency equipment available and its location
2. A brief description of any testing or maintenance programs for the available emergency equipment
3. An indication that hazard identification marking is provided for each storage area
4. Location of posted emergency response procedures
5. Safety Data Sheets (SDSs) for all hazardous materials stored on site
6. A list of responsible personnel who are designated and trained to be liaison personnel for the fire department; these individuals should be knowledgeable in the site emergency response procedures and should aid the emergency responders with the following functions:
    a. Pre-emergency planning
    b. Identifying where flammable, pyrophoric, oxidizing, and toxic gases are located
    c. Accessing SDSs
7. A list of the types and quantities of compressed and liquefied gases normally at the facility

A.6.5.3.2
Laboratory personnel should be thoroughly indoctrinated in procedures to follow in cases of clothing fires. The most important instruction, one that should be stressed until it becomes second nature to all personnel, is to immediately drop to the floor and roll. All personnel should recognize that, in case of ignition of another person's clothing, they should immediately knock that person to the floor and roll that person around to smother the flames. Too often a person will panic and run if clothing ignites, resulting in more severe, often fatal, burn injuries.

Fire-retardant or flame-resistant clothing is one option available to help reduce the occurrence of clothing fires. Refer to NFPA 1975 for performance requirements and test methods for fire-resistant clothing.

It should be emphasized that use of safety showers, fire blankets, or fire extinguishers are of secondary importance. These items should be used only when immediately at hand. It should be recognized that rolling on the floor not only smothers the fire but also helps to keep flames out of the victim's face, reducing inhalation of smoke.

12.2.1

Instructors in teaching labs shall be trained and knowledgeable in fire safety procedures, emergency plans, the hazards present in the lab, the appropriate use of PPE, and how to properly conduct a hazard risk assessment.

A.12.2.1

Instructors should be knowledgeable of the five general principles of safety as referenced in the *OSHA Standard for Occupational Exposure to Hazardous Chemicals in Laboratories, Section 1910.1450, Appendix A – Culture of Safety*. This information can be found on the OSHA website at www.osha.gov.

Note: These plans must be site-specific and easily accessible to the staff. The NYC Department of Education's Office of Occupational Safety and Health coordinates the Safety and Health training program and updates it as necessary. Please refer to the NYCDOE Infohub Employee Safety and Health page (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health) for updated guidance and forms.

Right-to-Know posters must be prominently displayed to inform the staff of the names of the site officers and location of SDS and RTK information. See the Right-to-Know section of the *Appendix* for related forms.

General Directions for

School Assistant Principals

Supervision of Students and Staff

- Ensure adequate supervision of students: Students in school must be under the direct supervision of a supervisor or his/her representative at all times, as required by the By-Laws of the Department of Education, and a principal may designate an assistant principal to supervise students.
- Supervise the lab specialist (if the school has a lab specialist) and ensure that any lab specialist duties are fulfilled by another qualified and trained staff member if there is no lab specialist on staff.

Conducting Safety Training for Staff

- Conduct science departmental conferences or meet with science teachers at the beginning of each term to review and practice safety procedures, including the use of ABC fire extinguishers, fire blankets, eyewash stations, and safety showers with all members of the science staff, including science teachers, special education teachers, other teachers of science (e.g., special education teachers), and laboratory specialists.
- Work with the custodian to train the science department faculty in the proper use of the fire extinguisher and fire blanket. Practice removing extinguishers correctly from the bracket on the wall. Practice correctly using an ABC powder type and a carbon dioxide extinguisher, and a fire blanket. For more information about types of fire extinguishers, see Fire Extinguishers on page 20.
- Provide Right-to-Know training for the staff on an annual basis.
- Ensure that all staff members review this manual. A signed statement from each staff member that the safety manual has been read should be collected and filed annually. A Science Safety Manual Sign-Off Sheet for Staff template can be found in the *Appendix*.

Ensure Presence of Working Safety Equipment and Safe Storage Procedures

- Make sure eyewash stations and safety showers operate properly. See details in General Directions for Laboratory Specialist.
- Contact the school custodian if a fire extinguisher needs to be inspected, serviced, or replaced. See Fire Extinguishers for more information.
- As specified in the Department of Education regulations (see ***Chancellor's Regulation A-701***, 2009), make sure that a well-stocked and current first aid kit is in each science laboratory and preparation room for emergencies. See First Aid for more information.
- At the beginning of each term, notify the principal in writing of any hazards, such as:
  - Improper organization of chemical storage
  - Defective gas fixtures, electrical outlets and connections, loose wiring, or exposed wires
  - Defective seats, desks, and tables that may cause injury
  - Inadequate storage cabinets. See Chemical Storage and Disposal on page 82 for more information about storage cabinet requirements.
  - Lack of fire blankets and fire extinguishers
  - Uneven and defective floors
  - Defective, inoperable locks and inadequate security of preparation rooms and storage rooms
  - Inoperable safety showers, eyewash stations, or fume hoods

If any hazards arise during the course of the term, notify the principal immediately.

Note: *Fume hoods should be inspected regularly, and any fume hoods that are not fully operable should be identified and serviced. Hazardous and volatile chemicals should only be used in classrooms where a fully operable fume hood is present.*

- Ensure that chemicals are stored safely and in compliance with all chemical storage requirements as outlined on page 82, and that a chemical inventory system has been established and is being used by staff.
- Prohibit storage of carcinogenic materials. A list of those substances currently considered carcinogens or probable carcinogens, has been included in the Substances Identified as Human Carcinogens by NIOSH section in the *Appendix*. Some of these may have been considered safe in the past, and thus may still be stored in the school. Substances that are known or probable carcinogens are prohibited from purchase, use, or storage in schools.

Develop and Implement Policies That Support Safe Use of Laboratory Space, Materials, and Equipment

- Do not assign persons to the preparation room who are not licensed as laboratory specialists or science teachers.
- Do not permit teachers without a science license or qualifying experience to use potentially hazardous specialized science apparatus or chemicals unless they are well-trained. Experiments, demonstrations, and work that include potential hazards should be carefully reviewed to ensure compliance with all necessary safety precautions.
- Inspect classrooms, preparation rooms, storage rooms, and fume hoods frequently to prevent the accumulation of materials that could lead to safety hazards, including cluttered floors and windowsills, blocked exits, exhibits or projects which overload shelves, and chemicals and glassware stored on demonstration tables. Science materials on shelves and rolling tables should not extend beyond the edge of the shelf.
- With the principal and lab specialist, coordinate collection and storage of all Safety Data Sheets (SDS). A current SDS should be available for each chemical in the building, and Safety Data Sheets should be stored in a central repository (e.g., a binder or digital file) whose location is shared with staff.

General Directions for

Lab Specialists or Science Assistant Principal

Laboratory Safety Equipment Inspection (see page 127 in *Appendix*)

1. Inspect eyewash stations, safety showers, fume hoods, fire blankets and fire extinguishers, and ensure that the results align with the results of the inspections that teachers have done of this equipment. Ask the custodian to inspect and service as needed.

2. Maintain a written or digital log of annual inspections, maintenance, and replacement of laboratory safety equipment, including eyewash stations, safety showers, and fire blankets.

3. Eyewash stations must conform to American National Standards Institute (ANSI) Z358.1-2014 standards. Plumbed eyewash stations are recommended and should provide tepid water (60ºF100ºF) for 15 minutes of flushing at a rate of 0.4 gallons per minute.

   - The eyewash station must be located in a strategic place in the room no more than 10 seconds from a hazard.
   - The eyewash station must be activated weekly and have an annual maintenance check.
   - Plumbed eyewash stations should be run for two to three minutes per week to ensure clean water is available for emergencies and inspected for issues at least once a month.
   - Non-plumbed eyewash stations that use bottled eyewash solution are not ideal, but may be used in locations that lack plumbing. Eyewash stations that use bottled eyewash solution should be checked routinely to ensure that they are in working order and that the bottled eyewash solution has not passed its expiration date. Bottled eyewash solution should be replaced every two years.

4. **Safety showers.** Where more than five gallons (19 L) of corrosive liquid or flammable liquid are stored, handled, or used, suitable facilities with fixed overhead or flexible hand-held showers shall be provided. Such shower shall be within 25 feet (7620 mm) of the laboratory unit and storage room door and shall be maintained in good working order, and readily accessible at all times.

   A tag must be affixed to the safety shower ring showing the date of the annual test.

Safety showers must conform to ANSI Z358.1-2014 standards. The emergency safety shower must be in a convenient place no more than 10 seconds from a hazard. It must provide 20 gallons of water per minute for 15 minutes, (American National Standard Institute, www.ansi.org). The safety showers must be activated weekly and have an annual maintenance check.

For further information on ANSI-358.1 Compliance, go to: http://www.gesafety.com/downloads/ANSIGuide.pdf.

5. Fire blankets, while no longer required, are still present in many classrooms. If you have do have fire blankets in classrooms, they must be inspected for rips and tears. Fire blankets that were purchased prior to 1980 may contain asbestos. If this is the case or you are unsure, dispose of the blanket immediately. Disposal must be handled through NYC School Construction Authority-approved asbestos removal contractors (http://www.nycsca.org/).

6. Per OSHA regulations, first aid kits must be inspected annually to ensure that all supplies are present, and to ensure that no items have expired. For more information, see First Aid Kits on page 36.

7. A tag indicating proper face velocity must be affixed to all **fume hoods**. Testing must be done annually at a 12" to 18" sash height, with a minimum face velocity of 80 feet/minute and a maximum of 120 feet/minute (NFPA 45). A maximum of 150 feet/minute in existing hoods is allowed where required (OSHA Standard). Face velocities out of range will require ASHRAE 110 testing.

8. **Fire extinguishers** must be placed according to NYC Fire Department code. All fire extinguishers are labeled according to class. No point shall be farther than 50 feet from an extinguisher. Fire extinguishers must be located in conspicuous locations, where they will be readily accessible and immediately available for use. These locations must be along normal paths of travel. Fire extinguishers are not allowed to be stored on the floor. For further information on portable fire extinguishers, go to: www.nyc.gov/html/fdny/pdf/cof_study_material/d_10_st_mat.pdf.

   ABC-rated fire extinguishers are sufficient for most labs. Class D fire extinguishers are required if you store water-reactive metals, such as sodium and potassium (see NFPA 484). Although Class D fire extinguishers are helpful in extinguishing water reactive materials, they are also extinguished by CO2 extinguishers and if these are not available an ABC extinguisher would do. However, only a Class D fire extinguisher will suppress a flammable solid or combustible metal fire.

   As per NFPA 484, the use of fine, dry sand, preferably less than 20 mesh, or other approved powder (see below) is an effective method of isolating incipient fires in combustible aluminum dust. An ample supply of such material should be kept in covered bins or receptacles located

in the operating areas where it can be reached at all times. A long-handled shovel of non-sparking metal should be provided at each such receptacle to afford a ready means of laying the material around the perimeter of the fire.

Approved powders include Met-L-X, dry flux, dry soda ash, and dry sodium chloride.

The chemical storage room must have an ABC-type fire extinguisher near the door that is placed at least 40 inches off the floor (mounted on wall) and accessible at all times. It is preferable that fire extinguishers be placed on the outside of a prep room or chemical stock room; however, to prevent accidental use or vandalism, they can be placed inside the prep or chemical storage rooms. All extinguishers need an annual inspection and monthly charge inspection on the gauge and must be in good working order at all times.

Types of Fire Extinguishers

Class of Fire	Water A	Dry Chemical ABC	Carbon Dioxide BC	Powder D
CLASS A Ordinary combustible materials like paper, wood, fabric, and usual trash	Yes	Yes	No Offers very little protection	No
CLASS B Flammable liquids (such as alcohols, ketones, etc.)	No	Yes	Yes But offers little protection	No
CLASS C Electrical equipment	No	Yes	Yes Only if it does not have a metal delivery hose	No
CLASS D Water-reactive chemicals, flammable solids, and combustible metals[1]	No	No	No	Yes

1 NFPA 484 and other industry literature including SDS sheets indicate that sand and sodium chloride are just as good in suppressing these types of fires. Instead of purchasing Class D fire extinguishers, provide an ample supply of dry sand or sodium chloride (in fire buckets) placarded as 'Use with Fire Suppression Only" FC901.4.3.

Maintenance and Usage of Laboratories and Prep/Demonstration Rooms

1. Confirm with the custodian that they are checking fire extinguishers monthly to ensure that they remain located in necessary places and are in good working condition. Fire extinguishers should also be inspected annually by an FDNY-certified professional inspector. As per Fire Code section 901.6.3.1, it shall be unlawful for any person engaged in the business of servicing portable fire extinguishers to service portable fire extinguishers without a portable fire extinguisher servicing company certificate issued by FDNY.
2. Inspect all spill cleanup kits and replenish chemicals if necessary.
3. If the school has active gas lines in any preparation rooms or laboratories, inspect gas jets for blockages caused by papers and other items. Remove, if possible, or have the gas jets serviced by the local gas company.
4. Notify the principal or principal's designee of the existence or development of any hazard.
5. Inspect student-made projects for safety hazards before these projects are demonstrated in the classroom.
6. Make sure that all rooms containing chemicals are properly ventilated and that there is no flame in the room when using flammable and/or volatile liquids such as alcohol.

FUNCTIONAL RESPONSIBILITIES

Preparation Room and Equipment Safety

- Close and lock the preparation room whenever it is not under the direct supervision of a licensed laboratory specialist or science teacher.
- Order protective eye goggles or face shields that comply with ANSI Z-87.1-2015 (American National Standard Institute, www.ansi.org).
- Advise teachers and students that these are available whenever necessary, and that goggles must be worn by all students and teachers during all science investigations using chemicals or potential projectiles.
- Inspect new equipment for hazards. Report any problems to the vendor and/or supervisor.
- Inspect used equipment to make sure it is in good working condition, particularly electric wires, plugs, and glassware that will be handled by students.
- Maintain a system for reporting broken or damaged equipment, and for ensuring that such equipment is either repaired by appropriate personnel or properly disposed of.

- Employ appropriate safety standards and methods in the storage and use of all supplies.
- Keep tools and sharp-edged instruments in good condition and stored in locked cabinets.
- Explosion-proof refrigerators should be used. No food or beverages should be stored in refrigerators used for instructional purposes. For more information, see Refrigerators and Other Appliances on page 46.
- Secure all compressed gas cylinders when in use. Secure them to a hand truck while transporting them.
- If the proper equipment is not available for a safe experiment or demonstration, **do not attempt the experiment or demonstration**.

Safety Procedures with Staff and Students

- Advise teachers regarding safety precautions required for the proper use and manipulation of specialized equipment and supplies. Suggest the use of plastic beakers, graduated cylinders, and other containers, rather than glass, for students with limited motor control, including younger students.
- In cooperation with the teacher, perform the actual procedures of each laboratory experiment or demonstration prior to the class session to see that all materials and apparatus work properly and safely.

Chemical Safety

(For more details, see Chemical Safety section on page 76.)

- Chemicals provided for student use should be put into smaller, labeled containers. The warnings and hazards on the SDS (also on the original containers) should be copied onto the new labels. If chemicals are kept at the teacher's desk, a large, clear sign for each chemical used should be posted at each bin.
- Review student laboratory experiments periodically for current safety practices. Disseminate information regarding any new safety regulations.
- In case of an emergency, have SDS readily available for hazardous chemicals used in laboratory experiments.
- Make sure a copy of your school's Chemical Hygiene Plan is available. You can find the Chemical Hygiene Plan on the NYCDOE Employee Safety and Health website (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health), or you may contact the NYCDOE Office of Occupational Safety and Health for a copy of the Chemical Hygiene Plan at (718) 935-2319. This plan is required under OSHA's Laboratory Standard Regulation (29 CFR1910.1450).

- Know how to manage chemical spills and make sure the proper personal protective equipment, (including goggles, gloves, aprons/lab coats, and face shields) and spill kits are available. Refer to the section entitled Handling Chemical Spills on page 81 for more information.
- Know how to handle chemical waste. Refer to the section entitled Hazardous Waste Management found on page 234.

Safe Transport of Science Equipment

- Use safety precautions in the transportation of all equipment and supplies to and from the science classrooms and laboratories.
- Transport long glass rods and tubing in a vertical position, observing door heights and other clearances.

Classroom Science Safety

- Make sure that a fire extinguisher and fire blanket are included in classrooms that are being used as science laboratories (non-science rooms).
- A current copy of the American Red Cross Standard First Aid should be kept with each first aid kit, as well as emergency telephone numbers and SDS.
- Post first aid charts including CPR and Heimlich maneuver.
- Make sure Fire Drill Exit Route is posted and communicated to staff and students regularly.
- Report any injury or accident to supervisor.

General Directions and Responsibilities for

Secondary School Science Teachers

The following are practices that science teachers and other staff members involved in science instruction should uphold to ensure that safe practices and a culture of safety awareness in all aspects of science teaching, learning, and laboratory activities.

Inspecting Classrooms for Safety Equipment and Potential Hazards

At the beginning of each term, all staff members should inspect their classrooms and laboratories and notify their supervisor of any hazards. Check for the presence of the following required safety equipment:

- **Fire extinguishers:** Type ABC extinguishers should be in all science spaces, regardless of grade level.
- **Eyewash stations:** At teacher's demo table in all science laboratory rooms.
- **Emergency safety showers:** Required at schools where more than five gallons of corrosive or flammable liquid is stored, handled, or used.
- **Goggle cabinets:** Laboratories in which investigations that involve liquid, heating, projectiles, or acids and bases should have a cabinet or other storage area for goggles. Schools where students do not have their own goggles should have a means, such as a UV cabinet, of disinfecting goggles between uses to minimize the potential for transferring viral or bacterial illnesses.

Understand the purposes and operation of the various kinds of fire extinguishers found in the science rooms and when to use each one. For example, do not direct a stream of water on oil or electrical fires; use the ABC fire extinguisher or sand.

SDS and Right-to-Know Training and Sharing of Information

See page 35 for information on Safety Data Sheets and Right-to-Know Training.

First Aid Training

School-based staff should be familiar with the procedures to be followed when an injury or accident occurs and be able to give permissible first aid. Additional information on First Aid can be found on page 36.

Teaching Safe Laboratory Procedures to Students

All staff should uphold the following practices for instructing and upholding laboratory safety.

BEFORE THE FIRST LABORATORY ACTIVITY

- Distribute and discuss the Student Laboratory Safety Contract (see page 119 in the *Appendix*) and information for students (see *Student Safety* section) to each of your laboratory students. Stress the need for the students and families to read and sign the document. After the parent/guardian has signed, keep the tear-off slips on file for one year.
- Provide instruction on safety procedures to all students at the beginning of each term.
- Show students the location and proper use of eyewash stations, safety showers, fire blanket, fume hood, and first aid kit.
- Introduce students to safety equipment, such as goggles, aprons, and gloves, which they will use in the laboratory as they are needed.
- Be aware of special medical problems of students, such as asthma or high sensitivity to irritating fumes. This information may be shared by school staff, or shared by students and their parents/guardians.

AT ALL TIMES THROUGHOUT THE SCHOOL YEAR

- Serve as role models for safety and convey the importance of safety to their students.
- Provide general and lab-specific safety instructions before starting an experiment or demonstration.
- Take approved safety precautions in the transportation of all equipment and supplies to and from the classrooms and laboratories.
- Test each new laboratory experiment and demonstration prior to class use to verify that everything is working properly and safely. Routine experiments and demonstrations should be checked often for safety hazards.

- Provide close supervision when students are using science equipment, chemicals, tools, or sharp-edged instruments. Count and account for all substances and equipment used and ensure that all equipment that has been returned is clean and in good working condition.
- Notify the science supervisor (or appropriate administrator) and laboratory specialist immediately of any hazard that comes to your attention.
- Examine all devices or equipment brought in by students and test them for safety hazards before demonstrating them to the class.
- Observe the following precautions when performing experiments where there is a possibility of splintering or flying glass, a flash, or an explosion:
  - Keep students at least 10 feet from the demonstration table when a shield is deemed not necessary (see NFPA, 2015 code 12.3.2.1.4).
  - Place a safety shield between the students, yourself, and the demonstration (see NFPA, 2015 Code 12.3.2.1.3).
- Make informed and safe decisions regarding the incorporation of laboratory and other hands-on and experiential activities in the science classroom, and ensure that all procedures and substances are allowed in New York City Department of Education school settings. See List of Banned Substances, Equipment, and Experiments on page 191 in the *Appendix*.

Legal Responsibilities for Science Safety—Secondary School Science Teachers

Science laboratory teachers have a duty of care to safely supervise students in the science laboratory. Unlike other subject teachers, science laboratory teachers must instruct their students in a designated area that contains materials and equipment that are potentially harmful if not handled properly. The list below includes specific legal responsibilities that science laboratory teachers must know to ensure a safe working environment; educators can also refer to the National Science Teaching Association's Legal Implications of Duty of Care for additional information.

- Know how to access the **Chemical Hygiene Plan** based on OSHA's Laboratory Standard criteria (OSHA 29 CFR 1910.1450 and the **Right-to-Know Standard** (OSHA 29 CFR 1910.1200). The **NYCDOE Chemical Hygiene Plan** can be found on the NYCDOE Employee Safety and Health page (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health).

- Ensure appropriate supervision of a science laboratory in which students are working and equipment is turned on or operating. Never leave a lab with students or working equipment unattended, and make sure that science laboratories are locked when not in use.
- Make sure that all of the students have a signed (by both student and parent/guardian) science safety contract on file before performing any activity in the laboratory.
- Know the proper protocol to follow when an accident does occur. If one or more employees sustained an injury, be sure that the principal or their designee completes an SH 900.2 Injury and Illness Incident Report. immediately following the incident. Make sure that you have read the New York City Science Safety Manual and that you have signed the following statement:

"I have read the General Directions for Teachers as well as the Specific Directions for the subjects that I am teaching and have collected all student permission slips with a parent/guardian signature."

Hazard Risk Assessment

(taken from the NFPA, 2015)

12.2 Instructor Responsibilities

Where instructors are performing demonstrations or students are conducting experiments using hazardous materials, the instructor shall be required to perform a documented hazard risk assessment, provide a safety briefing to students, provide adequate personal protective equipment (PPE), and place a safety barrier (as required) between students and the demonstration or experiment to prevent personal injury.

A.12.2

A documented hazard assessment is a written evaluation of the hazards of the experiment, including the appropriate personnel protective equipment required, safe work practices, emergency procedures, and waste disposal. It is recommended that this assessment be peer reviewed.

A hazard risk assessment can be created once for each planned demonstration or experiment and updated yearly to ensure that it accurately reflects the activities and safety precautions for the demonstration or experiment.

In educational and instructional laboratories where experiments are conducted by students, the teacher shall be responsible for conducting a safety briefing prior to the start of each experiment to review the hazards of the chemicals used, the personal protective equipment required for the experiment, and a review of the emergency procedures.

General Directions for

Custodians

- Provide proper ventilation and illumination of science storerooms, preparation rooms, laboratories, and science classrooms.
- Have fire extinguishers inspected monthly. Then, service and/or replace as necessary. Inspection dates should be recorded on the attached tag. As per Fire Code section 906.2, portable fire extinguishers shall be selected, installed, and maintained in accordance with Fire Code section 906 and NFPA 10 (2007).
  - As per Fire Code section 906.2.1.2, annual servicing and recharging of fire extinguishers shall be performed by a person or company holding a portable fire extinguisher servicing company certificate.
  - As per Fire Code section 906.3.4, the minimum size, number, and placement of portable fire extinguishers in occupancies in which there is a Class D fire hazard risk (combustible metals) shall be in accordance with NFPA 10 (2007).
  - All fire extinguishers and fume hoods are required to undergo the annual inspection and servicing.
- Provide fire extinguishers for each science lab, prep room, and classroom.
- Be familiar with the New York State Right-to-Know Standards and the Bloodborne Pathogens Standard.
- New York State Green Cleaning Law, 2006 (Chapter 584) requires elementary and secondary schools to procure and use environmentally sensitive cleaning and maintenance products with assistance from and in accordance with guidelines prescribed by the Office of General Services Commissioner.
- When notified by the assistant principal that chemicals need to be removed from the school, the custodian prepares and submits a work order (PO-18) to his/her plant manager, attaching the list of chemicals that need to be removed. A request is then submitted to the Environmental Health & Safety Office at the Department of Education's Division of Facilities.
- Is responsible for the disposal of any specimens that have been preserved in formaldehyde or formalin. For more information on disposal of dissection specimens, see Best Practices for Dissections on page 59 or Fluid-Preserved Specimens on page 108.
- Communicate any new fire regulations to the school's science department.

- Act as liaison with the FDNY if a current Fire Department Permit needs to be obtained for the chemical storage area.
- The operation of a non-production chemical laboratory is required to comply with the following FDNY code and rule sections as outlined in the FDNY Certificate of Fitness Study Material, 2014 (http://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d14-noe-study-materials.pdf).
  - Non-production chemical laboratories: [Fire Code Section 2706]
  - Former laboratory rule for pre-existing [prior to 2008] laboratories [Rule Section 4827-01(g)(2)]
  - Standard on fire protection for laboratories using chemicals: [NFPA 45, 2004 edition for new lab design requirements (post 2008) and NFPA 45, 2015 edition for all other general requirements]
  - General requirements for the storage, handling, and use of hazardous materials: [Fire Code Chapter 2703]
  - Compressed gases: [Fire Code Sections 3003-3005]
  - Cryogenic liquids: [Fire Code Sections 3203-3205]
  - Flammable and combustible liquids: [Fire Code Sections 3403, 3404.3]
  - Flammable gases: [Fire Code Section 3503]
  - Flammable solids: [Fire Code Section 3603]
  - Highly toxic and toxic materials: [Fire Code Sections 3703.1, 3704.1, 3704.2]
  - Organic peroxides: [Fire Code Section 3903]
  - Oxidizers: [Fire Code Section 4003]
  - Pyrophoric materials: [Fire Code Section 4103]
  - Unstable (Reactive) materials: [Fire Code Section 4303]
  - Water-reactive solids and liquids: [Fire Code Section 4403]

General Directions for

Secondary School Science Students

Students are important partners in maintaining and upholding lab safety. They can model responsible, safe behavior and procedures, and can notify teachers or other staff if they see any situations that are potentially hazardous. Be sure that students are aware of the important role that they play in a safe laboratory and remind them to be proactive about identifying and reporting unsafe situations.

Below is a list of best practices that students should uphold when working in a laboratory setting. Students should always be briefed on specific hazards of a given lab activity, and safe procedures should be provided in writing and also explained orally and/or demonstrated to students to ensure that students have a clear understanding of what safe behavior and management of hazards looks like for any laboratory activity that they do.

General Laboratory Safety

- Students should know the location of fire extinguishers, fire blankets, eyewash stations, safety showers, and first aid kits.
- Students are to report immediately anything in the laboratory that seems unusual or improper, such as broken, cracked, or jagged apparatus, and reactions that appear to be proceeding in a peculiar or unexpected manner.
- Students are to report immediately to the teacher any personal injury (burn, scratch, cut, or corrosive liquid on the skin or clothing) no matter how trivial it may appear.
- Students should behave properly and not try any procedures that have not been assigned or approved by the teacher. They should report to the teacher any behavior on the part of other students that is disruptive or dangerous.
- Students should never handle apparatus or chemicals in the laboratory unless they have had specific instructions.
- Students should transport science and laboratory materials through the halls only when classes are not passing.

Safety with Heating

1. Students should be informed of all potential hazards with any heating apparatus. See Heat and Light for more information about safe use when using a heating apparatus.
2. Students should be reminded to exercise appropriate precautions with open flame heating sources (e.g., Bunsen burners) and should tie their hair back and take care to close the gas lines after using any gas-powered burner.
3. Students should not grasp any apparatus that has been heated unless they have allowed ample time for cooling.

Chemical and Reagent Safety

1. Students should be informed of any potentially hazardous chemicals that they will be working with and should take care to follow all appropriate safety procedures with a given chemical.
2. Students may not test any chemicals or substances or drink out of laboratory glassware or vessels. Students may smell substances only when given specific instructions by the teacher. The teacher will demonstrate the appropriate method of wafting chemicals.
3. Students are never to pour reagents back into bottles or to exchange stoppers of bottles, or to place stoppers on the table. Stoppers should be replaced immediately after using reagents.
4. The teacher will demonstrate how students are to pour liquids properly from a bottle without spilling. Students should take care to follow these directions when pouring liquid from a bottle.
5. Students may not dilute any concentrated acid or base as it can be dangerous.

Sharps, Glassware, and Equipment Safety

1. Before working with sharp tools, students must demonstrate to the teacher that they know how to use them safely. You should have students physically demonstrate how they would use a tool as evidence of their understanding.
2. Glass wool and steel wool should be handled carefully to avoid getting fragments into the skin. Where appropriate, use a grasping tool, such as tongs, or wear gloves.
3. Make sure that the delivery tubes are not clogged when a gas is being collected by water displacement and a thistle tube is employed to add acid. Otherwise, explosive pressure may develop or acid may be spattered.

4. Students should not use direct sunlight as a source of light for the microscope. Students should not observe a solar eclipse directly through a telescope or binoculars. Instead, the image should be projected on a screen or viewed through special eclipse glasses, compliant with the ISO 12312-2 international safety standard for such products.

At-Home Science Safety

1. Students should be cautioned about the possible dangers from work done at home in connection with projects and science fairs. The NYCDOE provides contracts that include at-home science safety guidance for potentially hazardous activities that involve heating and/or sharp or acidic/alkaline items and for non-hazardous activities.
   - Safety Contract for Conducting Remote Hands-On Activities and Hands-On Laboratory Activities Involving Hazardous Use of Materials/Tools at Home
   - Safety Contract for Conducting Remote Hands-On Activities and Hands-On Laboratory Activities at Home
2. Students and their teachers and families should ensure that at-home projects comply with rules and regulations of specific fairs and competitions. Rules and regulations can vary from fair to fair; however, at-home investigations must comply with all safety and ethical requirements of the given fair or competition in order to be eligible for participation.
3. Students should inform the teacher of any proposed at-home science activities, and teachers should carefully review these proposals and require that students revise or find an alternative to proposals that are unsafe for at-home investigating.
4. Students should submit a signed permission slip or letter from a parent/guardian indicating that their parent/guardian has been informed of all aspects of the student's at-home science project and consents to the students doing this project in or around their home.

What Is Involved in Science Safety at the Secondary School Level

General Safety Procedures

Laboratory safety is everyone's responsibility, and care should be taken at all times to ensure that all users of a laboratory space—students and staff alike—have a common understanding and awareness of laboratory safety.

The following instructions apply to all laboratory situations:

- Students should be instructed not to eat, drink, or inhale anything in the laboratory unless specifically told to do so.
- Students should be told to wash their hands after using laboratory materials.
- Teachers should demonstrate the proper method of wafting (rather than direct smelling) to assess odors.
- Increase ventilation by opening more windows or utilize a fume hood if working with odoriferous or volatile materials in the laboratory.
- Nitrile gloves and bleach should be available in the laboratory or classroom, particularly for accidents involving body fluids or other substances.
- Long hair and loose clothing (including long sleeves) should be secured when working in a laboratory.
- Students should never be directed to clean up broken glass or body fluids.
- Goggles must be worn by students when there is any activity occurring anywhere in the laboratory room that might pose an eye hazard. If chemicals, glassware, or heat are used, goggles must be worn.
- Students should not wear contact lenses when working with volatile chemicals whose vapors could irritate students' eyes.
- Only closed toe shoes should be worn in the laboratory. Students should not wear sandals, flip-flops, or ballet flats, which can leave the foot exposed.
- Students should be notified that they are to report all (potentially) dangerous situations to the teacher immediately.

Conducting a Safety Audit of a Laboratory or Classroom Space

At the beginning of each term, all staff members should inspect their classrooms and laboratories, and notify the appropriate authorities of any hazards. Check for the presence of the following required safety equipment:

- **Fire extinguishers:** Type ABC extinguishers should be in all science spaces, regardless of grade level.
- **Eyewash stations:** At teacher's demo table in all science laboratory rooms.
- **Emergency safety showers:** Required in schools where more than five gallons of corrosive or flammable liquid is stored, handled, or used.
- **Goggle cabinets:** Laboratories in which investigations that involve liquid, heating, projectiles, or acids and bases should have a class set of goggles that are stored in a UV sanitation cabinet.
- **First aid kits:** One first aid kit per classroom. For more information on first aid kits, see page 36.
- **Spill kits:** Needed for cleaning up chemical spills. For more information on spills, see page 81.

Make sure that all safety equipment is in good working condition and easily accessible to staff and students.

In cases where a demonstration or laboratory room is not adjacent to the prep room, then that laboratory or demonstration room must have an emergency shower. As per NYCFC 2706.9 (New York City Fire Code, 2014), the shower must be within 25 feet of the laboratory unit and storage room door, and shall be maintained in good working order and readily accessible at all times.

Ductless fume hoods are prohibited for use with operations that involve flammable or toxic chemicals, as per NFPA45-2004 Section 8.4.1 and NFPA45-2004 A8.4.1. Fixed fume hoods are required in school prep rooms and laboratories that contain toxic or flammable chemicals.

Staff should also inspect classrooms and laboratories to ensure that safety signage indicating the location of each piece of safety equipment, as well as safety rules and regulations, are updated and located in necessary locations within the classroom or laboratory.

Eye Protection

- All persons must wear eye protection whenever chemicals are handled, glassware is used, flames are involved, or when there is a danger of splattering of liquids, or chipping of ores, minerals, and rock samples. This includes students and faculty who are not actively engaged in the experiment or demonstration.
- Ordinary eyeglasses do not provide adequate protection for use in the science laboratory or classroom. Contact lenses afford no protection and may be harmful to the eyes because chemicals can be trapped beneath them. Only safety goggles marked with the code "Z87" provide the necessary protection. Safety goggles are either Type G, which has no ventilation, or Type H, which is indirectly ventilated. Both types are equipped with flexible edging, so they fit firmly against the face, protecting against splashes as well as flying fragments of glass or rock. Students who must wear contacts should inform the teacher and be required to wear non-vented Type G goggles.
- "Safety glasses" are unacceptable. These are similar in appearance to ordinary eyeglasses and have side shields that are not as effective as safety goggles against large chemical splashes.
- Protective eyewear used by one class should be properly sterilized by an approved Board of Health method before being distributed to the next class. Ideally, a goggle sanitizer should be present in every laboratory room.

SDS and Right-to-Know Training and Sharing of Information

Every member of the school staff should know the location of the Safety Data Sheets (SDS) and be familiar with the information for each chemical on hand. These should be located in a central and accessible location (e.g., main office).

The entire staff should also be familiar with New York State Right-to-Know laws, EPA regulations, New York City Fire Department rules and regulations for schools, and Department of Education special circulars regarding safety.

An annual Safety and Health training session must be given to review employee rights, employer responsibilities, and to review the health and safety hazards associated with the use of chemicals and other substances. Staff must be knowledgeable of the identity of their:

- Site Safety Officer
- Chemical Hygiene Officer
- Blood Borne Pathogens Site Employee Safety Administrator
- Certificate of Fitness holder

Safety Data Sheets (SDS) and Right-to-Know information must be publicized and available.

When supplies and equipment are set up, make certain that students do not have unsupervised access to chemicals in the preparation rooms, closets, stockrooms, classrooms, and laboratories.

First Aid

As specified in the Department of Education regulations (see Chancellor's Regulation A-701, 2009), make sure that a first aid kit is in each science laboratory and preparation room for emergencies. Ample reserve stocks of first aid material are to be available. A current copy of the American Red Cross Standard First Aid should be kept with each first aid kit. It is desirable to post laboratory emergency charts in each laboratory and preparation room, including a CPR and a Heimlich maneuver chart, and all personnel should be able to identify the staff members in their building who have completed CPR and AED training.

School-based staff should be familiar with the procedure to be followed when an injury or accident occurs, give permissible first aid (see Chancellor's Regulation A-701, 2021, https://www.schools.nyc.gov/docs/default-source/default-document-library/a-701-school-health-services), then:

1. Escort the injured person to the school medical office, if appropriate, or call for assistance.
2. Report the accident immediately to the principal or assistant principal.
3. Complete the accident report.

Remember: To encourage safe practices, staff should always set a good safety example when teaching science in the classroom, the laboratory, or in the field.

Administer first aid guided by the following statement from The Administration of Safety in New York Schools. For additional information, see Chancellor's Regulation A-701, Section VI 2021 (https://www.schools.nyc.gov/docs/default-source/default-document-library/a-701-school-health-services).

In rendering first aid, the guiding principle is that the person is administering only immediate temporary care pending administration of competent medical care. According to the New York City Rules (R.C.N.Y.§49.15, 2016), when a student is injured or becomes ill under such circumstances that immediate medical care is needed, the person in charge shall obtain necessary emergency medical care and shall notify the parent or guardian of the child. Procedures included in the American Red Cross official textbook should be followed. Several especially relevant additional first aid procedures follow:

Nosebleeds: Have paper towels available and carefully hand them to students so they can use them to control bleeding. Student should remain calm, sit upright in a chair, and pinch the bridge of his nose. Notify the school nurse. Notify the custodian if it is necessary to clean up blood.

Burns From Fires and Chemicals: For chemical burns, wash and flush area with water and remove any clothing or jewelry that may have been in contact with the chemicals. For burns caused by fire or hot objects, apply cold water IMMEDIATELY until the pain subsides. If clothing catches on fire, use stop-drop-and-roll method and douse victim with water from the safety shower. Fire blankets should be used as a last resort because they retain the heat and increase the severity of the burns. Remove charred clothing, and cover burned area with a clean, cold, wet cloth. If victim appears to be in shock, make sure he/she is kept warm. Summon medical help as quickly as possible.

Eye Injuries From Chemicals: Quickly flush eyes thoroughly with running water for at least 15 minutes. Be sure lids are kept open by holding them away from the eyeball. Remove contact lenses if present. In first aid treatment of the eye, use water only. Summon medical attention, but do not interrupt the washing procedure.

Inhalation of Gases: If a student inhales a toxic gas, such as hydrogen sulfide, or sulfur dioxide, immediately remove the student to fresh air and summon medical help.

Ingested Poisonous Chemicals: CALL POISON CONTROL IMMEDIATELY. THE NATIONAL HOTLINE phone number is 1-800-222-1222.

Keep this number by the nearest telephone.

Note: *Poison Control prefers you use this number and will automatically connect you to the center. Poison Control takes precedence to SDS. Do not give water unless directed to do so by a qualified medical professional.*

Teaching Safe Laboratory Procedures to Students

All staff should uphold the following practices for instructing and upholding laboratory safety.

BEFORE THE FIRST LABORATORY ACTIVITY

- Provide instruction on overall general safety procedures to all students at the beginning of each term. Provide contracts for all students and their parents/guardians to sign, indicating that they are aware of the safety rules. See Student Laboratory Safety Contract on page 119 in the *Appendix*.
- Show students the location and proper use of eyewash stations, safety showers, fire blanket, fume hood, and first aid kit.
- Introduce students to safety equipment, such as goggles, aprons, and gloves, which they will use in the laboratory as they are needed.

- Stress to students that laboratory safety is a team effort, and that they should report any unsafe situations to the teacher or lab specialist immediately.
- Show students where and how to store personal belongings during laboratory activities. Student backpacks and notebooks must be stored in a location that permits students to safely walk around the classroom. Student materials must not be stored on the floor, under desks, or anywhere else where they could become a trip hazard.

AT ALL TIMES THROUGHOUT THE SCHOOL YEAR

- Serve as role models for safety and convey the importance of safety to their students.
- Give safety instructions that are clear, comprehensive, and relevant to the specific activity before starting an experiment or demonstration.
- Take approved safety precautions in the transportation of all equipment and supplies to and from the classrooms and laboratories.
- Test each new laboratory experiment and demonstration prior to class use to verify that everything is working properly and safely. Routine experiments and demonstrations should be checked often for safety hazards.
- Provide close supervision when students are using science equipment, chemicals, tools, or sharp-edged instruments. Count and account for all substances and equipment used.

PROTECTIVE EYEWEAR AND PERSONAL PROTECTIVE EQUIPMENT

- All persons must wear eye protection whenever chemicals are handled, glassware is used, flames are involved, or when there is a danger of splattering of liquids, or chipping of ores, minerals, and rock samples. This includes students and faculty who are not actively engaged in the experiment or demonstration.
- Ordinary eyeglasses do not provide adequate protection for use in the science laboratory or classroom. Contact lenses afford no protection and may be harmful to the eyes because chemicals can be trapped beneath them. Only safety goggles marked with the code “Z87” provide the necessary protection. Safety goggles are either Type G, which has no ventilation, or Type H, which is indirectly ventilated. Both types are equipped with flexible edging so they fit firmly against the skin of the face, protecting against splashes as well as flying fragments of glass or rock. Students who must wear contacts should inform the teacher and be required to wear non-vented Type G goggles.
- “Safety glasses” are unacceptable. These are similar in appearance to ordinary eyeglasses and have side shields which are not as effective against large chemical splashes.

- Protective eyewear used by one class should be properly sterilized by an approved Board of Health method before being distributed to the next class. Ideally, a goggle sanitizer should be present in every laboratory room.
- Nitrile gloves should be worn when handling chemicals, dissecting or handling preserved organisms, working with potential biohazards, or when conducting gel electrophoresis or other activities that could become contaminated with cells from one's hands. For more information about some common laboratory activities that require wearing of nitrile gloves, see Chemical Safety, Dissections, Microbiology and Biohazards, and Gel Electrophoresis.

Equipment and Supply Usage and Storage

- Employ appropriate safety standards and methods in the storage and use of all supplies.
- Keep tools and sharp-edged instruments in good condition and stored in locked cabinets.
- Explosion-proof refrigerators should be used. No food or beverages should be stored in refrigerators used for instructional purposes.
- Secure all compressed gas cylinders when in use. Secure them to a hand truck while transporting them.

Information pertaining to specific types of equipment and appliances is outlined below.

Electricity and Electrical Appliances

- At the start of any activity involving electricity, students should be reminded not to experiment with household current in school or at home.
- You should also be familiar with the location of the electrical shut off switch and of the fuse or circuit breaker box. Ensure that the electrical panels are accessible; the area around the breaker boxes should be clear of stored materials. OSHA and NFPA standard require three-foot clearance around electrical panels.
- Certain electrical sources of low amperage and voltage can, under certain circumstances, result in serious injury or death. There is a significant difference in the degree of hazard posed by DC and AC sources. Low voltage DC sources are not typically fatal, although they can cause burns. However, sources as low as 24 volts AC have been known to be fatal. Students should be instructed to avoid water spills near equipment and to avoid inserting objects into any electrical apparatus.
- Electrical cords should never be allowed to hang over the edge of a table. Personal injury or breakage of equipment can occur if someone trips on or pulls a loose cord.
- Examine all electrical equipment for frayed cords, exposed wires, or loose connections. It is strongly advisable to have a qualified repair service replace or repair all damaged equipment.
- Caution students against grasping any electrical device that has just been used. Many electrical devices remain hot after use and may cause serious and painful burns. Any electrical equipment used in the classroom should have a maximum voltage of 30V. Batteries/rechargeable batteries may be used as an alternative to current from a wall socket.

- Check all circuits before students power them. Take all necessary precautions to avoid accidental short circuits. Inspect all electric cords and extensions regularly for worn insulation and broken connectors. In schools where there is a main keyed switch, it should be used in the same manner as the gas key switch for the power supply or electrical outlets in the lab. This will ensure student safety and reduction of electrical equipment repair costs.
- All power supplies or outlets located at a teacher's desk or students' tables must have an on/off switch. There should also be an LCD indicator to show if the power is on or off.
- All electrical equipment used in physics must have an on/off switch. There should also be an external, replaceable fuse. Before plugging in or unplugging any equipment, outlet switches as well as equipment must be in the off position.
- Avoid the use of the heavy, old-type lead acid batteries in labs. Use the smaller, lightweight alkaline batteries.
- A battery eliminator or adaptor is recommended in place of a dry cell. The use of an adaptor or eliminator with multi-voltage, a switch, and external fuse is less expensive and safer. If you must use dry cells, make sure they do not ooze, and if they do, properly dispose of them using the chemical removal procedures. If students have touched the chemicals, make sure they wash their hands thoroughly.
- Make sure that all appliances that connect to wall outlets have either polarized two-prong plugs or grounded three-prong plugs. When removing a plug from a wall socket, always grasp the plug, not the wire.
- Whenever several outlets on the same line are used, the total power should not exceed 1500 watts.
- Avoid running extension cords throughout the room as these can cause injury to students moving around the room.
- Use surge protectors when using multiple devices to avoid an overload of electrical circuits.
- Limit the line voltage in student experiments to a maximum of 30 volts. This does not apply to electrical laboratories or shops where students have special training and background.
- Cover exposed water faucets and other grounded fixtures with an insulating material whenever there is a likelihood of contact with exposed parts of an operating electric circuit.
- Make changes only on non-powered (power cord removed) circuits. When working on electrical devices, such as radios, televisions, and computer monitors, make certain that the current is off. Wait a few minutes, and then, discharge large capacitors to chassis ground using a low resistance insulated shorting wire before touching any internal components. Caution students

about the high voltage STATIC charges that exist in these and many other electronic appliances, even after the current has been turned off. Severe burns and shock can result from contact with high voltages.

- Clearly mark the high voltage terminals of induction coils, and caution students against touching these terminals when the induction coil is operating.
- Stress that no foreign objects be pushed into any piece of electric equipment, especially when it is connected to a source of current.
- Never bypass protective devices, such as fuses and circuit breakers. When replacing fuses, do not substitute a fuse that has a higher current rating than the original.
- Make sure students and adults dry their hands thoroughly before handling or disconnecting cables and that the equipment has been turned off before disconnecting.

Water and Liquids

Liquids should be stored in appropriate labeled containers and should have lids on them when not in use. Make sure to keep liquids away from electrical outlets, cords, and appliances. Clean up any spills promptly. See Handling Chemical Spills on page 81 for more information on cleaning up spills.

Glassware, Tubing, and Breakable Items

- Glassware should be inspected periodically to make sure it is clean and in good condition. Do not use glassware that is chipped, cracked, or broken.
- Observe the following precautions when inserting glass tubing, thistle tubes, or glass rods into rubber stoppers:
  - The ends of the tubing or rod being inserted should be fire polished.
  - The tubing should fit the hole in the stopper.
  - Moisten the glass tubing and the hole with a lubricant, such as water or soap solution.
  - Use cloth or leather gloves to protect hands from injury in case the glass tubing breaks.
  - Grasp the glass tubing very close to the rubber stopper.
  - Insert the glass tubing through the hole in the stopper with a gentle twisting motion. Never force glass tubing.

- When removing glass tubing, thistle tubes, or glass rods from rubber stoppers, observe the following precautions:
  - Remove glass tubing from rubber stopper as soon as possible after use to prevent the glass from freezing to the stopper.
  - Remove glass tubing that has frozen in a rubber stopper by using a lubricated cork-borer that is just large enough to slip over the glass. Protect hands with cloth or gloves. Slowly twist the cork borer through the stopper to bore the frozen glass tubing out of the stopper.
  - *Note that special care must be taken if a knife or single-edge razor blade is used to split the stopper. Do not permit students to perform this procedure.*
- In certain instances, plastic may be an acceptable alternative and should be used whenever possible to minimize risk of broken glass.
- When using prepared slides under a microscope, remind students how to focus under high power so as not to crack glass microscope slides or coverslips. Warn students that thin glass cover slips are prone to breaking when students try to flex them. Any broken glass slides or coverslips should be discarded as broken glass. Plastic coverslips, which are flexible and do not crack, are a good alternative to glass coverslips.
- Students should be warned not to touch broken glass as it is sharp and often hard to detect until it pierces flesh.
- Heat resistant glassware or HDPE plastic (Nalgene) should be used when heating.
- Dispose of all chipped, cracked, or broken glassware in a designated glass container that will not rip or tear. Do not dispose of broken glass in the regular trash.

Sharp Items

Sharp items (scalpel blades, etc.) should be kept in good condition and free of rust. Do not use blades that are dull, rusty, or damaged. All sharps should be disposed in a designated sharps waste container.

Safe Usage of Equipment and Appliances in the Science Laboratory

Technology, including computers and tablets, digital probes, measurement tools, and microscopes, and items for specific experimental work (e.g., gel electrophoresis kits) have added additional dimensions and opportunities for observations of phenomena in science classrooms.

Be sure to do a trial run with any laboratory equipment you plan to use in class prior to using it with students and use this to help inform the design of your lesson plan and the directions that are given to the students. Make sure that students have learned how to safely and accurately use a given piece of equipment before they begin to use it to collect data. Students should also understand how to set up a piece of equipment, and how to put it away or return it at the end of an investigation.

Management of Equipment

Have a materials management process in place to ensure the safety of the students as well as the responsible use of the equipment and supplies.

The teacher should plan the activity well and consider the type and number of devices that will be needed, how these devices will be distributed to the students, and for the safe return of all the devices.

The teacher should establish classroom management procedures, such as sign-out sheets, student roles within the laboratory team, etc.

Environmental hazards that can damage equipment should also be monitored. Dust, including chalk dust, can penetrate any electronic equipment. The use of whiteboards in labs may be preferable, though alcohol-based dry-erase markers may present a fire hazard.

3D Printers

3D printers use thermoplastics that, when heated, release nanoparticles in the air. These chemicals are known to cause cardio-respiratory problems, such as asthma, skin allergies, and rashes, as well as strokes. Refer to your 3D printer's manual for specific safety information for your device. The Environmental Health and Safety Department at Carnegie Mellon University recommends the following when using 3D printers in the classroom:

- Conduct a health assessment prior to beginning the use of 3D printers in your classroom.
- Place 3D printers in a well-ventilated area, away from students.
- Make sure the cover to the printer is tightly closed until the printing job is completely finished.
- All students working directly with 3D printers must wear dust masks, safety goggles, and non-permeable gloves, as thermoplastics and uncured printed material are hazardous and can cause skin irritation.
- Once printing is completed, discard any used support materials per your printer's specific guidelines. Be aware that these materials may be considered hazardous waste, and if so, will need to be disposed of appropriately.

The Use of Computers, Tablets, and Graphing Calculators

Computers, tablets, and graphing calculators must be kept away from direct heat, sunlight, liquids, and magnets. Store computers in a designated area in which they will be at the appropriate temperature recommended by the manufacturer. Clean computer equipment often, using the appropriate cleaners when not in session, and store computers in a safe, cool place.

It is strongly recommended that devices, such as laptops, tablets, and graphing calculators are battery-powered when used in the laboratory rooms. Avoid running multiple extension cords and plugging multiple devices into power outlets to avoid accidents and overload of electrical circuits. Use devices in a power-save or low-battery mode whenever possible to maximize battery life.

Probeware Tools

- Probeware is a general term for dataloggers, sensors, and software that are used to collect and analyze measurements taken during scientific investigations (Park, 2008). These are great tools that allow students to collect accurate data in real time and to quickly analyze and graph the data necessary for interpretation and the drawing of conclusions.
- Refer to the manufacturer's manual for safety, usage, and storage of probeware. Each sensor has its own Safety Data Sheet that contains important information: what is its function and how it should be used. Battery-operated sensors that contain a li-polymer battery must be charged periodically for optimal performance.
- Probes and accessories should be stored in a dry, secure unit and not in boxes or drawers where they may be near electrically charged objects. The battery portion of the sensors should not be exposed to fire or direct heat.
- It is important to model for students the safe and correct way to use the probeware.

Microscopes

- The proper use of the microscope should be reviewed with students prior to use.
- Microscopes should be used only under supervision.
- Microscopes are costly, heavy, and somewhat delicate pieces of equipment and should be handled carefully. Students should be instructed on the correct method of carrying microscopes (with two hands, close to the body). Do not allow them to "swing" the microscope.
- Care should be taken in placing the microscope on the desk so that it will not fall and hurt someone.
- Students should be shown how to carefully clean the objectives and eyepieces with lens paper.

- Students should be cautioned about cracking slides when changing to high-power resolution. Students should not use the coarse adjustment knob when the high-power objective is in use.
- Microscopes should be maintained properly (adjusted/repaired if needed) approximately once a year.
- Pond water can be used in the class for microscopy investigations, but make sure that it is not contaminated or polluted before distributing to the students.

Microtome

- It is recommended that schools purchase prepared slides whenever possible.
- If it is determined that students need to use a microtome, they should be instructed to use caution and keep their fingers away from the blade while cleaning or cutting with it, and only after being provided with a thorough demonstration from the teacher on the safe usage of this biological apparatus.

Centrifuges

Balance each tube of materials with another tube filled with water according to the manufacturer's directions. Use only tubes designed for the centrifuge as these can withstand the strong forces created. Only use cuvettes approved for use in the centrifuge/mini-centrifuge.

Refrigerators and Other Appliances

Refrigerators, microwaves, dishwashers, and other scientific or household appliances in a laboratory prep room should be maintained according to the manufacturer's instructions, and should be inspected at least annually to ensure they are in good working condition.

Flammable items should only be stored in an explosion-proof chemical storage refrigerator that has been specifically designed for storing flammable materials. All chemical storage refrigerators must have a label that states "For Chemical Storage Only—No Food Permitted" affixed to their front door.

Disposal of Appliances and Equipment

Appliances that are broken or obsolete should be discarded of properly. Contact your custodian for guidance on how to dispose of specific types of appliances and equipment.

Safe Use of Tools in Science and STEM Classrooms

Teachers may use tools for STEM projects, particularly in cases of robotics or other engineering design projects.

Tools—Common Safety Concerns in STEM

Before allowing students to use power tools or common hand tools, teachers are expected to demonstrate the safe and practical application of that tool and the corresponding personal protective equipment needed. Don't assume that students know the names and functions of the tools that will be used.

Teachers should make sure they are confident with how to use tools safely and in how to demonstrate their safe use for students. School districts are required to provide training on this under OSHA 2002 Hand & Power Tools regulations (https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910SubpartP). Please ensure that all staff members using tools with students are compliant and trained in this aspect of STEM.

Tools Used in the Classroom

Teachers must demonstrate and properly model the safe use of ALL tools with students prior to students handling any tools. Students should be made aware the options that they have for properly using tools in their quest to solve problems using engineering and inquiry.

Tools need to be used and stored appropriately in a secure location and sanitized prior to and post usage.

Common Hazards with Hand Tools in STEM Programs

Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples include the following:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other people who are nearby.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike the user or others.
- If the jaws of a wrench are sprung, the wrench might slip.
- If impact tools, such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or others.

Use of Different Tools for Different Applications

Students sometimes don't use hand tools for their intended use. It is this misuse that results in many preventable injuries. STEM educators must consistently reinforce the importance of proper tool usage and recognize that proper modelling with clear instructions is essential to the student's overall safety.

There are four classes of common hand tools, with each presenting a unique set of hazards:

1. Cutting Tools
2. Torsion Tools
3. Shock Tools
4. Thermal Processing Tools

Cutting Tools

Cutting tools include saws, chisels, planes, files, knives, taps and dies, snips, and abrasive materials. Concentration and control are essential for safe operation of all tools, cutting tools being no exception. It is very important that cutting tools are kept sharp and in good working order. The sharpness of a tool is essential for safety. Dull blades have the potential to reduce control and cause greater physical harm.

Given the material the tools are designed to cut, the cutting edge should be sharpened to the proper angle. Teachers should ensure that students are instructed in the proper selection process of each cutting tool for a variety of materials and operations. Selecting the proper size and type of tool allows students to learn and follow through with each correct procedure. Many injuries are a result of burrs and chips created while cutting. Care should always be used in chip removal—never brushing the material with their hands. Gloves may protect students' hands from accidental injury and should be a consideration for PPE when using saws, sharp instruments, and other cutting tools.

Torsion Tools

Torsion tools include wrenches, pliers, Allen wrenches, and screwdrivers. These tools are found to be the most abused and misused set of tools. The availability of screwdrivers leads to unnecessary abuse and subsequently becomes a source of frequent injury.

Several unnecessary abuses of screwdrivers, which may be prevented, include being used improperly as punches, wedges and pry bars. The tips of screwdrivers should always be kept clean and ground to their original shape, whenever possible, to ensure the proper fit into a screw slot. To reduce the misuse of screwdrivers, an adequate selection of drivers should be readily available.

To safely use any wrench, the user is required to always be alert and prepared for the possibility that the wrench may slip off the fastener and cause injury. Wrenches are made in many different sizes; therefore, it is essential the proper size wrench be used.

Generally, socket wrenches are the safest to use and offer the most flexibility, while box wrenches offer greater safety over an open-ended wrench. Adjustable wrenches are recommended for light-duty jobs and should have limited applications.

It is imperative for students to learn the proper tool choice for each type of job. Torsion tools proving to be too large or too small will require extra force. Proper fit, coupled with the degree and direction of force, ensures safer procedures. The insulation of tool handles is necessary when working with electricity.

Impact Tools

Impact tools, or shock tools, are best exemplified by hammers in various types and sizes with varying degrees of hardness. Different configurations are used for specific purposes. They should be selected and used for their intended purposes only.

Discard any hammer if it is dented, chipped, mushroomed, has a loose head or split handle, or shows excessive wear. As with any impact tool, discarded debris may fly readily, and every student within the work area should always wear safety glasses.

Thermal Processing Tools

One way to condition and assemble materials is through a process of heat energy known as thermal processing. Some commonly used thermal tools include hot glue guns, hot wire cutters, soldering irons, heat guns, strip heaters, torches, welders, lasers, kilns, furnaces and ovens.

Any heat-producing tool carries with it the potential to severely burn the user and is a source of ignition. In order to minimize impending hazards, protective safety equipment should be worn, and the work area should be kept clear of all flammable materials.

Natural gas, acetylene, and other energy sources are very dangerous. This increases the need to inspect equipment often and keep it in good working condition.

Tools Typically Found in a STEM Classroom or Robotics or Makerspace Facility Include:

- C-clamps
- Vise & Jigs
- Hand Saws & Miter Boxes
- Hand Drills & Various Bits
- Claw Hammers
- Wire Cutters/Bolt Cutters
- Allen Wrenches/Keys
- Squares—framing, carpenter
- Pliers—needle nose, slip joint
- Ratchet & Sockets
- Wrenches—adjustable, fixed
- Screw Drivers—Phillips, slot
- Standing Drills—bit, brace style
- Files—triangular, regular
- Glue Guns—safety style, low-heat
- Knives & Sharp Edges—Grade 4 and above

Considerations for Using Tools in the STEM Classroom

Instruction and supervision must be provided by a qualified instructor. Teachers who are uncertain about the safe use of a particular tool or material with students should first consult with someone having the appropriate science or technology expertise. Do NOT use anything that you are unfamiliar with.

Hand tools should be introduced by the teacher, including its proper use and demonstrate the safety precautions needed before each lesson/activity.

Students must be at the proper developmental level and possess adequate motor skills for individual use of tools. Tools should be the proper size for the age and size of the students. ENSURE THAT THESE TOOLS ARE SANITIZED OFTEN.

Students should demonstrate understanding of safe tool and equipment use to the instructor before working independently. Make sure they are using it safely.

Wherever possible, a jig or vise should be used to hold materials, allowing students to have both hands free. This is a skill set that students should be taught through explanation and modeling of proper use.

Classroom hand tools must be kept in good working order (e.g., saws kept sharp, hammers with intact handles and secured heads, glassware without cracks or sharp edges). Inspect ALL tools prior to and before storing them away.

There are some basic rules that should be followed to prevent the hazards associated with hand and power tools as directed by OSHA:

- Keep all tools in good condition with regular maintenance.
- Do not put tools in your pockets.
- Do not run with tools in your hand.
- Use the right tool for the job/task at hand.
- Examine each tool for damage before use and do not use damaged tools. Notify the teacher if a tool seems broken or damaged.
- Operate tools according to the manufacturer's instructions.
- Provide and use properly the right personal protective equipment.

Humane and Safe Treatment of Live Animals

The integration of living organisms in the classroom and laboratory is encouraged and supported by the National Science Teachers' Association, the National Association of Biology Teachers, The Humane Society of the United States, the Animal Welfare Institute, the National Society for Medical Research, the New York State Department of Education, and the New York City Department of Education. However, humane and respectful handling of these plants and animals is mandatory.

This section on humane treatment of live animals is divided into **three sections**:

1. Best practices in incorporating the use of live animals into instruction
2. Specific district, state, and federal regulations pertaining to the use of live animals in K–12 instructional and experimental settings
3. Alternatives to using live animals in instruction

Section 1: Best Practices in Use of Live Animals in Instruction

Science teachers have the responsibility of instilling in their students the care and respect for all living organisms and must:

- Review New York State Humane Education Laws and all NYCDOE and school-specific policies regarding the humane treatment and care of animals.
- Make sound curricular and pedagogical decisions and have specific and meaningful learning objectives with regard to the use of animals in the classroom or laboratory space.
- Ensure that all investigations involving live animals are limited to observation and comparison, and that animals are handled minimally. Students may engage in investigations that manipulate an environmental variable to observe an organism's response, but these investigations must be vetted to ensure humane treatment and should not expose the animal to harmful stimuli or environmental factors. The New York State Humane Education Laws provide more details on policies around investigations with animals.
- Ensure that students understand the importance of caring for an animal in a humane manner, and that they are able to explain how to safely and humanely care for and work with the specific live animal(s) in your classroom or laboratory.

- Report bites, scratches, or any other injuries incurred from classroom animals to the school administration immediately.
- Address issues of allergies and fear of animals in a morally responsible manner, respecting the feelings of the student and the wellbeing of the animal. Check student health records in advance to avoid bringing in animals that will exacerbate student allergies, and have contingency plans in place (e.g., placing a student's seat on the opposite side of the room from the animal or temporarily relocating the animal to another classroom) should a student be allergic to an animal already in your classroom.
- Do not allow students to bring wild animals or pets into the science classroom. Exotic, wild, and poisonous animals/reptiles are **prohibited** by the NYC Health Codes (24 RCNY Health Code § 161.01). Additionally, animals that can sting (e.g., bees, wasps) or that are high-risk rabies carriers (e.g., unvaccinated dogs and cats) should not be used in the classroom.
- Animals should be purchased or adopted from reputable vendors or organizations (e.g., a scientific supply company, or reputable pet/aquarium supply shop or animal shelter).
- Protect classroom animals and plants in cases where the school building is sprayed with pesticide or cleaned with chemical cleaners.
- Be knowledgeable about the proper care and handling of animals "appropriate to the species so both the students and the animals stay safe and healthy during all activities."[1]
- Ensure that animals are provided with sufficient and appropriate food, water, shelter, and other needs to ensure their well-being at all times, including during school holidays and closures.
- Ensure that animals have access to veterinary care if needed.
- Plan for the removal, care and return of the animal during weekend, holidays, extended vacation times (e.g., winter break, spring break, Presidents' Week), and at the end of the school year.
- Have a plan for humanely rehoming animals that may not be able to remain in your classroom. This is particularly important for projects such as egg hatching, in which chicks or ducklings will grow quickly and within a matter of weeks will be too large to humanely keep in most classroom settings. It is illegal to release most classroom animals into the wild; the only animals that may be legally and humanely released are those that are native species to the New York City ecosystem.

1 NSTA position statement, Responsible Use of Live Animals and Dissections in the Science Classroom

- Some investigations involve raising native species of animals (e.g., Monarch butterflies) that can be safely and humanely released into the local ecosystem at certain times of the year. The New York State Department of Environmental Conservation has additional information on wildlife release licensing regulations and requirements for specific species (see https://www.dec.ny.gov/permits/45832.html).
- **Make sure that the students wash their hands after each and every activity that involves handling live animals**.

Specific guidance around types of animals is below.

Mammals, Birds, and Reptiles

- Use heavy gloves when handling animals.
- Avoid hand-to-mouth contact when handling animals or cages.
- Rats, rabbits, hamsters, and mice are best picked up by the scruff of the neck, with the hand placed under the body for support.
- All mammals used in the classroom should be inoculated for rabies.
- Clean and disinfect cages to ensure dry and odor-free care.
- The animal cage should be constructed of 1/4-inch wire mesh or smaller. A converted aquarium with wire mesh top may prove satisfactory.
- Children should be cautioned never to tease animals or to insert fingers or objects through wire mesh cages.
- When young are to be handled, first remove the mother to another cage.
- Dispose of feces and bedding in a sanitary manner (flush down toilet or seal in plastic bag).

Fish and Aquatic Animals

- Obtain fish from tanks where all occupants appear healthy. It is recommended that aquatic organisms be purchased from a reputable aquarium supply store or science supply vendor.
- Follow all directions to maintain an aquarium environment that is appropriate for the species that are present in an aquarium.

Invertebrate Animals

- Invertebrate animals, such as worms, insects, crustaceans, and mollusks, should be housed in appropriate environments that meet their physiological needs.
- While there are less strict state and federal regulations around humane treatment of invertebrate animals, teachers should still ensure that use of invertebrate animals is aligned with learning objectives for students, and that student projects are carefully reviewed to maximize humane treatment of animals.

Section 2: New York State Humane Education Laws

At present, New York State requires the humane treatment of live animals in education. The New York State Laws Related to Human Education and Treatment of Animals are below; please note that while some phrases refer to elementary schools, these same laws apply to animals used in secondary educational settings.

New York State Laws Related to Humane Education and Treatment of Animals

Experimenting with vertebrate animals is **forbidden** (NYS Humane Education Law—Section 809.5). If an animal is going to be used for experimentation, use an invertebrate such as the pill bug, round worm, etc. No experiment that could cause harm, pain, or discomfort should be conducted on any animal, including invertebrates.

Sec. 809. Instruction in the humane treatment of animals.

1. **The officer, board or commission authorized or required to prescribe courses of instruction shall cause instruction to be given in every elementary school under state control or supported wholly or partly by public money of the state, in the humane treatment and protection of animals and the importance of the part they play in the economy of nature as well as the necessity of controlling the proliferation of animals which are subsequently abandoned and caused to suffer extreme cruelty.** Such instruction shall be for such period of time during each school year as the board of regents may prescribe and may be joined with work in literature, reading, language, nature study or ethnology. Such weekly instruction may be divided into two or more periods. A school district shall not be entitled to participate in the public school money on account of any school or the attendance at any school subject to the provisions of this section, if the instruction required hereby is not given therein.

2. **Study and care of live animals.** Any school which cares for or uses animals for study shall ensure that each animal in such school be afforded the following: appropriate quarters; sufficient space for the normal behavior and postural requirements of the species; proper ventilation, lighting, and temperature control; adequate food and clean drinking water; and quarters which shall be cleaned on a regular basis and located in an area where undue stress and disturbance are minimized.

3. **Application.** The provisions of this section shall not be construed to prohibit or constrain vocational instruction in the normal practice of animal husbandry or prohibit or constrain instruction in environmental education activities as established by the department of environmental conservation.

4. **Dissection of animals.** Any student expressing a moral or religious objection to the performance or witnessing of the dissection of an animal, either wholly or in part, shall be provided the opportunity to undertake and complete an alternative project that shall be approved by such student`s teacher; provided, however, that such objection is substantiated in writing by the student`s parent or legal guardian. Students who perform alternative projects who do not perform or witness the dissection of animals shall not be penalized.

   See the Dissections section of the science safety manual for more guidance on conducting safe and ethical dissections.

5. **Treatment of live vertebrate animals.**

   a. Except as provided for in this subdivision, no school district, school principal, administrator, or teacher shall require or permit the performance of a lesson or experimental study on a live vertebrate animal in any such school or during any activity conducted under the auspices of such school whether or not the activity takes place on the premises of such school where such lesson or experimental study employs:

      (i) micro-organisms which cause disease in humans or animals,

      (ii) ionizing radiation,

      (iii) known cancer producing agents,

      (iv) chemicals at toxic levels,

      (v) drugs producing pain or deformity,

      (vi) severe extremes of temperature,

      (vii) electric or other shock,

      (viii) excessive noise,

      (ix) noxious fumes,

      (x) exercise to exhaustion,

      (xi) overcrowding,

      (xii) paralysis by muscle relaxants or other means,

      (xiii) deprivation or excess of food, water or other essential nutrients,

      (xiv) surgery or other invasive procedures,

      (xv) other extreme stimuli, or

      (xvi) termination of life.

b. Notwithstanding any inconsistent provision of this section, the commissioner may, upon the submission of a written program plan, issue to such school a written waiver of such restrictions for students subject to the following provisions: (i) the student shall be in grade ten, eleven, or twelve; and (ii) the student shall be under the supervision of one or more teachers certified in science; and (iii) the student shall be pursuing an accelerated course of study in the sciences as defined by the commissioner in preparation for taking a state or national advanced placement examination. The commissioner shall issue a waiver of such restrictions for any teacher certified in science instructing such student. The written program plan shall include, but not be limited to: (i) the educational basis for requesting a waiver; (ii) the objective of the lesson or experiment; (iii) the methods and techniques to be used; and (iv) any other information required by the commissioner.

6. **Report.** On or before the first day of January next succeeding the effective date of this amended section, the commissioner shall annually submit a report to the governor and the legislature which shall include, but not be limited to, the number of written program plan proposals submitted by schools and the number of such proposals subsequently approved by the commissioner. In those cases where a program plan proposal has been approved by the commissioner, such plan shall be appended to and become a part of the commissioner's annual report.

Section 3: Alternatives to Having Animals in the Classroom[2]

There are a number of alternative ways to directly observe animals without keeping animals in the classroom. Some suggestions are outlined below.

1. Go for a Nature Walk
   There is no better way to learn about wildlife than to head outdoors. Don't have any big natural spaces nearby? Even the trees and grassy patches on your school's block can be teeming with life, from insects to squirrels to birds.

2. Go on a Field Trip to a Zoo, Aquarium, Park, or Nature Center
   New York City offers a wealth of field trip sites, including zoos, botanical gardens, parks, and an aquarium. All of these organizations offer a range of in-person and virtual field trip opportunities for various grade levels. More information about conducting safe field trips that comply with Chancellor's Regulation A-670: School Trips can be found in the Field Trips section of this manual.

2 H.E.A.R.T.: Humane Education Advocates Reaching Teachers. For more information, see www.teachheart.org.

3. Observe Animals Virtually
   Many zoos, parks, and other organizations provide live webcam coverage of selected animals. Students can use these webcams to observe animal structure, function, and behavior.

4. Go Birdwatching
   Birdwatching is a safe alternative to hatching chicks or keeping birds in the classroom, and New York City's location on the Atlantic flyway enables students to observe a variety of birds over the different seasons. Students may also observe birds through birdcams that provide footage of nests and bird behavior.

5. Visit or Partner with an Animal Shelter
   Visiting an animal shelter not only introduces children to animals, it also helps them learn about companion animal overpopulation, adoption, and spay/neuter. Additionally, animal shelters may have programs in which staff members can visit your school with selected ambassador animals, or may offer programs that allow students to make toys or collect materials (e.g., old towels) for shelter animals.

Dissection and Dissection Alternatives

NYCDOE Policy on Dissection and Dissection Alternatives

Pursuant to Section 809 of the NYS Education Law, any student expressing a moral or religious objection to performing or witnessing the dissection of an animal, either wholly or in part, shall be provided the opportunity to complete an alternative project that does not include use of specimens. Students exercising this choice shall not be penalized in any manner, such as receiving a lower grade or a more arduous alternative project. Testing and evaluation under such circumstances should be designed to measure the student's knowledge of the course objectives rather than the process of dissection itself.

The NYCDOE's policy is to give verbal and written notice about rights under the law to all students, who are enrolled in a course that includes dissection. A notification letter must also be sent to parents or legal guardians allowing them the opportunity to substantiate in writing, as required by the law, their child's decision to opt out of dissections occurring in the classroom. Such written notice should be available upon request at the school and must be distributed to parents and students at least once at the beginning of the school year. All biology instructors should be informed of this policy in a written memo. This policy should also be included in any curriculum guide and be posted in all science classrooms. Please add the necessary information to this sample letter and then share it with parents and legal guardians.

Best Practices for Dissections

Preparing for Dissections

- Base laboratory and dissection activities on carefully planned curriculum objectives.
- Plan laboratory and dissection activities that are appropriate to the maturity level of the students.
- Be prepared to present an alternative to dissection to students who are not participating in the actual dissection.
- Address such issues as allergies and squeamishness about dealing with animal specimens in advance of beginning a dissection activity. You can also give students who are squeamish about touching a dissection specimen the option of having a role such as notetaker that allows them to observe the dissection without having to directly handle the specimen.
- Use prepared specimens purchased from a reputable and reliable scientific supply company. Formaldehyde and related compounds are not to be used; safer preservatives exist that do not endanger students' and teachers' health. Aim to obtain specimens that are at least 99.7% formalin-free.
- Fresh (non-preserved) specimens, such as squid or chicken wings, may be used as an alternative to preserved specimens. These specimens may be purchased at local markets, butcher shops or counters, fish markets, or other FDA-approved facilities. Using salvaged specimens (e.g., roadkill) is not safe practice.
- Ensure that sufficient personal protective equipment, including disposable latex or nitrile gloves, chemical splash goggles, and aprons are available and used by all students, teachers, and visitors to the classroom.
- Inspect dissection scalpels, scissors, and other dissection tools in advance to make sure that they are clean, sharp, and free of rust. Rusty or dull tools can be more dangerous than sharpened tools.
- Students should be briefed on all aspects of dissection prior to starting a dissection activity, including:
  - safe and respectful handling of the dissection specimen
  - function and proper use of dissection kit instruments
  - proper wearing of personal protective equipment, such as splash goggles, gloves, and aprons
  - proper cleanup and disposal procedures

- Students should be instructed to avoid wearing contact lenses on the days when they will be dissecting preserved specimens, as vapors from the preservative may cause eye irritation.
- Please follow the directions that are attached to the dissection specimen regarding rinsing prior to use or not before commencing the dissection.
- Notify your custodial staff in advance of a dissection activity so that they can work with you to ensure appropriate disposal of used specimens.

During Dissections

- Conduct laboratory and dissection activities with consideration and appreciation for the organism.
- Conduct laboratory and dissection activities in a clean and organized workspace with care and laboratory precision.
- Dissection specimens should be placed and properly mounted in a dissection tray. Do not dissect a specimen while holding it.
- Students should use careful and gentle motions when handling scalpels and other sharp instruments and should make cuts in a direction away from their body and from others. Teachers should model appropriate use of scalpels and other dissection tools for students so that students have a clear understanding of how to use these instruments safely and effectively.
- Students should wear gloves at all times during a dissection and should wear goggles to protect their eyes in case some fluid squirts from the specimen.
- There should be no eating, drinking, or gum-chewing during a dissection activity.
- The classroom should stay well-ventilated throughout the dissection activity.

After Dissections

- Provide 10–15 minutes at the end of the dissection activity to allow for students to repackage or dispose of their specimens, clean, dry, and return dissection tools, and to clean up their work areas.
- Students should wash, dry, and return all scalpels, dissection pans, and other dissection tools to the teacher. Teachers should inspect tools to ensure that they have been fully cleaned and dried and should count up dissection tools to ensure that all tools that were distributed have been returned.

- Provide plenty of paper towels for cleanup.
- All tabletops and surfaces where dissection has occurred should be cleaned and wiped down with a cleaning spray at the end of a dissection activity.
- Dissection specimens that will be reused in a subsequent class period should be carefully repackaged and stored in a cool, dark, and dry location.
- Dissection specimens that will be discarded should wrapped in a double plastic bag. Preserved specimens purchased from a reputable vendor that are packed without additional preservative solution (e.g., dissection parts) are not considered hazardous waste and can be placed with regular garbage. Dissection specimens that are stored in liquid preservative solution (e.g., in a bucket or jar) are considered biological waste and will require that you work with your custodial staff to let them know that biological waste will be removed and to ask the custodian to create a work request, trade code 75.

Alternatives to Dissection

Teachers may choose to use videos, virtual dissections, graphics, or clear plastic models to supplement or provide a pedagogically sound alternative to a hands-on dissection. Products offered by vendors can be used as alternatives to dissections; price ranges vary as do the products themselves. Teachers may also be able to find high-quality, free-of-charge virtual dissection activities online.

Safety with Microbiology and Biohazardous Materials

Science laboratories in K–12 schools are considered to be Biohazard Safety Level 1 (BSL-1) facilities, meaning that schools should observe all BSL-1 safety guidelines, as outlined by the American Society of Microbiology's Guidelines for Biosafety in Teaching Laboratories. These guidelines, along with guidance specific to New York City Department of Education schools, are shared below.

General Requirements for BSL-1 Microbiology Settings

Personal Protection Requirements

- Students and staff should wear safety goggles or safety glasses when handling liquid cultures, when performing procedures that may create a splash hazard, or when spread plating.
- Students and staff should wear closed-toe shoes that cover the top of the foot. Ballet flat-style shoes are unacceptable because they do not cover the entire foot. The material of the shoe should not quickly absorb liquids nor allow the liquid to easily pass through.
- Gloves are not required for standard laboratory procedures using BSL-1 organisms if students' hands are free of open cuts or abrasion and proper hand hygiene is performed. Proper hand hygiene involves thorough hand cleansing prior to and immediately after finishing handling microorganisms and any time that microbes accidentally contact the skin. Hand cleansing is performed by washing with soap and water or rubbing with an alcohol-based hand sanitizer.

Laboratory Physical Space Requirements

- All microbiology activities must take place in a designated laboratory space that includes a sink with soap for hand washing and an eyewash station.
- Recommended: Students should keep all personal belongings (including cell phones) in an area separate from the work area or in an out-of-the way location.
- Recommended: Use a working and validated autoclave to disinfect used materials and cultures following laboratory activities.

Stock Culture Requirements

- Maintain a curated culture collection that contains cultures from authorized or commercial sources (e.g., ATCC, NCIMB, Carolina Biological Supply Company, Flinn Scientific, Inc., or other reliable science supplier); a full list of authorized culture collections can be found at World Federation for Culture Collections (http://www.wfcc.info).
  - Cultures from nonauthorized or noncommercial culture collections should not be used in an instructional lab.
  - Cultures acquired from other institutions can be used if there is clear provenance (a clear chain of ownership) and the culture was originally obtained from an authorized or commercial source.
  - Clinical cultures acquired from hospitals or clinical labs should never be maintained or used in an instructional setting.
- A well-maintained and cataloged culture collection containing authenticated stock cultures with clear provenance (clear chain of ownership). This includes maintaining records for each culture, including:
  - where the culture came from
  - the stock number from the originating culture collection
  - when the culture was first acquired
  - when the culture was first subcultured
  - any subsequent subculturing for stock or storage purposes
  - BSL level as defined by the commercial source of the culture *(Note: all cultures used in secondary school settings must be BSL-1 cultures.)*
- Ensure that the cultures you acquire are suited to a BSL-1 setting
  - Most culture collections state the appropriate BSL required to work with the organism
  - The American Biosafety Association also maintains a Risk Group database that has BSL information on common strains (https://my.absa.org/tiki-index.php?page=Riskgroups)
- Do not subculture or handle (e.g., Gram staining) unknown microbes isolated from the environment.
- Obtain fresh stock cultures of microorganisms annually (e.g., purchased, revived from frozen stock cultures, etc.) to be certain of the source culture, minimize accumulation of spontaneous mutations, and reduce contamination.

Standard Microbiology Laboratory Practices

Preventing contamination or spread of microbes used in a laboratory setting

- Use only institution-provided marking pens and writing instruments while working with microbes. These remain in the lab at all times and must be disinfected on a regular basis.
- Do not handle personal items (cosmetics, cell phones, laptops, calculators, pens, pencils, etc.) while in the laboratory. Cell phone usage is sometimes permitted during lab; however, cell phones MUST be kept in a resealable plastic bag. After use, the bag should be disposed of in the proper receptacle.
- Wash hands after entering and before exiting the laboratory.
- Do not bring food, gum, drinks (including water), or water bottles into the laboratory.
- Do not touch the face, apply cosmetics, adjust contact lenses, or bite nails.
- Keep door closed while the laboratory is in session. The teacher or administrator in charge approves all personnel entering the laboratory.
- Disinfect bench before and after the laboratory session with a disinfectant known to kill the organisms handled. Use disinfectants according to manufacturer instructions.
- Use proper transport vessels (test tube racks) for moving cultures in the laboratory, and store vessels containing cultures in leak-proof containers when work with them is complete.
- Use leak-proof containers for storage and transport of infectious materials.

Working with Live Cultures of Microbes

The degree to which microorganisms can be used safely in the laboratory depends upon the maturity and proper training of the students, the experience of the teacher, the availability of appropriate apparatus and the type of organism being studied. Precautions must be taken when handling microorganisms to prevent the possible spread of disease. All cultures must be handled as potential pathogens. Proper precautions must be taken when disposing of test tubes and petri dishes where these organisms have been cultured.

- Culture only non-pathogenic species of bacteria, algae, fungi, protozoans, viruses, and bacteriophages. Pathogens are regulated by the Federal Health Service and cannot be shipped to schools or individuals. Many non-pathogenic strains of bacteria have been specially developed for use in teaching laboratories and can be purchased from a reputable biological supply vendor.

- Do not prepare cultures from human or animal skin, saliva, mucous, cough spray, or any other body fluid.
- Always use sterile technique when working with microorganisms, and make sure that students have been trained in relevant sterile techniques before they begin to work with microorganisms. Sterile technique protocols include:
  - Use only sterilized swabs or inoculating loops to transfer bacteria from a sample site or culture to a petri dish.
  - Containers that contain live microbes or medium that microbes can grow on should have lids or seals to keep them sterile, and those lids or seals should be kept shut unless something is being transferred into or out of a container. Staff and students should minimize the amount of time that a container containing microbes or medium is opened to prevent contamination.
  - Use disposable loops for re-culturing or transferring bacteria whenever possible.* Alcohol flaming sterilization processes that use steel inoculating loops and Bunsen burners should only be used if no disposable loops are available.

  ** Only transfer bacterial cultures from strains that have been purchased from a reputable science vendor and that have been specifically developed for teaching laboratories (e.g., E. coli strains used in the AP Biology Transformation Lab) and that are known to be nonpathogenic. Never re-culture or transfer bacterial cultures that have been collected from the environment, as they could include pathogenic strains.*
- Petri dishes that are not being re-cultured should be sealed with transparent tape or Parafilm. Any Petri dishes which are passed around the class for inspection should be sealed in advance.
- Do not permit a broth culture to wet the cotton plug or cap.
- Do not permit fermentation to take place in a closed system or tightly sealed container. If using glass fermentation tubes, use a cotton ball to plug the entrance to the tube.
- Pipettes used for transferring cultures or for making dilutions can be hazardous if students are not trained in proper techniques. Teachers should model the correct method for using pipettes, including how to draw liquid into a pipette and how to measure the amount of liquid taken up by a pipette.
  - **Never mouth pipette.** Instead, use a mechanical pipette or a bulb attachment. Use of disposable pipettes is recommended for transferring cultures of microorganisms.

- To prevent possible spread of disease, even disposable pipette tips must be sterilized before discarding. This can be accomplished by autoclaving or soaking the pipettes in a solution of Lysol or 10% bleach.
- Non-disposable pipettes can be cleaned and reused by placing them into a cylinder containing disinfectant solution, washing them in an automatic pipette washer, and then sterilizing them. To sterilize pipettes, place them in a sterilizing can and heat them for two hours in a hot-air oven at 160–190 degrees Celsius. Keep the pipettes in the sterilized can. Alternatively, the pipettes can be autoclaved or soaked in a solution of Lysol or 10% bleach.

- Label all containers clearly. Petri dishes should be labeled on the bottom half of the dish (where the agar is), rather than on the lid.
- Minimize the use of sharps. Use needles and scalpels according to appropriate guidelines and precautions.
- Advise immune-compromised students (including those who are pregnant or may become pregnant) and students living with or caring for an immunocompromised individual to consult physicians to determine the appropriate level of participation in the laboratory.
- Recommended: Keep notetaking and discussion practices separate from work with hazardous or infectious material.

Human Body Fluids, Cells and Tissues

Due to the risk of disease transmission, experiments and demonstrations using body fluids, such as blood, saliva, or urine, should never be done in a secondary science setting. Synthetic body fluids purchased from scientific supply companies can be used to offer students a safe laboratory experience that simulates working with real body fluids. For example, synthetic blood-typing kits purchased from a reputable science supply vendor can be used to replace now-banned blood typing investigations.

Use of students' own cheek cells for introductory microscopy activities or DNA extraction is not allowed, as the risk of disease transmission is too high. As an alternative, use preserved slides of human cheek cells or other tissues for microscopy; these can be purchased from a reputable vendor. For DNA extraction activities, use plant materials (e.g., bananas, strawberries) or organ meats (e.g., thymus gland) sourced from a reputable butcher or market.

Human blood and potentially infectious body fluids that are present in a lab due to injury, nosebleed, etc., should be treated as potentially infectious. Universal precautions shall be observed to prevent contact with blood or other potentially infectious materials. Because of confidentiality legislation, a science teacher will not know if his or her student has a bloodborne pathogen [OSHA, 1910.1030(d) (1)].

Biohazard Spills

Students should be instructed to immediately notify the teacher in charge of spills that occur in the classroom or laboratory.

Standard (Universal) Precautions must be followed when dealing with spills of cultures containing live microorganisms. Cover the area with a paper towel without touching the fluid. Clear the area and notify the custodian for immediate cleanup.

Solutions of 10% bleach are necessary to clean the contaminated site. You should use the minimum amount of bleach needed to sterilize the items. If the spill happens in a room where a new class is entering, inform that class's teacher and prevent student access to the area.

Sterilization and Disposal of Microbiological Materials

- Arrange for proper (safe) decontamination and disposal of contaminated material (e.g., in a properly maintained and validated autoclave) or arrange for licensed waste removal in accordance with local, state, and federal guidelines.
- Sterilize all contaminated material, including used Petri dishes, prior to discarding. Ideally, items should be autoclaved; if no autoclave is available, soak in a solution of Lysol or 10% bleach.
  - As plastic petri dishes can melt or leak during autoclaving, you must place them in an autoclave bag (available from most science/laboratory vendors) or a sterilization container prior to autoclaving.
  - Seal all containers or bags of items to be autoclaved with autoclave tape that will change color during autoclaving, indicating that a sufficiently high temperature was reached to sterilize items.
  - Items being autoclaved in an autoclave bag should be placed in an autoclave-safe plastic or metal dish in case leaks occur during autoclaving.
  - Review and follow the autoclave manufacturer's instructions for use.
- Disposable items that have been autoclaved should remain in their sealed bag or container that they were autoclaved in. This bag or container should be placed in a biohazard bag (available from science supply vendors) and/or into a biohazard or medical waste box.
- Disposable items that were disinfected using Lysol or 10% bleach should be placed into a biohazard bag prior to disposing.

- In addition to used or contaminated disposable items, unused petri dishes containing nutrient agar or other media that can support a wide variety of microbial species should also be disposed as biohazards, as pathogenic bacteria could colonize these dishes if they are disposed in the regular garbage.
- Disinfected microbiological waste that is in a biohazard bag is considered biological waste and will require that contact the Office of Occupational Safety and Health for appropriate disposal. Schools may have or coordinate biohazard through their nurse's office. Other disinfected materials can be disposed in regular waste.

Heat and Light

Heat is used in many experiments and may be generated by flames, light bulbs, water baths, or hot plates, and precautions are needed to ensure that they are safely used. In order to reduce the hazard of burns, place heat sources so that students do not have to reach across them during the experiment.

Exercise caution around items being heated. Heat sources should never be left unattended when they are turned on. As items that are being heated can boil over, splatter, or give off vapors, students and teachers should wear goggles and make sure to keep an appropriate distance from substances that are being heated. Test tubes that are being heated should be angled away from people.

Students should be reminded that substances remain hot for some time after being removed from the heat source and they should continue to handle them with care. Heat-protective gloves or mitts should be worn when handling any equipment that has been heated. Equipment should be allowed to cool on insulated mats and must be completely cool before handling. Whenever possible, use water baths, Lab-Aids Lab-Master System, or other alternatives to open-flame heaters such as Bunsen burners to heat substances. Specific safety precautions for different types of heat sources are described in more detail below.

Heating Substances in Test Tubes

Special precautions must be taken when heating substances in test tubes:

- Caution students who are about to heat material in test tubes not to look down into the tube. Tell them to hold test tube at a 45° angle to flame, and never to point the mouth of the tube toward themselves or others. The test tube holder or tongs should hold test tubes near the lip of the tube. If material boils over, this will prevent it from touching the hand holding it.
- Instruct students to slowly heat substances in test tubes, moving the tube evenly over the flame. Otherwise, the vapor meeting a mass of matter above it may cause the bottom of the tube to be blown out or the matter to be ejected violently. The test tube holder should not be heated and should be held carefully. Students should always be closely supervised when heating material in test tubes.

Experiments and Demonstrations Involving Open Flames

Care must be taken to ensure safety when experiments or demonstrations using open flames are involved. The section involving gas burners provides more detail around safe operation of this piece of equipment. Check and confirm that fire extinguishers and any additional fire safety equipment are in good working condition, and that the teacher or instructor knows how to use fire safety equipment, before conducting any demonstration or experiment that uses an open flame. **As a reminder, the Rainbow Experiment is forbidden in NYCDOE schools**. See List of Banned Substances, Equipment, and Experiments on page 191 in the *Appendix* for more details.

Incandescent Lamps

Incandescent lamps are used as both light and heat sources. The surface of the lamp bulbs as well as the sockets and nearby material can reach high temperatures. Warn students not to touch the bulbs, sockets, or any other equipment or material that is near a bulb until the equipment is cool. Also, warn students not to splash water on a hot bulb, as the sudden contraction of the glass upon cooling could cause the bulb to shatter.

Heat-Generating Sources

Commonly used generators of heat in the science laboratory include Bunsen burners and hot plates; additional heating sources that may be used include water baths, microwaves, incubators, or heating units, such as Lab-Aids Lab-Masters. Safety guidance for different types of heat sources is below. Please use alternatives to open-flame heat sources (e.g., Bunsen burners) whenever possible.

Hot Plates

The National Science Teachers' Association (NSTA) and the New York City Department of Education advocate the use of hot plates instead of gas burners. Hot plates should be inspected before using to ensure that they are in good working condition. Remember that hot plates remain hot after being turned off and should still be handled cautiously. Many hot plates will have a light that illuminates to indicate if the hot plate is hot; ensure that students are aware of this indicator.

Water Baths

Water baths may be used to heat items. Water baths are recommended over heating items in a beaker of water on a hot plate. Water baths should be carefully inspected to ensure that they are in good condition, free of leaks, and that electrical cords are in good condition. Students should be instructed that an electrically powered appliance that holds water can pose a shock hazard if the water bath is moved or placed on an unsteady or unlevel surface while it is plugged in and operating.

Gas Burners (aka Bunsen Burners)

The Bunsen burner, which has been used for generations in high schools, is now considered dangerous, and heating alternatives, such as hot plates or hot water baths should be used in place of Bunsen burners whenever possible.

Science teachers may use Bunsen burners for laboratory activities for which alternative heat sources are not feasible, provided that their laboratory has access to gas lines. If Bunsen burners are to be used, be aware of the following:

Open flames present fire hazards. Bunsen Burners and other devices produce an open flame and burn at a high temperature (more than 2000 degrees Fahrenheit). There is always the potential for something to catch fire with any flame. Follow these guidelines to reduce the fire risk. In case of a fire, activate the nearest fire alarm pull station, notify all lab personnel, and evacuate the building.

- Place the burner away from any overhead shelving, equipment, or light fixtures by at least 12 inches.
- Remove all papers, notebooks, combustible materials, and excess chemicals from the area.
- Tie back any long hair, dangling jewelry, or loose clothing.
- Only use tubing rated for gas. Don't use tygon tubing.
- Inspect hose for cracks, holes, pinch points, or any defect. Replace all hoses found to have a defect before using. Ensure that the hose fits securely on the gas valve and the burner.
- Utilize a sparker/lighter with extended nozzle to ignite the burner. Never use a match to ignite a burner.
- Adjust the flame to regulate air flow and produce an appropriate flame for the experiment (typically a medium blue flame).
- Allow the burner to cool before handling. Never touch the hot barrel of the burner.
- Ensure that the main gas valve is off before leaving the laboratory.

Shut off gas when done.

Do not leave open flames unattended.

Never leave the laboratory while the burner is on.

The Fire Department of New York provides additional guidance around working with open flames. See below or in the full Fire Department of New York (FDNY) Laboratory Safety Rules on page 89.

Laboratory operations using open flames shall be performed in accordance with the following requirements:

1. Whenever possible, alternative methods to the use of open flames, such as heating mantles, hot plates, glass bead sterilizers, or infrared loop sterilizers, shall be used.
2. Tubing connecting a gas supply to a torch or Bunsen burner shall be in good condition, compatible with the gas being used and rated at least 150% of working pressure. Tubing connections shall be gas-tight at the gas supply and the torch/burner. Prior to each use, all connections shall be verified for tightness.
3. If open flame operations are performed outside a hood, operations shall not be conducted under shelves, cabinets, or other overhanging equipment.
4. Combustible materials shall be kept at least 0.610 m (24 in.) away from the open flame.

Alcohol, Propane, And Butane Burners

Per Fire Code section 3803.2.1.4, alcohol, propane, and butane burners are not permitted in classrooms. Many serious accidents have occurred due to alcohol burners. Propane burners are **not permitted** to be used by students for laboratory experiments. They may be used by custodians on non-flammable surfaces only and stored in locked metal cabinets.

Lab-Masters

The Lab-Aids Lab-Master uses a safe, electric, shielded heating element to heat solutions and solids, using a desiccator-type insert. Heat can be monitored using either the base unit itself or monitored to the nearest degree Celsius by using the temperature probe. We recommend using small boiling chips with new test tubes to avoid superheating. Students should use safety eyewear when using the heater. For more information, see Appendix E, the Lab-Master User Manual, in the Natural Approach to Chemistry Laboratory Investigations book, 2nd edition, p. 183, “Using the heater,” and “Heating to a specified temperature.” You can also visit the Lab-Aids website at https://lab-aids.com, or email Ed Monk at emonk@lab-aids.com.

Light and Lasers

Optics

Avoid the use of burning candles to obtain the image produced by mirrors and lenses. Use low wattage bulbs instead of burning candles.

Do not use broken glass slabs, mirrors or lenses.

Ultraviolet Light

Prolonged exposure to ultraviolet (UV) light can cause serious burns to the retina. Make sure that no one looks directly into the source of ultraviolet radiation. For activities requiring more prolonged exposure, such as the observation of UV fluorescence and charged electroscope phenomena, supply students with goggles, which are appropriate for the wavelength of UV light being used. Ordinary eyeglasses, polycarbonate plastic lenses, and glass shields between the demonstrator and the students will also provide a large measure of protection from UV light damage to the eye.

The dangers of using ultraviolet light can be minimized using the flowing precautions:

- Wear UV protection rated goggles (ANSI Z87.1-2015 Standard).
- Do not operate the ultraviolet lamp near a water source.
- Wear the appropriate protective clothing and PPE.

Laser Safety

Lasers are light sources which emit coherent beams of light. Common wavelengths of wavelengths used are 405nm (violet), 473nm (blue), 532nm (green), 593.5nm (orange/yellow), and 650-670nm (red).

Laser beams are intense and concentrated, and it is important that students and teachers exercise caution and adhere to the safety guidance outlined below when using lasers.

- Students and staff should wear laser safety glasses whose wavelength and optical density are appropriate for the laser they are using.
- Avoid looking directly into the laser beam of your laser or pointing the beam at any other person or animals. Lasers with any wavelength over 5mW will cause permanent damage to your vision. Note that not all laser beams are visible to the naked eye.
- Do not point the laser beam at reflective surfaces such as mirrors: a reflected beam can act like a direct beam on your eye.
- Never view a laser beam using an optical instrument, such as binoculars or a microscope.

(ANSI Z136.5, 2009) specifically provides laser safety guidance by evaluating and minimizing hazards associated with laser radiation in educational settings at all levels.

The lasers that are most useful for teaching science are those that emit low-power continuous-wave visible beams (wavelengths ranging from 400 to 700 nanometers). For special demonstrations or students' projects that require other types of lasers, close supervision by trained and knowledgeable personnel is important to avoid safety hazards. New York City code 10-134.2 Regulation of laser pointers prohibits selling or providing laser pointers to individuals under the age of 19; therefore, laser pointers should be considered to be potentially hazardous, and should only be used for teacher demonstrations.

All lasers used in schools must comply with the Laser Performance Standard of the U.S. Department of Health and Human Resources and with Title 21, Chapter 1, Subchapter J, Part 1040 of the Code of Federal Regulations.

These regulations specify safety features and classify lasers into four classes. The least dangerous is Class 1 and the most dangerous is Class 4.

Caution: It is strongly recommended that any laser with a rating above Class 2 be removed from the school.

The classifications for Laser Devices were altered in 2009 and the table below reflects these changes:

Laser Class	Safety Information
Class 1	Safe under all conditions of normal use
Class 1M	Safe for all conditions except when passed through magnifying optics, such as a microscope or telescope.
Class 2	Considered safe because the "blink reflex" will limit exposure to no more than 0.25 seconds (limited to 1mW continuous wave)
Class 2M	Safe due to the "blink reflex" if not viewed through optical instruments.
Class 3R	Considered safe if handed correctly with restricted beam viewing (limited to 5 MW)
Class 3B	Hazardous to the eye if exposed directly, but diffused reflections are not harmful.
Class 4	Highest and most dangerous class of laser; can burn the skin and/or cause devastating and permanent eye damage. May be a fire risk by igniting combustible material.

Class 1. The power of a beam emitted by a Class 1 laser (below 0.4 microwatt) presents very little risk of damage to any part of the human body.

Class 2. The beam emitted by a Class 2 laser (visible light 0.4 microwatt to 5 milliwatts) is not considered hazardous to the skin regardless of the exposure time. However, because of the beam's dazzling brightness, a long exposure can present hazards to the eyes. Normal eye reflexes automatically prevent exposures longer than 0.25 second. However, an intentional exposure of 15 minutes or more, by deliberately staring into the beam, is considered hazardous and should never be allowed.

The following classes of lasers have been determined to be unsafe for school use:

Class 3A. A focused beam from a Class 3A laser entering the eye, or a spread-out beam viewed for an extended time is definitely hazardous.

Class 3B. The direct beams emitted by a class 3B laser (5 to 500 milliwatts) are considered to be an acute hazard to the skin and eyes.

Class 4. Both the direct and diffuse beams from Class 4 lasers (greater than 500 milliwatts) are not only dangerous fire and skin hazards, but they can cause immediate death.

Chemical, Safety, Usage, Preparation, and Disposal

General Safety with Chemicals

1. Every chemical—even basic household substances, such as table salt or vinegar—can be potentially unsafe, and it is important to be familiar with the risks and hazards of a given chemical. A chemical's SDS (Safety Data Sheet) and NIOSH (National Institute for Occupational Safety and Health) ratings provide information about potential hazards that will inform the safe handling and storage of a given chemical.

2. The hazards that may be associated with a chemical fall into two broad categories:

   - **Health Considerations:** The health considerations of a chemical are based on its toxicity and biological effects. This includes concerns about whether the chemical is poisonous, toxic, mutagenic, carcinogenic, or harmful to human organs.

   - **Safety Considerations:** The safety considerations of a chemical are based on its ability to be stable when handled. This includes concerns about how explosive, unstable, flammable, reactive, and exothermic a chemical may be.

   The New York State Education Department provides guidance on chemical storage and management on its School Chemical Management and Storage Guidelines page (http://www.nysed.gov/curriculum-instruction/school-chemical-management-and-storage-guidelines). This is in compliance with the Federal OSHA standards. OSHA (Occupational Safety and Health Administration, www.osha.gov), NIOSH (National Institute for Occupational Safety & Health), and SDS (Safety Data Sheets) also list categories and levels of hazards for chemicals. The National Institute for Occupational Safety and Health (NIOSH)) maintains a Pocket Guide to Chemical Hazards. The NIOSH pocket guide can be accessed as a PDF download or as a mobile app from the NIOSH website at https://www.cdc.gov/niosh/npg/default.html. Hazard information can also be found in a chemical's SDS.

3. Teachers need to carefully choose the chemicals they use in demonstrations and laboratory activities. Chemicals used should be relevant to the science topic being taught and should advance student understanding of concepts. Teachers should use the safest chemicals that can be used to illustrate a concept or reaction. The Green Chemistry and Less-Hazardous Alternatives section on page 81 offers additional resources around safer alternatives.

4. Be sure to read and adhere to every chemical's SDS (Safety Data Sheet) and NIOSH (National Institute for Occupational Safety and Health) ratings, which will provide information about potential hazards that will inform the safe handling and storage of a given chemical.

Note: *Most ratings for chemicals given in SDS (Safety Data Sheets) are industry-based. That is, hazards are listed where prolonged exposure is very possible or where the time-weighted average of multiple exposures is potentially high, typically an eight-hour exposure. Most chemicals used in schools are handled for very short periods of time, rarely more than 40 continuous minutes. Plan for the shortest time of exposure to chemicals.*

5. Every chemical should be handled properly, and in minimal concentration and amount to achieve the desired reaction or observable outcome. Many hazards listed for compounds are based upon direct exposure to the pure solid or liquid form of a chemical. These hazards decrease when a compound is diluted. General guidance regarding concentrations and amounts of chemicals are outlined below:

i. Most solutions for use by students should be between 0.1 M and 1.0 M.

ii. Solutions of 1.0 M to 2.0 M should be kept at the teacher's desk. The teacher should directly oversee student use of such solutions.

iii. Solutions greater than 2.0 M, such as drops of concentrated 12M acid, should be handled and dispensed to students by the teacher.

iv. Procedures should call for the smallest possible quantity of reagents or chemicals that are sufficient to make observations. Generally, 1–2 mL of chemicals per test tube make adequate observations possible.

Any dilutions of solutions from stock bottles should be done in the fume hood. Appropriate personal protective equipment, including goggles, gloves, an apron or lab coat, and a face shield, should be worn while performing dilutions.

6. All chemicals must be appropriately labeled. Chemicals that are in the stock bottles that were received directly from a vendor should already have labels on the stock bottle; this information can be used to create labels for other containers that the chemical may be transferred to for storage. Schools may want to use digital chemical labelling software for this purpose.

A label should follow OSHA guidelines and include the following information:

- Name of substance
- Batch number of substance
- Information about potential hazards, depicted as a:
  - pictogram
  - signal word
  - hazard statement

- Precautionary Statements
  - prevention
  - response
  - storage
  - disposal

  Additional guidance around labeling of chemicals can be found in this OSHA Brief: Hazard Communication Standard: Labels and Pictograms.

7. Avoid using chemicals with the following characteristics:

   a. Less than a 50mg/kg LD50 rating (a "poison")

   b. Listed as a known human carcinogen

   c. Flashpoints below 23°C (73°F) with boiling points below 38°C (100°F)

   d. Materials that form explosive mixtures with air

   e. Materials that are explosive without a strong initiating source of heat

   LD50 is a technical term that is used to evaluate and define the acute toxicity of a chemical. LD50 refers to the "lethal dose that will kill 50% of a population."

8. Avoid combining incompatible chemicals during laboratory preparation or laboratory activities. For more information, see Specific Chemical Incompatibilities on page 225 in the *Appendix*.

9. Minimize exposure to chemicals. Bring only the amount of chemical needed for the activity into the laboratory classroom. Keep containers containing chemicals closed whenever possible, and dispose of used chemicals once an activity is completed. Specifics regarding chemical disposal can be found in the Chemical Storage and Disposal section on page 82 of this manual.

10. Safety procedures for each laboratory activity with chemicals must be planned and shared with students prior to beginning the activity. Teachers should model safe procedures for students and should be vigilant that students are continuing to follow these procedures. Certain safety procedures that should be present in all chemistry laboratory activities include:

    i. Wear goggles and any other required personal protective equipment, including gloves, aprons or a lab coat, and if necessary, a face shield, at all times when handling chemicals.

    ii. Never taste chemicals.

    iii. Never directly inhale or smell chemicals. Instead, waft the odor toward your nose.

iv. Never touch chemicals or their solutions unless they are known to be safe.

As different chemicals present different hazards, teachers should take time to ensure that the safety procedures for a given laboratory activity address hazards presented by the specific chemicals used in that activity, and should communicate these chemical-specific safety precautions to students.

11. Wear appropriate personal protective equipment (PPE), such as goggles, gloves, and aprons when working with chemicals. This applies to teachers or lab specialists who are preparing laboratory activities and to students while working with chemicals in a laboratory setting. More information about specific PPE needs and maintenance can be found on Part III: Managing Hazards and Risks section of the *Appendix*.

12. All equipment (e.g., glassware and crucibles) used in chemistry laboratory activities should be inspected in advance to make sure that it is clean, dry, and in good condition.

13. All rooms containing chemicals or where students or adults will be working with chemicals must be properly ventilated. Prepare chemical reactions that give off toxic vapors or flammable gases under a fume hood.

14. All rooms where chemical preparation or laboratory activities are taking place should have all appropriate safety equipment accessible and in good working condition. More information about specifics of safety equipment can be found in Laboratory Safety Equipment Inspection on page 127 of this manual.

15. Quantities of chemicals in an instructional lab shall be limited to the lowest possible amounts or volumes necessary and in no case shall exceed the pre-laboratory unit quantities specified in 10.1.1[1] or the maximum allowable quantities specified in the Fire Code and the Building Code.

16. Dispensing of bulk quantities of chemicals for an experiment or demonstration shall be performed in a prep room outside of the classroom. For existing educational and instructional laboratories that do not have a separate preparation room, the dispensing of bulk quantities of chemicals for experiments or demonstrations shall be performed prior to the arrival of the students in the classroom. The minimum amount of chemical(s) needed to perform the experiment or demonstration shall be transferred to small, appropriately labeled, sealable bottle(s) or dropper bottle(s).

17. Do not return surplus chemicals to their containers. Do not pour excess reagent solutions back into their stock bottles. Prepare the proper protocol for chemical cleanup for each laboratory exercise in advance.

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1 The density and total amount of flammable and combustible liquids, including waste in laboratory work areas and in the laboratory unit outside the flammable liquid storage rooms shall not exceed 4L per 9.3m^2 of the laboratory unit.

18. Do not place any bottles, especially those containing acids, bases, or volatile organic liquids, near heating pipes or in direct sunlight. Dangerous gas pressures can develop under such conditions.

19. Keep flammable or explosive chemicals away from heat sources at all times.

20. **Methanol-based flame tests (also known as the "rainbow demonstration") are prohibited by the New York City Department of Education.** Teachers should use videos or safer alternatives in place of methanol-based flame tests.

Acids and Bases

1. Be sure to wear gloves and goggles when working with acids and bases. When diluting acids or bases, always add the acid or base to the water slowly as outlined below. If you were to reverse the procedure and add the acid or base to the water, this could generate heat, which could result in violent splattering.

2. The following procedure should be used to prepare a diluted acid:

    a. Start with water in a heat-resistant container that is neither chipped nor scratched.

    b. Place the container in a sink filled with cold water.

    c. Slowly add small quantities of the concentrated acid to the water while stirring constantly.

3. Open containers of volatile chemicals, such as hydrochloric acid, under the fume hood, while operational, to remove excessive concentrated harmful vapors. Follow Chemical Hygiene Plan guidance on the specific acid or base that you are working with.

4. Never allow students to taste the salt formed by neutralization reactions.

5. Take extra precautions with concentrated acids and bases and other corrosive and toxic chemicals. Do not allow students to handle concentrated acids and bases. If acids or bases are spilled on skin or clothing, wash immediately with large quantities of water.

Green Chemistry and Less-Hazardous Alternatives

Alternative "Green" laboratory activities are designed to have less impact on the environment by creating lower levels of waste and toxicity than traditional chemistry. Green chemistry is pollution prevention at the molecular level. Green lab activities will also reduce the need for many of the FDNY, NOISH and EPA rules and regulations at the school. "Green Chemistry" laboratory activities meet the three basic factors for the "greening" of chemistry laboratory activities:

i. They reduce the quantity of potentially hazardous chemicals (safety).

ii. They convey the same core chemistry concepts (performance).

iii. They are able to be executed with less toxic and costly materials (cost).

Beyond Benign Green Chemistry Education's website provides additional resources and activities for green chemistry.

Handling Chemical Spills

1. Chemical spills that occur on the skin or the eyes must be treated **immediately**. Flush with water from a plumbed eyewash station as soon as possible for at least 15 minutes. Read the SDS and seek medical attention if necessary.
2. Know the protocol for each type of spill before it happens and prepare a spill kit for each chemistry laboratory that can be used in the event of a spill. Details about spill protocols and spill kits can be found in the Chemical Spills section on page 231 of the *Appendix*.
3. If a spill occurs, ascertain what a type of spill it is and whether it will require outside assistance for cleanup. Additional information about the types of spills and cleanup can be found in the Chemical Spills section of the *Appendix*.

Note: *Acids, bases, and flammable chemical spills need to be treated differently in order to neutralize or contain each type of accidental release. The SDS will have clear instructions in Section 6 –* ***Accidental release measures****, which provides recommendations on the appropriate response to spills, leaks, or* ***releases****, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment.*

Chemical Storage and Disposal

The guidelines below will help you to store and dispose of chemicals safely. Additional chemical storage information can be found in the Fire Department of New York (FDNY) Laboratory Codes and Rules for Non-Production Chemistry Laboratories on page 172, and in the Steps to a Safe and Clean Laboratory section on page 181 of the *Appendix*. The United Federation of Teachers provides a Chemical Storage and Handling slide deck with helpful visuals.

Managing Your Chemical Storage

1. Conduct an inspection of all the chemicals in your laboratory (refer to "Steps to a Clean and Safe Laboratory" in the Appendices) at least once a year to update chemical inventory and to ensure that chemicals are appropriately labeled, have not expired, and have not degraded or shown other changes (e.g., crystallization) that would make them unusable. If possible, conduct this inspection during a time of the year when students are not present in the building.

2. Handling and storage of chemicals shall comply with the manufacturers' recommendations and Safety Data Sheets.

3. Keep all bottles labeled at all times. Labels should comply with Global Harmonizing System (GHS) standards, and should contain at least: the name or formula, concentration, date of receipt and/or preparation, and special hazards. More information can be found in this OSHA flyer regarding labeling: https://www.osha.gov/sites/default/files/publications/OSHAquickfacts-lab-safety-labeling-chemical-transfer.pdf.

   Every label must contain the chemical identity, a signal word (i.e., DANGER or WARNING), universal hazard symbols or pictograms, manufacturer information AND precautionary statements. Generally, the manufacturer will comply and have this already.

   It should be noted secondary (transfer) containers also need labeling. This label must contain two key pieces of information: the identity of the name of the chemical, and the hazards present.

4. Containers of materials that become hazardous during prolonged storage shall be dated by the teacher or lab specialist when first opened. Containers that become hazardous during prolonged storage in unopened containers shall also be **dated with the date when their container was first opened** in the laboratory chemical inventory. Such materials shall be properly managed **and disposed of according to the expiration date**, and recommendations on the label. In general, all chemicals, including those considered inert (e.g., salts, sugars, starches) should be used within a three-year time period.

5. Replace old and damaged labels with GHS-compliant labels before they become useless. This will avoid a situation in which you have unlabeled and unidentified chemicals, which creates a potentially dangerous situation for storage and disposal. Consider using a software system or template to ensure that replacement labels are GHS-compliant.

   Reminder: Any labels that are unlabeled or unidentifiable should be assumed to be hazardous and should be disposed of according to Hazardous Waste Disposal Procedures on page 234.

Chemicals Banned from Schools

- Carcinogenic and mutagenic chemicals are prohibited from use or storage in schools.
- Explosives should not be used or stored in schools. The NYC Fire Department Code, Chapter 34 limits certain explosives and regulates the quantity of certain combustibles and dangerous chemicals that may be stored in public high schools. See the Explosives section on page 189 in the *Appendix*.

Organizing a Chemical Storage Area

1. Chemicals should NOT be arranged alphabetically by chemical cation names. Anions are a better indicator of reactivity and compatibility. See Chemical Storage and Recommendations, 2016 at http://www.dec.ny.gov/docs/materials_minerals_pdf/chemstorage.pdf or other reliable sources. Suggested Shelf Storage Patterns for inorganic and organic compounds can be found on page 227 in the *Appendix*.
2. Make sure that chemicals that react with each other are not stored in close proximity.
3. Chemicals should be stored on sturdy shelves that are made of a nonreactive material. Shelves should be inspected periodically to ensure that they are structurally sound and that there is no risk of collapse.
4. Store all acids in a soapstone or acid resistant storeroom or certified chemical cabinet that is specifically designed for acid or base storage. Never store acids in ordinary closets, cupboards, or cabinets. To prevent breakage, store close to floor level if possible, and never above eye level. Nitric acid must be isolated from ALL other substances, especially Acetic acid which together can be combustible. If you are not offering an AP Chemistry or other advanced chemistry program that requires the use of nitric acid, please use a less hazardous and more environmentally sensitive alternative to nitric acid. Contact a reliable science supplier for a list of options that will allow the same results with much safer chemicals.
5. Do not overstock shelves or store chemicals on countertops or on the floor.

6. Avoid storing liquid chemicals above eye level (72” in height) and avoid storing chemicals in aisles or other areas with increased foot traffic.

7. Heavy boxes or containers should be stored on lower shelves and should not be stored above shoulder level.

8. Make certain that combustibles and poisons are kept securely locked in metal, stone-lined, or other cabinets designed for that purpose.

9. Store flammables in a dedicated flammable cabinet. This cabinet must adhere to NYC Fire Department codes. These codes conform to OSHA requirements, NFPA code 30.

10. Make sure that storage cabinets for sodium, potassium, calcium, and calcium carbide exhibit this warning in bold, easily read letters:

In Case of Fire

Do Not Use Water

11. Inspect chemical cabinets monthly for hazards and eliminate them if possible. Record the date of each inspection. Report any hazards that were not eliminated to your supervisor for further action.

12. Storage of chemicals in the fume hood is prohibited. See the Fire Department of New York (FDNY) Laboratory Codes and Rules for Non-Production Chemistry Laboratories on page 172 for additional information about chemical storage.

Preparing and Displaying Inventory Paperwork

1. Prepare a chemical inventory according to NYC Department of Education guidelines, which is available at https://infohub.nyced.org/docs/default-source/doe-employees-only/chemicalinventoryform4.pdf?sfvrsn=60894705_2. Digital chemical inventory software can also be used for this purpose. This must be updated on an ongoing basis as chemicals are ordered and added, or used up and/or disposed of, and must be kept in a secure location and be available for inspection. (See the *Appendix* for a copy of the inventory sheet and instructions.) This inventory is required by the New York State Commission of Education (Education State Law 305, Section 1, and Subdivision 19). It is required by all elementary and secondary schools.

2. Prepare a NYC Right-to-Know Facilities Inventory form for hazardous chemicals. The compliance package for annual reporting of hazardous substances in New York City may be obtained through the NYC Department of Environmental Protection Community Right-to-Know Program's site at https://www1.nyc.gov/site/dep/about/community-right-to-know-program.page. This report is is due to the NYCDOE Division of School Facilities each year on March 1.

   Additional details about Guidelines for Community Right-to-Know Laws can be found on page page 173 in the *Appendix* or on the NYCDOE Employee Safety and Health webpage.

Ordering and Disposing of Chemicals

1. Chemicals may only be ordered through ShopDOE.
2. When ordering chemicals, in general, a one-year supply is the recommended maximum. It is safer to purchase smaller quantities of chemicals each year.
3. Follow NYCDOE protocols for chemical waste disposal.
   - Store different chemical waste substances separately in labeled containers. The labels should list the specific hazards and the date the substance became waste.
   - Notify the principal or assistant principal and custodian when chemical waste disposal is required.
   - Work with your school's custodian to complete a PO-18 Chemical Removal Request form that lists the type, amount and room location of the chemicals that you want removed.

     The custodian will:

     1. Complete a PO-18 and attach the list of chemicals being removed from the school.
     2. Use Trade Code 75 on the PO-18, Crew #IN27.
     3. The custodian will send the PO-18 Form to the NYCDOE Office of Environmental Safety and Health.
4. Dispose of old chemicals that show bulging containers, liquids in solids, solids in liquids, darkening or clouding of solutions, or spotting on solids. Dispose of chemicals that have specific shelf lives indicated on label. In general, dispose of chemicals that are three or more years old.
5. Unlabeled bottles of chemicals whose identity is not known should be handled according to protocol in the section entitled Hazardous Waste Management found in the *Appendix*.

6. Waste chemicals **shall not** be combined or mixed with other waste chemicals unless they have been evaluated for compatibility by a qualified person.

7. Chemical waste containers shall be labeled in accordance with the regulations of the New York State Department of Environmental Conservation.

8. Liquid waste containers stored in laboratory work areas shall not exceed 20L (5 gal).

9. Flammable and combustible liquid waste quantities shall not exceed five gallons.

Fire Department of New York (FDNY) Certificate of Fitness Requirement for Chemical Laboratories

As per the National Fire Protection Association 45 (NFPA® 2015), a laboratory using chemicals is defined as: "All educational laboratory units and instructional laboratory units in which any quantity of chemicals, as defined in NFPA 704, with one or more of the following hazard ratings, is handled or stored: health – 2, 3, or 4; flammability – 2, 3, or 4; or instability – 2, 3, or 4."

The NYC Fire Code defines a laboratory unit as an enclosed space of a minimum one-hour fire-rated construction, designed or used as a laboratory. Laboratory units may include one or more separate laboratory work areas, and accessory storage rooms or spaces within or contiguous with the laboratory unit, such as offices and lavatories.

A permit is required to store, handle, or use hazardous materials in a laboratory unit in quantities exceeding:

a. 1 gallon (3.8 L) of flammable liquid

b. 1 gallon (3.8 L) of combustible liquid

c. 75 SCF (2.12 m3) of flammable gas

d. those set forth in section 105.6 of the NYC Fire Code for other types of hazardous materials (e.g., oxidizers, water reactives, toxics, corrosives).

Laboratory operations requiring a permit shall be under the personal supervision of a D-14 certificate of fitness holder. At least one D-14 certificate of fitness holder shall be present on each floor of the laboratory unit on which laboratory operations using hazardous materials are being conducted while the laboratory is in operation. This requirement will be satisfied if all teachers performing laboratory activities with hazardous chemicals hold a D-14 Certificate of Fitness. Additional certificate of fitness holders shall be provided as the commissioner may require as a condition of the permit. Accessory laboratory chemical storage rooms (prep rooms and stock rooms) shall be under the general supervision of a D-15 certificate of fitness holder.

Certificate of Fitness D-14

Supervise the Handling and Uses of Chemicals in NYC K–12 School Labs Description

All teachers who use hazardous chemicals in laboratories in NYC K–12 schools require a Certificate of Fitness to Supervise the Handling and Use of Chemicals in NYC K–12 School Laboratories (D-14). All laboratories in NYC 6–12 schools that use hazardous chemicals in laboratory activities require a Certificate of Fitness holder to supervise the handling and use of hazardous chemicals in NYC K–12 School Laboratories (D-14).

To obtain this Certificate of Fitness, applicants must have either:

- a NYS Department of Education Permanent or Professional Certification as a Biology, Chemistry, Earth Science or Physics (7–12) Teacher; or
- a NYS Department of Education General Science (7–12) Teacher Extension Certification.

Information about the D-14 Certificate of Fitness and the application processes can be found on the FDNY's Certificate of Fitness Handling and Use of Chemicals in NYC K–12 School Laboratories (D-14) page at https://www1.nyc.gov/nycbusiness/description/cof-d14/about.

All applicants should review the Certificate of Fitness Study Materials: https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d14-noe-study-materials.pdf.

For more details on the Alternative route, please visit: https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d14-aip.pdf.

Note: Science teachers who do not have a D-14 Certificate of Fitness may still perform laboratory activities, provided that these activities do not use hazardous chemicals. If a teacher does not obtain a D-14 certificate of fitness, hazardous chemicals cannot be as part of their instruction. Instead, consider eliminating or substituting hazardous chemicals by integrating green chemistry in lab activities.

Certificate of Fitness D-15

Supervise the Storage and Handling of Chemicals in the NYC K–12 School Labs

All chemical storage (prep/stock) rooms that store hazardous chemicals in NYC grades 6–12 schools require a D-15 certificate of fitness holder to supervise the storage and handling of hazardous materials.

To obtain this certificate of fitness, applicants must have either;

- a New York City Department of Education Certification as a laboratory specialist and have met the special requirements, or
- a NYS Department of Education Permanent or Professional Certification as a Biology, Chemistry, Earth Science or Physics (7–12) Teacher, or
- a NYS Department of Education General Science (7-12) Teacher Extension Certification.

All laboratory specialists who store and handle hazardous chemicals in NYC K–12 Schools require a Certificate of Fitness for School Laboratories (D-15).

Information about the D-15 Certificate of Fitness and the application processes can be found on the FDNY's Certificate of Fitness Supervising the Storage and Handling of Chemicals in NYC K–12 School Laboratories (D-15) page at https://www1.nyc.gov/nycbusiness/description/cof-d15/about.

All applicants should review the Certificate of Fitness Study Materials: https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d15-noe-study-materials.pdf.

The Alternative Issuance Route can be done by someone in the school (Science Supervisors/Science Teachers/Lab Technicians).

The NYC Fire Department rules include additional guidance around chemical storage. FDNY rules pertaining to chemical storage can be found in FDNY Laboratory Safety Rules on page 89.

FDNY Laboratory Safety Rules

The Fire Department implements the New York City Fire Code by adopting rules. A rule is an agency regulation that has the force of law. All of the Fire Department rules are compiled in Title 3 of the Rules of the City of New York. The most current Rules of the Fire Department of the City of New York were adopted in January 2016 as an amendment of the National Fire Protection Agency (NFPA–2015) by the New York City Fire Commissioner.

The Fire Department has adopted these rules in response to a number of recent fires in school laboratories. The 2015 edition of NFPA 45 addresses a number of concerns associated with those fires. Among the changes made by these modifications are the following operational and maintenance requirements:

- Risk assessment for all experiments and demonstrations that use hazardous chemicals
- Establishment of teacher responsibilities
- Initial and annual refresher training on the laboratory's emergency plan for teachers and laboratory specialists
- OSHA and NIOSHA training to be done by NYCDOE Office of Occupational Safety and Health.
- Chemical Emergency Response Training is provided in partnership with the UFT
- Restrictions on the use of Bunsen burners and other open flames
- Prohibition of the use of improperly functioning exhaust hoods
- Prohibitions on the handling and use of hazardous materials when laboratory exhaust ventilation is improperly functioning.

The NYC Fire Department Rules can be found in their entirety at: https://www1.nyc.gov/site/fdny/codes/fire-department-rules/fire-dept-rules.page

The specific Rules of the Fire Department of the City of New York that pertain to the New York City Department of Education schools, Grades 6–12 are as follows:

- An educational lab unit is under direct supervision of a teacher and used for educational purposes for students through grade 12.

- Experiments and tests conducted in educational and instructional laboratory units shall be under the direct supervision of a teacher. When teachers are performing demonstrations or students are conducting experiments using hazardous materials, the teacher shall be required to complete a documented hazard risk assessment (see Hazardous Materials, pages 186–188), provide a safety briefing to students, provide adequate personal protective equipment, and place a safety barrier, when required by 14.4.2.1.3, between students and the demonstration or experiment to prevent personal injury.

- A second means of access to an exit shall be provided from a laboratory work area if a laboratory unit exceeds 93 m^2 (1000 ft.) or a hood in a laboratory work area is located adjacent to the means of exit access.

NEW

- **Emergency Plan:** Plans for laboratory emergencies shall be established for all new and existing laboratories. The emergency plan should be part of the School Safety Plan (https://infohub.nyced.org/nyc-doe-topics/students-and-families/safety-and-emergency-preparedness/emergency-readiness) and shall include the procedures to be followed in the event of a fire, or chemical emergency as follows:

  1. Procedures for sounding the alarm;
  2. Procedures for notifying and coordinating with the fire department or other response agencies;
  3. Procedures for evacuating and accounting for personnel, primary and secondary routes as applicable;
  4. Procedures and schedules for conducting drills;
  5. Procedures for shutting down and isolating equipment under emergency conditions to include the assignment and personnel responsible for maintaining critical functions or for shut down of process operations;
  6. Appointment and training of personnel to carry out assigned duties, including steps to be taken at the time of initial assignment, as responsibilities or response actions change, and at the time anticipated duties change;
  7. Aisles designated as necessary for movement of personnel and emergency response;
  8. Maintenance of fire protection equipment[1] and safe procedures for startup following the abatement of an emergency.

1 Custodial Responsibility

- All laboratory users, including, but not limited to, teachers and lab specialists, shall be trained on the emergency plan prior to laboratory use and at least annually thereafter on the emergency plan. Records for such training shall be maintained in accordance with FC107.7 by the principal.
- If laboratory exhaust ventilation is out of service or inoperable, all laboratory operations involving chemicals shall be suspended until the deficiency is corrected. All hazardous materials shall be secured safely or removed from the laboratory until the time that the deficiency is corrected. Inoperable exhaust ventilation should be reported to the immediate supervisor.
- All activities inside the hood shall be suspended immediately following the discovery of deficiencies that cause the hood to perform outside the limits established by regulatory authority requirements and/or nationally recognized standards.
- Schools should adhere to the FDNY permitting process for chemical store rooms and labs. More information on the permitting process can be found at https://www.uft.org/files/attachments/fire-code-requirements.pdf and https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d15-noe-study-materials.pdf
- Containers of materials that become hazardous during prolonged storage shall be dated by the teacher or lab specialist **when they received the item** AND the date **when the container was first opened** in the laboratory chemical inventory. Such materials shall be properly managed **and disposed of according to the expiration date**, and recommendations on the label.
- Storage of chemicals in the fume hood is prohibited. Schools seeking exceptions to this rule so as to be able to store chemicals in the fume hood for a prolonged period of time for an experiment need to obtain permission from the Fire Department.
- Chemical quantities outside of storage shall be maintained at the lowest possible level necessary for the work performed.
- Handling and storage of chemicals shall conform to the manufacturers' recommendations and safety data sheets.
- Waste chemicals **shall not** be combined or mixed with other waste chemicals unless they have been evaluated for compatibility by a qualified and trained person. Examples of qualified and trained personnel include a D-14 or D-15 certificate of fitness holder (or eligible candidate if they have yet to obtain their certificate), Chemical Hygiene Officer, Certified Industrial Hygienist, Certified Safety Professional or hazardous waste disposal company professional.
- Chemical waste containers shall be labeled in accordance with the regulations of the New York State Department of Environmental Conservation.
- Liquid waste containers stored in laboratory work areas shall not exceed 20L (5 gal).
- Flammable and combustible liquid waste quantities shall not exceed 5 gallons.

- Waste quantities shall be included in the maximum allowable quantity for the laboratory unit.
- Laboratory operations using open flames shall be performed in accordance with the following requirements:

  1. Whenever possible, alternative methods to the use of open flames, such as heating mantles, hot plates, glass bead sterilizers, or infrared loop sterilizers, shall be used.
  2. Tubing connecting a gas supply to a torch or Bunsen burner shall be in good condition, compatible with the gas being used and rated at least 150 percent of working pressure. Tubing connections shall be gas-tight at the gas supply and the torch/burner. Prior to each use, all connections shall be verified for tightness.
  3. If open flame operations are performed outside a hood, operations shall not be conducted under shelves, cabinets, or other overhanging equipment.
  4. Combustible materials shall be kept at least 0.610 m (2 ft.) away for the open flame.

- Graphic systems used to identify hazards shall comply with ANSI Z535.1. *Safety color core*; ANSI Z535.2, *Environmental and Facility Safety signs*; ANSI Z535.3, *Criteria for Safety Symbols*; and ANSI Z 535.4, *Product Safety Signs and Labels*.

NEW

- **Hazards Risk Assessment:** Prior to teachers or lab specialists performing demonstrations or students conducting experiments using hazardous chemicals, (See Hazardous Materials, page 186 through 188) a documented hazard risk assessment shall be performed. A hazard risk assessment is a written document prepared by a qualified person, and shall include all of the following:

  1. An evaluation of the hazards of the demonstration or experiment
  2. Appropriate personal protective equipment required;
  3. Emergency procedures;
  4. Safe work procedures; and
  5. Waste disposal procedures.

- Whenever teachers are performing demonstrations or students are conducting experiments using hazardous materials, the teacher shall be fully familiar with the hazard risk assessment, provide a safety briefing to the students, and insure that adequate personal protective equipment has been provided and is being properly used, and ensure the safety barriers are in place.[2]
- Supervision – Educational laboratory units and instructional laboratory units shall be under the direct supervision of a teacher while the laboratory is in operation.
- Teachers in teaching labs shall be trained and knowledgeable in fire safety procedures, emergency plans, the hazards present in the lab, the appropriate use of personal protective equipment, and how to properly conduct a hazards risk assessment.
- In educational and instructional laboratories where experiments are conducted by students, the teacher shall be responsible for conducting a safety briefing prior to the start of each experiment to review the hazards of the chemicals used, the personal protective equipment required for the experiment, and a review of the emergency procedures.
- Bulk quantities of chemicals shall be stored in a locked room outside the classroom in educational laboratories. Chemicals stored and in use in an educational laboratory shall be limited to the amount needed for daily use in the laboratory. Chemicals stored in an educational laboratory shall be kept in an appropriate, locked cabinet except for the amounts actually used during an individual class session.
- Quantities of chemicals in an instructional lab shall be limited to the lowest possible necessary and in no case shall exceed the pre-laboratory unit quantities specified in 10.1.1[3] or the maximum allowable quantities specified in the Fire Code and the Building Code.
- Dispensing of bulk quantities of chemicals for an experiment or demonstration shall be performed in a prep room outside of the classroom.
- For existing educational and instructional laboratories that do not have a separate preparation room, the dispensing of bulk quantities of chemicals for experiments or demonstrations shall be performed prior to the arrival of the students in the classroom.
- The minimum amount of chemical(s) needed to perform the experiment or demonstration shall be transferred to a small, appropriately labeled, sealable bottle(s) or dropper bottle(s).

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2 12.3.2.1.3 (NFPA 2015) the shield shall be at least 0.610m (24 in.) and shall wrap 180 degrees around the hazard or extend at least (0.305m (12 in.) beyond the hazard in both directions.
12.3.2.1.4 Experiments or demonstrations involving chemicals that are performed outside a fume hood where a shield is not utilized shall be performed in a location that is at least 3.05 m (10 ft.) from students.

3 The density and total amount of flammable and combustible liquids, including waste in laboratory work areas and in the laboratory unit outside the flammable liquid storage rooms shall not exceed 4L per 9.3m2 of the laboratory unit.

- Experiments or demonstrations shall be performed in a location that does not block access to the means of egress form the laboratory work area.
- Experiments or demonstrations that involve or produce hazardous quantities of fumes, vapors, particulates, or gases shall be performed in a chemical fume hood or other ventilation device adequate to capture the materials.

NEW

- Experiments or demonstrations involving chemicals that are performed outside a fume hood where the separation distance of 10 feet is not possible shall be performed behind an impact-resistant plastic or tempered-glass safety shield.

1. The shield shall be at least 0.610m (24 in.) high and shall wrap 180 degrees around the hazard or extend at least 0.305m (12 in.) beyond the hazard in both directions.
2. The shield shall be secured to the work surface with bolts or clamps to keep it in place.

In cases where no safety shield is available, teacher may elect to substitute videos for live demonstrations.

- Experiments or demonstrations involving chemicals that are performed outside a fume hood where a shield is not utilized shall be performed in a location that is at least 3.05 m (10 ft.) from students.
- Experiments or demonstrations using flammable liquids and open flames shall be performed by a licensed chemistry teacher.

NEW

- The lab shut down procedures during an emergency evacuation must be included in the addendum section of the School Safety Plan.

- Custodial Record-Keeping must include the following: showers, eyewash stations, fire extinguishers, fume hoods, sprinkler systems
- Fume hood has to have an exchange rate (velocity) of 80–120 linear feet per minute (FPM)—if it does not it will be shut down. Also shut down if sash is not working or glass is cracked.
- Correct cabinets (see Chemical Storage and Disposal on page 82) have to be used for flammables, corrosives, and volatile liquids and incompatible chemicals shall not be stored in the same cabinet.
- Liquid Storage room for large quantities, not to exceed 300 gallons of chemicals or five gallons per square foot of floor area.

- Fixed overhead or flexible handheld showers shall be provided where more than 5 gallons of corrosive or flammable liquid are stored, handled or used. The shower must be within 25 ft. of the laboratory unit and storage door and maintained and accessible at all times. It should be inspected on a semi-annual basis.
- Anything that is deemed inoperable should be reported to the supervisor immediately.
- It is unlawful for any non-production[4] laboratory to store, handle or use any of the following:
  - **a.** Explosives
  - **b.** Unclassified detonable organic peroxide
  - **c.** Detonable pyrophoric material
  - **d.** Detonable unstable (reactive) material
  - **e.** Detonable water-reactive material.
  - **f.** Class 4 unstable (reactive) material
  - **g.** Class 4 oxidizing material
  - **h.** Below grade flammable gas

4 A non-production chemical laboratory is a building or portion of a building where chemicals or gases are stored, handled or used on a non-production basis for testing, research, experimental, instructional or educational purposes.

Safety During Outdoor or Offsite Investigative Activities

Field Trips

A well-organized field trip with carefully planned activities greatly enhances the safety and educational value for all participants. However, field trips come with inherent risks, and care must be taken to ensure that all field trips comply with Chancellor's Regulation A-670: School Trips and that site-specific safety measures are taken.

The following strategies can make field trips safer:

- Plan the logistics of your trip in advance, including:
  - Transportation to the field trip site: See the NYCDOE Office of Pupil Transportation's Resources for Schools page for more information on reserving a bus or obtaining a Certificate of Free Transportation to travel by subway.
  - Providing food: To provide lunch on the trip, you can request that your school cafeteria staff prepare bagged lunches for your students to take on the trip. Make this request at least two days before your trip to give your cafeteria staff adequate notice to prepare your lunches.
  - Visit the field trip site prior to the trip. Note potential hazards or situations that may be challenging for specific students en route to the site and at the actual site (e.g., loud noises, narrow pathways). Share this information with your students before taking the trip. If going to a site that is outdoors (e.g., a park, a field research site), it is also good practice to take note of the closest bathroom facility should it be needed during the trip.
  - Develop and distribute a permission slip and a list of appropriate clothing and essential supplies or equipment (e.g., water bottle, bagged lunch) to be brought on the trip. The permission slip and clothing/equipment information should be distributed to parents and guardians at least two weeks in advance of the trip. Parents/guardians should be notified of trip details and any related costs for trip activities on the permission slip form. A sample permission slip form can be found in the Chancellor's Regulation A-670 materials; you should also check with your school to see if there is a school-specific permission slip form that you should use.
  - Familiarize students with all the potential dangers related to the trip, such as:

- deep or rapid water hazards
- poisonous plants or potentially dangerous animals
- risks associated with mites, ticks, and other insect stings
- not turning over logs or rocks unless given permission
- never tasting, touching, or smelling anything without permission or specific instruction

— It is suggested that you prepare and carry with you:

- a first aid kit if one will not be available at the site.
- tissues, band-aids, and wet wipes
- for outdoor field trips in cold weather, a few additional jackets/sweatshirts and hats for students who do not bring enough warm clothing
- an extra water bottle or two, particularly on hot days

- Follow all field trip guidelines as outlined in Chancellor's Regulation A-670: School Trips.

— Request written permission for the trip from the school administration and obtain written parental consent for all students who will be going on the field trip.

— Plan for and arrange adequate adult supervision. For routine day trips within New York City:

- For elementary and middle school students, at least one (1) staff member and two (2) additional adults are required for up to thirty (30) students.
- For high school students, at least one (1) staff member and one (1) additional adult are required for up to thirty (30) students. The required staff member must be a teacher or a supervisor. The other adult(s) may be a parent volunteer or a member of the instructional staff (e.g., teacher, dean, guidance counselor, social worker) or a paraprofessional or school aide.
- At the elementary level, for each additional ten (10) students, an additional adult is required. At the middle and high school levels, for each additional fifteen (15) students participating, an additional adult is required.

- Establish and review rules for safe conduct prior to the trip.

— Organize a buddy system. Students who bring cell phones on trips are encouraged to exchange numbers with their buddy.

— If your field trip allows students to disperse from one another for a portion of time (e.g., to explore a museum gallery), make sure that students are given clear directions about where and when to reconvene.

— Make sure that students know what to do (e.g., go to a pre-identified rendezvous location, call a teacher or field trip buddy) if they become separated from the group during the trip.

- Instruct students as to proper behavior on transportation vehicles. Check that all students are safely seated and that all seat belts have been secured.
- Consult with authorities to find out if you are allowed to collect specimens. If specimens are collected, try not to disturb the ecological system. Have an adequate number of unbreakable containers (i.e., plastic containers or cups) for student collection.
- Conduct a post trip check for mites and ticks, bites, scratches, and cuts, etc., when appropriate.

Fieldwork

Many science teachers will have students engage in fieldwork, particularly in units that focus on ecology, environmental science, or human impact on the environment. The guidance below outlines basic safety when conducting research or encountering living organisms in the field.

Marine and Freshwater Sampling

Field ecology activities may have students collect and examine water or organisms that live in shoreline or marine environments through activities such as seining. Students should be cautioned against tasting or eating any organism collected in the field. All animal specimens that are collected should be quickly examined or photographed and returned to the water as quickly as possible. Students should be warned of the hazards involved in the collection and handling of specimens with claws, spines, or poisonous secretions, such as crayfish, sea urchins, and jellyfish. Some students may be hypersensitive to stings by aquatic organisms. Proper footgear (boots, sneakers, or waders) should be worn when collecting specimens; students should not wear sandals or other open-toed shoes.

Teachers should be aware of water depth, tides, and currents when planning any kind of activity that involves students wading into a body of water to collect specimens. This is particularly important in tidal bodies of water and/or when water is murky and it is difficult to see changes in depth. Students should be carefully chaperoned and should not enter water that is deeper than knee height at any time. Students who are uncomfortable wading into water must have an alternative way to participate on land.

Water

When collecting water samples from natural water sources, there should be close supervision. If it is necessary to enter the water, protective boots should be worn, and the water should always remain below the knees. If samples are collected from an elevated bank, a collecting device should be used that does not require stretching out over the water. Students should never work alone. Do not sample water that is stagnant or that contains known amounts of industrial effluent. In cases where water samples may contain sewage effluent or other possible contaminants,

students and staff should wear disposable nitrile gloves when handling specimens and should wash or sanitize their hands after sampling is completed.

Land Animals

Field studies of vertebrate animals should be limited to observational studies only. If engaging in an activity in which there is the possibility of handling terrestrial invertebrate animals, students should be cautioned against touching certain field animals because of the diseases they may harbor or the injury they may inflict with teeth, tails and claws. Students should only use appropriate tools or apparatus to handle animals in such situations. If a field trip involves going into tall grasses, fields, and woods, students should dress to prevent scratches and tick bites. This includes wearing caps or hats and dressing in light-colored, long-sleeved shirts and pants, and tucking the bottom of students' pants into their footgear. Advise students to tie back long hair. As explained in the Humane and Safe Treatment of Live Animals section on page 52, no field animals should be collected and taken home by students or brought into the classroom.

Plants

Before a field trip, students should be instructed on the identification and avoidance of poison ivy, poison oak, poison sumac, nettles, burrs, and thorns, if there is a possibility that they will be encountered (Refer to Cornell University Poison Plants Information Database, http://www.ansci.cornell.edu/plants/). On field trips, only allow students to pick or eat plants whose identity has been verified and where it has been confirmed that students are allowed to pick or eat. In lessons on flowers and molds, take care to prevent the excessive distribution of pollen or spores. Some students may be allergic to these materials.

Other Offsite Activities

Activities that involve students leaving their home (e.g., to observe wildlife in a local park) need to provide explicit guidance for how students can keep themselves and their belongings safe during such an activity. Students should inform an adult in their household of where they are going, and how long they anticipate being there; students should also bring a charged cell phone if they have one. Directions for such activities must clearly state that younger (K-6) students should always be accompanied by an adult when leaving home to engage in such an activity. Schools should refer to the NYCDOE At-Home Science Safety Contracts for Potentially Hazardous and Non-Hazardous materials for guidance and should ensure that they distribute this contract to students and families.

Student Research and Participation in

Science Fairs, Symposia, Journals, and other Public Events or Publications

Science fairs, symposia or expos provide an opportunity for students to conduct longer-term scientific or engineering design investigations and engage in the practices of science. Some schools hold their own symposium or fair; students may also choose to participate in fairs and competitions that are run by external organizations.

As in the science classroom, students engaged in science projects must follow appropriate safety regulations. If students are presenting their work at district, regional, or national/international science fairs, they must also follow the rules and regulations of these fairs to ensure the safety of both the children and the community. Parents/guardians who are supervising their children's projects must also be aware of the safety rules and regulations, and teachers should distribute and collect a consent form for parents/guardians to review and provide informed consent for all activities that their child is engaged in during a long-term investigation and/or participation in a science fair, journal, or other external event or publication.

DOE Policy on NYC Public School Students Conducting Research in Schools

Increasingly, NYC schools are offering courses in behavioral science research, providing students with the opportunity to design and carry out research projects. The DOE's Institutional Review Board (IRB) affirms the importance of students learning about the principles of behavioral science research and ethical treatment of human research subjects.

Based on previous experience in the IRB with research conducted by students in NYC public schools, such research does not require DOE IRB review/approval; rather, the responsibility for reviewing students' research projects, monitoring the development of research protocols, overseeing data collection processes, and ensuring data security and disposal, should reside with a school's research course instructors and/or a faculty research review committee/school-based IRB.

The DOE IRB has developed the following guidelines to assist schools overseeing student research and data collection. These guidelines embody many of the federal regulations governing research with human subjects as well as policies and procedures that reflect the jurisdictional concerns of the NYC DOE.

- Students may conduct research with other students in their own school or at other schools, provided that they submit a research proposal to their teacher outlining:
  - the research topic;
  - design/methodology;
  - risks/benefits;
  - measures that will be taken to protect the privacy and confidentiality of research participants;
  - who will have access to the data;
  - how the research findings will be used.
- Students conducting research with other students must make it clear that participation is voluntary and participants can withdraw at any time or choose not to answer any questions with which they are uncomfortable.
- Students conducting classroom observations should obtain the consent of the classroom teacher(s). Data collection should not distract from classroom instructional time.
- Survey instruments should include a check box for students to indicate they have agreed to be surveyed, thus protecting the anonymity of respondents. When a research project involves a pre- and post-test, a list of the names of respondents to the pre-test and the ID numbers assigned to them should be stored in a secure location. At the conclusion of the post-test, all names should be removed from survey instruments and replaced with ID numbers.
- When interviews or focus groups are included in a student's research project, an assent form (for students 17 and under) or consent form (for students 18 and over) to be signed and dated by the research participant and by the student conducting the research should be provided.
- The names of students participating in interviews and focus groups should be replaced with ID numbers on transcripts of interviews and focus groups to ensure the privacy and confidentiality of research respondents.
- Interviews and focus groups may be audiotaped with the permission of participants.
- Videotaping public school students for research purposes is prohibited by DOE policy.
- All data collected from research participants should be reported anonymously.

- Student researchers should refrain from collecting information that might expose study participants to (1) psychological risk such as discomfort, embarrassment, worry or anxiety; (2) social risk such as damage to reputation; (3) risk of breach of confidentiality or anonymity. Examples of this type of information would be religious affiliation, sexual identity and behaviors, use of alcohol, drugs, illegal behaviors, and other information that might be self-incriminating.
- Student researchers should not use deception in recruiting other students to participate in their research. The purpose of the research should be clearly stated.
- Teachers and students should ensure that all hard copy and electronic data are securely stored to prevent unauthorized access, disclosure, or loss. Hard copy records should be stored in a manner that limits access to only authorized individuals. For example, filing cabinets/areas should be locked and placed in secured/locked rooms.

Questions about these guidelines are welcome and should be directed to IRB@schools.nyc.gov.

Many external science and engineering fairs and journals require proof of additional review and approval of research involving human test subjects. Teachers and students should carefully review all rules and regulations for any fair, journal, or other event or publication that they plan to submit research to.

Information about Student Research Projects Involving Animal Test Subjects

All research projects involving animals that are not conducted in an external research setting are subject to the NYCDOE policies around use of vertebrate or invertebrate animals in scientific investigations. This includes projects that are performed at a school, a student's home, or in the student's local community. For more information about regulations regarding the use and treatment of animals in scientific investigations, see Humane and Safe Treatment of Live Animals on page 52. Individual schools must carefully review all student research proposals involving animals to ensure that they comply with all humane treatment requirements and to ensure that there is a compelling scientific rationale for any student research project involving invertebrate or vertebrate animals.

Students who are doing scientific research involving animals at an external research institution (e.g., an institution of higher education, a zoo or aquarium) may have to have their research proposal reviewed and approved by that institution's Institutional Animal Care and Use Committee (IUCAC). Students and their external research advisors should check with the external institution for specific regulations.

Many external science and engineering fairs and journals require proof of additional review and approval of research involving animals. Teachers and students should carefully review all rules and regulations for any fair, journal, or other event or publication that they plan to submit research to.

Information about Student Research Projects Involving Potentially Hazardous Materials

All student research projects involving potentially hazardous materials such as microbes, chemicals, or reagents, or equipment are subject to the NYCDOE policies around use, storage, and disposal of potentially hazardous materials, including microbes and potential biohazards, chemicals, and equipment. This includes projects that are performed at a school, a student's home, or in the student's local community.

Individual schools must carefully review all student research proposals involving potentially hazardous materials to ensure that they comply with all safety requirements and to ensure that there is a compelling scientific rationale for the use of potentially hazardous materials.

Students who are doing scientific research involving potentially hazardous materials at an external research institution (e.g., an institution of higher education, a zoo or aquarium) may have to have their research proposal reviewed and approved by that institution's Biosafety committee. Students and their external research advisors should check with the external institution for specific regulations.

Many external science and engineering fairs and journals require proof of additional review and approval of research involving potentially hazardous materials. Teachers and students should carefully review all rules and regulations for any fair, journal, or other event or publication that they plan to submit research to.

About the NYCDOE Institutional Review Board

The Institutional Review Board (IRB) is an administrative body established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of the institution with which it is affiliated.

The IRB is charged with the responsibility of reviewing, prior to its initiation, all research (whether funded or not) involving human participants. The IRB is concerned with protecting the welfare, rights, and privacy of human subjects. The IRB has the authority to approve, disapprove, monitor, and require modifications in all research activities that fall within its jurisdiction as specified by both the federal, state, and city regulations and institutional policy. The NYCDOE has two constituted IRBs. Established in 1980, each IRB is composed of 15 members of varying backgrounds and is required to provide complete and adequate review of human research and its institutional, legal, scientific, and social implications. Each NYCDOE IRB also includes at least one member who is not affiliated with the institution and one member who is not a scientist.

All student research requires a designated faculty advisor and must be carried out under direct faculty supervision and in accordance with all applicable federal, state, city, and institutional rules and regulations governing research with human subjects. For more information about the NYCDOE IRB, see https://infohub.nyced.org/working-with-the-doe/research-irb/doing-research-in-new-york-city-public-schools or email IRB@schools.nyc.gov.

Additional Safety Precautions for

Life Sciences, Earth Science, Chemistry, and Physics

The following directions primarily pertain to materials and procedures that are used in specific disciplines in secondary science; however, these should apply in any course or situation in which these materials or procedures are used.

Life Science/Biology

Dissections: See Dissection and Dissection Alternatives on page page 58 and Best Practices for Dissections, page 59.

Microscopy: See Microscopes on page 45.

Microbiology and Biohazards: See Safety with Microbiology and Biohazardous Materials on page 62.

Plant Care in Science

Many teachers have plants in their science classrooms for both decorative and educational purposes. You should be aware that not all plants have been analyzed for their toxicity; therefore, several practical suggestions for safely working with plants are listed below.

Instruct students not to place any part of a plant in their mouths without your permission. Many common plants such as daffodil bulbs; foxglove leaves; rhododendron leaves, stems, and flowers; and certain mushrooms may be toxic or fatal if eaten. Refer to the **Cornell University Poison Plants Information Database**: http://www.poisonousplants.ansci.cornell.edu/php/plants.php.

You should check student health records prior to introducing specific plants to the science classroom environment. Some children may experience allergic reactions to specific plants; in these situations, you can ensure that the student does not sit near or handle the plant, or you can remove the plant from the classroom.

Test for Simple Sugar

Simple sugar tests involving Benedict's Solution require heating. See Heat-Generating Sources for more information on safe heating procedures.

Benedict's Qualitative Solution/Powder presents no additional hazards.

Benedict's Quantitative Solution contains potassium thiocynate, which is moderately toxic. Caution students not to ingest any of this solution, and to wear gloves or wash their hands thoroughly after using this solution to quantify the amount of sugar in a food.

Test for Protein

Biuret solution contains 10% sodium hydroxide, which is very corrosive to the eyes and skin. Students and staff MUST wear safety goggles when working with Biuret solution. Gloves are also recommended when using this solution to test for proteins. Immediately wash off any Biuret solution that splashes on a student's skin with water. **Do not substitute more hazardous protein identification tests, such as the Xanthoproteic test, which uses heated concentrated nitric acid, or the Ninhydrin test, which employs triketohydrindene, in place of the Biuret test**.

Bromthymol Blue as a Carbon Dioxide Indicator

Bromthymol blue is a popular indicator that turns yellow in the presence of carbon dioxide. When testing for carbon dioxide, caution students to gently blow through a straw to exhale into a solution containing bromthymol blue. Tell them that they should never ingest or inhale this solution. Students should wear protective goggles while performing this activity.

Provide individual straws or mouthpieces for students who are asked to blow into tubes, balloons, or plastic bags. Students should never share straws or mouthpieces. Have a container with 10% bleach solution available for used straws or mouthpieces.

Investigations of Skeletal Anatomy

If you are using chicken bones to demonstrate the skeletal system, bones, ligaments, and joints, make sure that all of the meat is removed from the bones. Soak the bones in a bleach/water solution for five days prior to use.

The use of owl pellets is acceptable if the pellets were purchased from a reputable NYCDOE vendor. Before starting, make sure that the students are not allergic to feathers or fur as the content of the owl pellet usually contain these contents.

Molecular DNA Analysis: Gel Electrophoresis

Gel electrophoresis activities can be used to illustrate techniques and applications in biotechnology. However, gel electrophoresis presents certain hazards, and therefore precautions should be taken. Be sure to review the safety rules below with students before engaging in any gel electrophoresis activities. Additionally, make sure to review and follow the manufacturer's instructions as outlined in the manual for the specific gel electrophoresis apparatus that you are using. Many reputable science vendors offer gel electrophoresis tools and kits that have been especially designed for, and are compliant with, safety requirements for a K–12 setting; use these kits if possible.

1. Goggles must be worn during gel electrophoresis procedures. Laboratory coats/aprons (or other protective clothing) are also suggested. Gloves should be worn to minimize exposure to chemicals and to ensure that the DNA is not degraded by nucleases found on the skin.

2. **Setup:** Make sure the gel electrophoresis apparatus is disconnected from the power supply before adding or loading the gel. The apparatus should remain disconnected until it is time to run the gel sample. Before turning on the power pack for the gel electrophoresis procedure, make sure the box is covered to prevent shocks. Students should faithfully follow the directions for connecting the leads to the gel electrophoresis chamber and never use voltage above those recommended. Turn off the power before disconnecting the leads or removing the cover of the electrophoresis chamber.

Note: *Teachers should closely supervise students during all aspects of gel electrophoresis set-up and sample loading, especially if students are new to this process.*

3. **Buffers:** Use the safest gel electrophoresis buffer available; buffer solutions appropriate for secondary science settings are available at reputable science vendors. Check the SDS (Safety Data Sheets) to decide which buffer is safest to use. These documents are with your school's Site Safety Officer.

4. **Gels:** Use agarose gels. The use of polyacrylamide gels is not allowed as acrylamide is a potentially serious health hazard (neurotoxin) and is possibly carcinogenic to humans.

5. **Stains:** Methylene blue and its oxidation products, known as thiazin dyes, are currently considered the safest dyes to stain DNA and RNA. Students should wear gloves if using methylene blue or other stains and should be warned that it can stain their clothing and shoes—lab coats or aprons are recommended. Do not use ethidium bromide to stain DNA; it has been shown to be a potential mutagen and potential carcinogen and is not safe for K–12 settings.

6. **Disposal and Clean Up:** Agarose gel should be disposed of by throwing it in the trash; not down the drain, as that will result in clogs. Disposable plastic pipettes and pipette tips should also be thrown into the regular trash. Students should make sure to properly unplug and clean and dry all gel electrophoresis apparatuses at the end of a laboratory activity.

Bacterial Transformation

Bacterial transformation lab investigations such as those used in AP Biology should only use cultures of microbes that have been specifically developed for a K–12 setting. For more information, see Safety with Microbiology and Biohazardous Materials on page 62.

Other Biotechnology Tools and Procedures

Schools offering advanced biotechnology or molecular biology classes may opt to use additional biotechnology tools (e.g., a thermocycler). Schools should follow all manufacturers' instructions for the safe operation of any tools or equipment and should use the safest reagents possible.

Use of Fluid-Preserved Specimens of Animals or Tissues that are Encased in a Jar or Closed Container (also known as "Embalmed Specimens")

There are many compelling alternatives to observation of fluid-preserved specimens, including interactive digital activities, diagrams, and videos, and schools are encouraged to use these alternatives in lieu of observing preserved specimens whenever possible. Schools that have a truly compelling reason for ordering new fluid-preserved specimens should order specimens preserved in a non-carcinogenic and safe formaldehyde substitute. Fluid-preserved specimens should only be observed inside of their container; do not open jars or containers when students are present.

Specimens preserved in formaldehyde, formaldehyde-related chemicals, or solutions of unknown chemical composition should not be used, as formaldehyde, formalin, and related compounds are suspected carcinogens and are not allowed in secondary school settings. If the liquid in a specimen jar is a goldish or tan color, it is likely an older, formalin-based solution that should not be in the school. Many of these "museum mount" specimens were ordered in the 1970s and 1980s, and still exist in schools today. Please arrange to have these specimens removed from your school; they should be disposed of safely in accordance with the policies of the NYCDOE's Division of School Facilities. (See Hazardous Chemicals section on page 186 for more information.) Phenol also is a strong irritant to the skin, and is toxic if ingested, inhaled or absorbed through the skin.

If a specimen jar breaks, contain the spill with absorbent material, such as paper towels or sand. Wear gloves to clean the spill. If you do not know the contents of the preservative liquid in the jar, absorbent material should be considered hazardous waste and must be treated accordingly. See Chemical Spills on page 81 for more information.

Earth Science

Rocks and Minerals

Acid Tests

Most chemical experiments with naturally occurring minerals involve the application of dilute hydrochloric acid to the specimen (most often to identify calcium carbonate, marble, and limestone). See the Acids and Bases section on page 80 for additional information on safety regarding acids and bases.

As gases may be released when dilute hydrochloric acid is applied to mineral specimens, such experiments should be performed in well-ventilated areas or in the fume hood.

Cleavage/Fracture Tests

Wear approved safety goggles (ANSI Z87.1-2015 Standard) when breaking rocks or mineral samples with a hammer. Students should be told of the dangers from flying particles from a work group other than their own. When breaking rocks, care should be taken to ensure that other students are not within range of flying particles. Rocks should be held firmly with long-handled pliers to avoid injury to the fingers and prevent movement. Students cannot handle or be exposed to asbestos-bearing minerals, such as tremolite and chrysolite.

Hardness Tests

Students must always be properly instructed on the proper technique used to determine hardness of a mineral. When scratching one mineral sample against another, care should be taken not to cut or gouge fingers and hands. Sharp, angular specimens should be handled with gloves.

When testing hardness by scratching a glass plate, students should not hold the glass plate in the palm of their hand. The glass plate should be thick and suitable for this purpose (NOT a microscope slide), placed on a flat surface, and scratched away from the body. Goggles should be worn in case the glass breaks and splinters, or if a piece of the mineral chips away.

Ultraviolet Light Used for Viewing Fluorescent Minerals

Any radiation with a wavelength shorter than 250nm should be considered dangerous. This includes the ultraviolet light (black light) used in some mineralogy laboratories. Never remove the protective shield in front of a UV source. Safety glasses with UV-absorbing lenses should be provided, and care must be taken that students do not burn their skin with the ultraviolet light.

Erosion/Deposition

Stream Table

Stream tables can have electric motors attached in order to pump water. Precautions should be taken to avoid spillage of water onto the electrical contacts. All electrical equipment should be regularly inspected for frayed power cords or damage to the housing.

Due to the possible inhalation of dust, diatomaceous earth should be avoided in stream tables. Diatomaceous earth contains amorphous diatomaceous silica and crystalline silica. Breathing crystalline silica over a prolonged period of time can cause silicosis.

Meteorology

Air Pressure

Air under pressure can cause explosions or make objects or parts of objects move suddenly and violently. Containers that are to be pressurized or evacuated must be able to withstand the differences in pressure without violently shattering. Glass containers should not be subjected to differences in air pressure unless they were designed for such purposes. Students should always wear protective goggles when performing air pressure experiments.

Magdeburg hemispheres are often used to demonstrate the force exerted on a surface by air pressure. When attempting to pull apart the hemispheres, students should be warned that if they are braced and pulling hard and the hemisphere gives way, they could go flying into objects behind them. Do not release the vacuum inside the hemispheres while students are pulling on them.

Confirm that any barometers, sling psychrometers, or thermometers do not contain mercury—any apparatus containing mercury should be disposed of using the Hazardous Materials processes outlined on page 234.

Astronomy

Lasers

(See Laser Safety in the *Light and Lasers* section, page 73).

Viewing the Sun

Light from the sun, including during eclipses of the sun, is harmful when viewed directly, and students must be clearly instructed not to look at the sun directly or through lenses, even momentarily. Watching a video is the safest way to view a solar eclipse. If viewing an eclipse in person, students can project images of the sun by projecting images onto a piece of paper through a pinhole or a convex lens, or the eclipse can be viewed through special eclipse glasses, compliant with the ISO 12312-2 international safety standard for such products.

Earth Science Performance Exam

The Earth Science Performance Examination (Part D) is administered in conjunction with the written Earth Science Regents examination. Part D is composed of the following three stations:

- Mineral and Rock Identification
- Locating an Epicenter
- Constructing and Analyzing an Asteroid's Elliptical Orbit

The following precautions should be included.

- Ceramic streak plates that are used to test hardness in mineral and rock identification tests should be handled carefully, as they can break if dropped.
- When plotting earthquake epicenters, safe drawing compasses must be used. Students should never use sharp pointed compasses.
- Students should be instructed to use the pushpins safely.

Physics

ELECTRICITY: See Equipment and Supply Usage and Storage on page 40.

LIGHTS AND LASERS: See Light and Lasers, page 73.

MASSES, WEIGHTS, AND PROJECTILES

1. No masses of weights of more than 500g should be given to the students. If heavier masses are required, then two or more masses of 500g each can be used. A combination of masses like 50g, 100g, or 200g is suggested.
2. Students and teachers should exercise precautions when engaging in any kind of laboratory that uses projectiles or falling objects (e.g., demonstrations of Hooke's Law or Newton's Laws). Ensure that the anticipated path of the projectile or falling object is free of humans and other living or non-living things that could be harmed if hit by a falling object; furthermore, make sure that there is nothing present that a projectile or falling object could ricochet from. Select projectiles and falling objects that are lightweight to minimize the forces exerted upon projectile launch and collision with a landing surface. When possible, provide a cushioned landing surface to absorb the shock of collision and to prevent the projectile or falling object from bouncing.
3. If paper airplanes are used, note that their sharp noses can cause damage if flown into an eye. Students must launch their airplanes in a single direction away from other students. All students should wear eye protection.
4. Rockets containing combustible chemicals are both illegal and dangerous and cannot be used by students or staff in New York City schools. This includes the solid rocket fuel engines, which are commercially available. Rockets that use compressed air and/or water pressure are permissible but must be used with caution as outlined below.
   - Use lightweight, non-metal parts for the nose, body, and fins of the rocket.

— Launch rockets outdoors, in an open area and in safe weather conditions, with wind speeds no greater than 20 mph. Rockets should be launched using a launch rod, tower, or rail that is pointed within 30 degrees of the vertical to ensure the rocket flies nearly straight up. Do not launch rockets at targets such as tall buildings, power lines, or near airplanes.

— Students must wear eye protection (ANSI Z87.1 – 2015 Standard) when working with pressurized water or air. Air/water pressure should not exceed 100 lbs/square inch.

— Rockets must not be pressurized until the area around the rocket is clear and the rocket is aimed away from students.

Pressurized and Vacuum Systems

Vacuum and pressurized systems are subjected to the pressures on and in them and can implode or explode if not they are not operated and maintained properly. This can result in flying glass, spattering chemicals, or fire. To minimize potential hazards, teachers should consider alternatives such as videos to replace live demonstrations of vacuum or pressurized apparatus.

All parts of any pressurized system, including pressurized chambers, valves, and vacuum lines should be regularly and carefully inspected to ensure they are in good working condition prior to use. Any pressurized apparatus should be stored in a cabinet in a preparation room when not in use.

1. If using a vacuum pump or pressurized system, ensure that proper connective hoses and vacuum plates are used. Any glassware (e.g., a bell jar) should be specifically designed to withstand the pressures of vacuum or pressurized systems; do not substitute with glassware not designed for this purpose. Students should stand a safe distance from a fume hood when observing pressurized or vacuum systems. Inspect all components of vacuum or pressurized systems to ensure they are in proper working condition prior to use.
2. When using a vacuum pump, be sure to vent exhaust into the fume hood. Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Mechanical vacuum pumps should not be used for distillation or concentration procedures using volatile materials. Use a water aspirator instead.
3. Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
4. Check any apparatus that generates pressure via steam in advance to assure that excessive pressures cannot develop before the steam is emitted. Check safety valves on commercial apparatus, such as pressure cookers and model steam engines, in accordance with the manufacturers' instructions. When generating steam in a test tube or flask, do not insert the stopper tightly or wire it down. Caution students to direct steam outlets away from anyone's face. In set-ups involving the use of two or more valves, one must always be kept open.

MAGNETISM

1. Avoid heavy and very powerful magnets. A powerful magnet can attract any loose steel object or fly to any stationary steel object hurting anyone in its path.
2. Avoid the use of iron filings that contain black iron powder. Black iron powder coming into contact with cuts can act as an irritant. Use instead magnetic chips or iron chips that are polished and free of dust. They can be purchased from science supply companies.
3. Safety goggles and disposable gloves should be worn while working with magnets and iron filings or chips.
4. Students should use long handled brushes to collect the iron filings or chips from the working area or lab bench. All equipment should be brushed until it is iron free.

APPARATUS

High Speed Rotating Apparatus

High-speed rotating apparatus should be used only by teachers for the purpose of demonstration; they should not be handled directly by students. Observe caution when using any apparatus that rotates at high speed. These include the Savart tooth wheel, siren disk, centrifugal hoop, and grindstones. Make certain that the safety nut is securely fastened and operate the apparatus at moderate speeds.

Tools

NEVER use a dull cutting tool. It may slip and cause serious injury. Cut away from yourself when using any sharp instrument. Cut sheet metal only with sharp shears. File the edges smooth using a file or emery cloth.

Rest hot soldering irons on metal stands to avoid burns and prevent fires. Use pliers or clamps to hold wires and metals for soldering. Soldering should be done in the fume hood to prevent accidental inhalation of soldering paste fumes.

See the Tools section for more information on safe use and maintenance of tools.

ELECTROMAGNETIC APPLICATIONS & MODERN PHYSICS

Electrostatic Generators

Electrostatic generators, such as Van de Graaff generators, are a real attention getter for students in the study of electrostatics. The following prudent safety procedures are in order, however:

1. The generator should only be operated by and under the direction of the teacher.
2. Electronic circuit or devices, such as cell phones, computers, and cameras can be permanently damaged by the machine's sparks. Keep them at least 50 feet (12 meters) away; ideally, store them in another classroom or office while operating the generator.
3. Always use a surge protector in line with the generator's power cord.
4. Students with epilepsy, heart or nervous system conditions, or pacemakers should never operate or be in the proximity of an electrostatic generator.
5. Never operate the generator near flammable or combustible materials.
6. Never leave the machine operating unattended.

Cathode Ray Tube

Cathode ray tubes are fragile and will implode when stressed. Computer monitors, oscilloscopes, and TV equipment should only be repaired by a licensed appliance repair person. Before making repairs, the equipment must first be disconnected from the 120-volt line and all high voltage capacitors. The picture tube shield must be discharged.

X-ray Tubes

X-ray tubes may be displayed but not used to generate X-rays. Crookes tubes should never be connected to voltages that are so high that the tubes produce X-rays. In case of doubt, always check with the tube's manufacturer.

Infrared Apparatus

When transmitting infrared radiation with parabolic reflectors or other focusing devices, caution students to avoid areas where concentrated beams can cause irritation or burns.

Chemistry

For chemical inventory and storage, see Chemical Storage and Disposal, page 82.

For safe practices using chemicals, see General Safety with Chemicals, page 76.

For safe practices regarding chemical spills, see Handling Chemical Spills, page 81.

For safe practice regarding chemical disposal, see Chemical Storage and Disposal, page 82.

Spectroscopic Analysis Using Flame Tests

It is recommended that teachers use spectrum tubes to show the properties of spectrum analysis. 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. These spectrum tubes and power supplies can be bought in most science warehouses.

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. In poorly ventilated or confined laboratories, flame tests should be performed in a fume hood. Never use methanol as an accelerant for flame tests.

The Rainbow demonstration is strictly forbidden. The ACS Committee on Chemical Safety's New and Improved Flame Test Procedure (https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/safetypractices/flame-tests-demonstration.pdf) offers a safer alternative. Teachers can also use videos of flame tests to illustrate concepts.

Chemicals Often Used in Flame Tests

Health/Safety #	Compound
1/0	Sodium Chloride (NaCl)
2/1	Strontium Chloride ($SrCl_2$)
3/1	Lithium Chloride (LiCl)
3/1	Copper Chloride ($CuCl_2$)
4/1	Barium Chloride ($BaCl_2$)

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

When performing flame tests, the nichrome wire or paper clip that is used should be held in a well-insulated holder or with long-handled pliers. The wire and holding device should be placed on an insulated mat and allowed to cool thoroughly before handling.

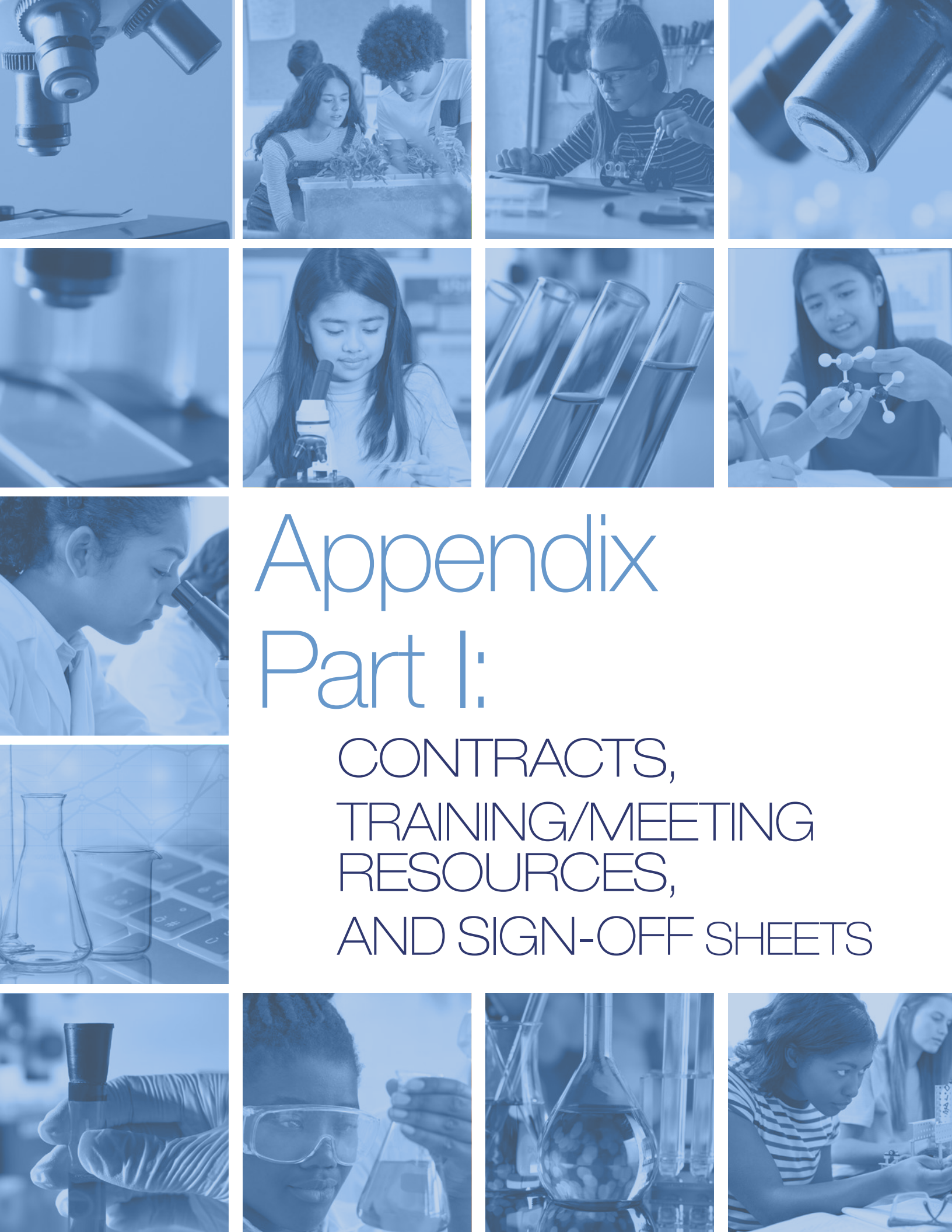
Goggles should be worn. An overloaded wire causes splattering and material can fall into the burner jets, causing blockage. Unknown chemicals should not be placed in the flame.

Health and Safety Data for Chemicals

The New York State Education Department has developed scales for the health and safety ratings of many chemicals. This is in compliance with the Federal OSHA standards. OSHA (Occupational Safety and Health Administration, www.osha.gov), NIOSH (National Institute for Occupational Safety & Health), and SDS (Safety Data Sheets) also list categories and levels of hazards for chemicals.

The National Institute for Occupational Safety and Health (NIOSH)) maintains a Pocket Guide to Chemical Hazards. The NIOSH pocket guide can be accessed as a PDF download or as a mobile app from the NIOSH website at https://www.cdc.gov/niosh/npg/default.html.

A table of restricted and banned chemicals that includes rationales for their restriction and guidance on purchasing, when allowed and appropriate, can be found in the List of Banned Substances, Equipment, and Experiments section of the *Appendix*.



Appendix Part I:

CONTRACTS, TRAINING/MEETING RESOURCES, AND SIGN-OFF SHEETS

a. Student Laboratory Safety Contract

***(NOTE:** These two pages should be duplicated and distributed to each student.)*

In the science laboratory, you will be carrying out laboratory activities that, while exciting and engaging, could be hazardous to the health and well-being of you and those around you if not done carefully and safely. This safety contract outlines some safety practices that you and your peers are always expected to uphold and follow. Your teacher will also provide specific instructions on how to carry out lab activities safety in the lab classroom that you're learning in and may also have additional safety instructions for specific lab activities. It is important to carefully follow any oral or written instructions that your teacher provides, and let your teacher know if you have any questions about any of their safety instructions.

The bottom portion of this contract requires signatures from you and your parent or guardian. After both of you have reviewed and signed this contract, it must be returned to your teacher so that you can participate in laboratory activities. Because laboratory activities are a critical component to nearly every science course, it is very important that you return a signed copy of this contract to your teacher at the start of your course. You should keep a paper or digital copy of this contract in your science notebook, Google Drive, or other location where you can refer to it easily, and you should review this contract prior to starting each new laboratory activity.

General Rules

1. Follow all instructions carefully. If you do not understand what you are expected to do, ask your teacher before proceeding.
2. Conduct yourself in a responsible manner whenever you are in the science laboratory. Activities such as running, horseplay, or pranks can create dangerous situations in a lab setting and are not allowed. Do not touch any equipment or chemicals until you are instructed to do so. Use care, courtesy, and common sense to help keep yourself and others safe.
3. Eating and drinking is not permitted in the laboratory. Do not use any glassware in the laboratory as a container for food or drinks. Keep your work area neat and clean. If available, wear a lab apron or coat.
4. Know where the safety equipment including the eyewash station, safety shower, fire extinguisher, and fire blanket, if present, are located. Notify your teacher immediately of any unsafe condition.
5. Use the fume hood when working with gaseous substances or substances that could give off fumes. Never put your head inside the fume hood.
6. If a fire drill occurs during a laboratory period, be sure to close all chemical containers and turn off any gas or electricity.
7. Keep your hands away from your eyes, mouth, and face when using chemicals or handling preserved specimens. Wash your hands with soap and water before leaving the laboratory.
8. Clean and return all equipment when instructed to do so by your teacher.

9. When handling sharp instruments, such as scissors and dissecting instruments, always carry them with the tips and points in a downward position. Always cut away from your body. Hold the instruments by their handles. If a sharp instrument falls off the table, do not try to catch it!
10. Wear goggles when instructed by your teacher. There are no exceptions to this rule. If you wear contact lenses, ask your teacher for non-vented safety goggles. If a chemical should splash into your eye or get on your skin, immediately flush the eye or skin with running water from the safety shower or eyewash station for at least 15 minutes. Notify your teacher at once.
11. Report any accident, including a chemical spill or breaking of equipment, to your teacher at once. Notify your teacher of any injury no matter how slight. This includes cuts and burns and chemical splashes on any part of the body.
12. Long hair, hanging jewelry, and loose or baggy clothing are hazardous in the laboratory. Long hair must be tied back. Hanging jewelry and loose clothing must be secured. No open-toe footwear (e.g., sandals) is allowed in the lab. Sneakers or closed toe shoes must be worn while in the lab.
13. Follow instructions for handling chemicals. Do not taste, touch, or smell any chemicals unless told to do so. Do not return unused chemicals to their stock containers. Dispose of all chemicals by following your teacher's instructions. Do not use the sink drains for mixing chemicals.
14. Follow instructions for the handing and dilution of acids and bases.
15. Follow directions for inserting and removing glass tubing from rubber stoppers.
16. Never handle broken glass with your bare hands. An adult should use a dustpan and a brush or broom for cleaning up broken glass.
17. Do not use glassware that is chipped or cracked.
18. Make sure your hands are dry before removing an electric plug from a socket. Report any damaged electrical equipment, including frayed wires and loose connections.
19. Be very careful when using a gas burner. Keep hair, clothing, and your hands safely away from an open flame. Never point the open end of a test tube that is being heated at yourself or anyone else. Hot glass and hot metal stay hot for a long time. Set them aside to cool on an insulated pad. Remember, hot glass and cold glass look exactly alike.

AGREEMENT

I, _____, have read and agree to follow all of the safety rules in this contract. I will follow my teacher's directions. I am aware that failure to follow these rules is dangerous and may result in my being barred from the laboratory, and that this may result in a failing grade.

_____ _____

Student Signature Date

Dear Parent or Guardian:

Your signature indicates that you have read these safety rules and have instructed your child to follow these rules and procedures in the science laboratory.

_____ _____

Parent/Guardian Signature Date

b. Safe and Humane Treatment of Classroom Animals Student Contract

NOTE: *These two pages should be duplicated and distributed to each student. Have students wash their hands and clean their nails following any activity with animals. When animals are present in the science classroom, special care should be taken to ensure that neither students nor animals are harmed.*

Students must adhere to the following rules for the safe and humane treatment of animals:

1. Students should be instructed in the proper handling and care of classroom animals.
2. Students are prohibited from teasing or abusing classroom animals.
3. Students should not insert their fingers or other objects into the cages and tanks that hold the classroom animals.
4. Students should only be allowed to handle classroom animals when under direct supervision.
5. All classroom animals must be healthy and free of disease.
6. Animals must be kept in secure cages and tanks that close securely and have no sharp edges that may harm the animal or the students.
7. Cages and tanks must be kept clean and waste materials must be disposed of in sealed garbage bags.
8. Cages and tanks must be washed with soap and water periodically.
9. Live animals collected from their natural environment are not allowed in science classrooms.
10. Prior to bringing live animals into a science classroom, students should be asked if they have a fear of the animals being introduced. Students should not be exposed to animals which they fear.
11. Students should use gloves when handling animals with teeth and/or claws.
12. Students must wash their hands both before and after handling animals. Germs can be spread from humans to animals, as well as from animals to humans.

13. Report any scratches or bites to the teacher immediately and obtain medical attention to avoid infection.
14. Students may experience allergic reactions to certain animals or the dust from their cages.
15. Parent permission must be granted before students are allowed to handle live animals.

AGREEMENT

I, _____, have read and agree to follow all the rules in this contract. I will follow my teacher's directions. I am aware that failure to follow these rules is dangerous to the classroom animals, my classmates, and myself.

_____ _____

Student Signature Date

Dear Parent or Guardian:

Your signature indicates that you have read these rules on the safe and humane treatment of animals and that you have instructed your child to follow these rules and procedures.

_____ _____

Parent/Guardian Signature Date

ALLERGIES TO ANY ANIMALS:

C. Sample Letter for Dissection Opt-Out

Note: *A signed form from each student should be kept on file.*

<<Add School Heading>> **<<Add Date>>**

Dear Parent/Guardian:

Your child is currently enrolled in a course in which animal dissection is part of classroom instruction. Dissection is defined as "the manipulation of preserved animals or animal parts for scientific study, which includes incising and may be followed by inspecting, touching, handling, and mounting."

In compliance with New York State Education Law 809, students have the right to "object to the performance or witnessing of the dissection of an animal, either wholly or in part." The New York City Department of Education offers students alternatives to animal dissection should their parents wish their child to abstain from these activities.

Alternatives to animal dissection may include but are not limited to computer-based virtual dissections, plastic models, videos, and charts. Alternative dissection techniques are designed to provide the student with knowledge similar to what is expected to be gained by students in the course who perform, participate in, or observe the dissection.

Students who have opted out of animal dissection exercises are given information on specific activities and resources to use as their alternative assignment. These students will receive assistance with their alternate task. Students who perform alternative projects and do not perform and witness the dissection of animals shall not be penalized.

If you do not want your child to participate in animal dissection activities as described within the course, please complete and sign the form below and return it to your child's science teacher by **(Date)**.

Sincerely,

<<Add teacher or assistant principal name>>

ALTERNATIVE TO ANIMAL DISSECTION OPT-OUT

I do not want my child to participate in animal dissection activities. Instead, I would like my child to be provided approved alternatives to animal dissection.

[Please print all information with the exception of your signature.]

Name of Student: _____

Science Course: _____

Parent/Guardian's Name: _____

Address: _____

_____

Phone Number: _____

Signature: _____

d. Science Safety Manual Sign-Off Sheet for Staff

New York City Department of Education Safety Manual Sign-Off Statement

NAME OF SCHOOL

Principal's Name

I have read the General Directions for Teachers as well as the Specific Directions for the subjects that I am teaching and, if teaching laboratory science courses, have collected all student safety contracts with student and parent/guardian signatures.

_____ _____

Teacher Date

e. Science Department Conference/Science Teacher Meeting Sample Agenda

Agenda for Assistant Principal/School Administrator Department Conference/Science Teacher Meeting

NAME OF SCHOOL

Principal's Name

REVIEW AND PRACTICE OF THE SAFETY PROCEDURES IN THE SCIENCE LABORATORY

Date: _____

Room: _____

Attendees: _____

_____

1. Location and Use of Fire Extinguishers
2. Location and Use of Safety Showers
3. Location and Use of Fire Blankets, If Present
4. Location and Use of Eye Wash Station
5. Location and Use of First-Aid Kit
6. Location and Use of the Goggles and Goggle Sanitizing Station

Attendee Sign Off: _____

f. Science Safety Walkthrough Checklists

This is a comprehensive safety checklist that covers potential hazards in secondary science settings. Some sections and topics (e.g., gas cylinders) may not be relevant to every school. This list is provided as a resource; however schools are not required to complete it.

School:	Codes	
Date of Inspection:	**N**	No
Inspector:	**Y**	Yes
	NA	Not Applicable
	DNO	Did Not Observe

Inspection Questions	Science Room Numbers									
FIRE EXTINGUISHER	ENTER CODES BELOW									
1. Do you have a fire extinguisher that is an ABC dry chemical type?										
2. Fire extinguisher is clearly labeled with a sign, is visible, easily accessible, and unobstructed.										
3. Safety seal on the fire extinguisher pin is intact.										
4. Gauge on the fire extinguisher indicates it is adequately charged.										
5. Fire extinguisher has a current inspection tag that is less than one year old.										

Inspection Questions	Science Room Numbers									
6. ABC type fire extinguishers are strategically located throughout the science laboratory and storage areas. You never have to travel more than 25 feet to get to one.										
7. Fire extinguisher is installed five feet above the ground, and weighs between 15 and 40 lbs.										
8. Fire extinguisher is hung on the wall and not sitting on the floor.										
9. Teachers have all been trained and have hands-on experience on how to use a fire extinguisher.										
10. A Class D fire extinguisher is available for use when reactive metals are present.										
11. FDNY-approved service company inspects fire extinguishers every year.										
Notes: *FIRE EXTINGUISHERS ALL IN WORKING ORDER AND FULLY CHARGED.*										

Inspection Questions	Science Room Numbers									
FIRE BLANKET	ENTER CODES BELOW									
12. If you have a fire blanket, is it made of 100% wool?										
13. Is the fire blanket clearly labeled, visible, easily accessible and unobstructed?										
14. If a fire blanket is present, is it properly stored and clearly labeled?										
15. Fire blanket is mounted on a wall no more than 30 inches off the floor.										
16. Teachers have all been trained on how and when to use a fire blanket.										
17. If any fire blankets are present, school personnel inspect the fire blanket(s) every year.										
Notes:										

Inspection Questions	Science Room Numbers									
EYEWASH	ENTER CODES BELOW									
18. Do you have an eyewash located in every room that uses any type or form of laboratory chemicals?										
19. The eyewash is labeled, visible, easily accessible and unobstructed.										
20. Eyewash treats both eyes at the same time, provides a continuous wash for 20 minutes and the water comes from a clean source.										
21. Eyewash is strategically located throughout the laboratory, preparation and storage areas. You never have to travel more than 25 feet to get to one.										
22. The water pressure in the room is sufficient enough to provide three gallons of water per minute to the eyewash.										
23. The eyewash has a “stay-on” valve which allows for hands-free operation.										
24. Eyewash effectiveness and operation are inspected weekly.										
Notes:										

Inspection Questions	Science Room Numbers									
SAFETY SHOWER/BODY DRENCH	ENTER CODES BELOW									
25. Do you have a safety shower/body drench in the chemistry laboratory and chemical storage area?										
26. Safety shower/drench is labeled, visible, easily accessible and unobstructed?										
27. Safety shower/body drench is strategically located throughout the laboratory and storage area. You never have to travel more than 50 feet to get to one.										
28. Water pressure in the room is sufficient enough to provide 20 gallons of water per minute to the safety shower or four gallons per minute to a body drench.										
29. Safety shower has a “stay on” valve which allows hands-free operation.										
30. Safety shower/body drench effectiveness and operation is tested weekly.										
31. Safety shower/body drench has a floor drain with a cap to prevent chemical from being poured down the drain.										
Notes:										

Inspection Questions	Science Room Numbers									
FIRST AID KIT	ENTER CODES BELOW									
32. Do you have a first aid kit?										
33. Is the kit labeled, visible, easily accessible and unobstructed?										
34. The first aid kit is adequately stocked and contains supplies specifically designed for chemical first aid.										
35. The first aid kit is inspected every six months and restocked when needed.										
36. A medical emergency plan exists and teachers have been trained on how to implement the plan.										
37. Science teachers and lab specialists should have first aid and CPR training.										
SAFETY SIGNS	ENTER CODES BELOW									
38. Fire exits are clearly marked with exit signs.										
39. Safety placards are prominently posted next to all safety equipment.										
40. Safety rules and posters are on display in the science classroom and laboratory										

Inspection Questions	Science Room Numbers									
MASTER UTILITY CONTROLS	ENTER CODES BELOW									
41. You know where the master electrical shutoff switch is located and how to turn it off and on.										
42. You know which electrical outlets are controlled by the master electrical switch.										
43. The master electrical switch is inspected yearly and is in good working order.										
44. The master electrical switch is clearly labeled, visible, easily accessible and unobstructed.										
45. You know where the gas shutoff valve is and how to turn it on and off.										
46. The gas shutoff valve is inspected once a year and is in good working order.										
47. The gas shutoff valve is clearly labeled, easily accessible and unobstructed.										
48. The gas shutoff valve is off or closed when gas jets are not in use.										
49. Student gas jet valves are inspected for closure at the end of each day.										
50. Does each water source have a water shutoff valve that is easily accessible and in good working order?										
Notes:										

Inspection Questions	Science Room Numbers									
SPILL CONTROL EQUIPMENT	ENTER CODES BELOW									
51. Do you have spill control equipment kept where chemicals are stored?										
52. Spill control equipment is large enough to handle the contents of your largest chemical bottle if it was broken.										
53. Spill control equipment is labeled, visible, easily accessible and unobstructed.										
54. Spill control equipment is inspected every year and is in good working order.										
55. Mercury spill control containment and cleanup equipment is available for use.										
56. Teachers have all received hands on training on how to handle a chemical spill.										
NOTES:										

Inspection Questions	Science Room Numbers									
FUME HOODS	ENTER CODES BELOW									
57. A fume hood is available where chemical solutions are prepared and in every chemistry laboratory that uses hazardous chemicals.										
58. Chemicals are never stored inside the fume hood.										
59. The fume hood has been tested every three months and has a face velocity of 100 ft./minute.										
60. The fume hood has an adjustable sash and is in good working order.										
61. The fume hood is located away from the primary entrance and exit and away from high traffic areas.										
62. The fume hood is vented directly to the outside of the building.										
63. The fume hood vent stack is at least 8 feet above the roof line and away from fresh air returns.										
NOTES:										

Inspection Questions	Science Room Numbers									
PERSONAL PROTECTION EQUIPMENT	ENTER CODES BELOW									
64. Goggles and all other forms of eye protection are available and meet ANZI Z87.1 standards and are so marked.										
65. Eye protection is stored close by and available for all who need to wear it.										
66. Eye protection is inspected yearly, is in good working order and comfortable to wear.										
67. Eye protection is cleaned and disinfected before it is used by another person.										
68. Eye protection is worn when chemicals, heat and/or glassware is used.										
69. Aprons are chemical-resistant and available to all laboratory participants.										
70. Chemical resistant gloves are available and used when handling hazardous laboratory chemicals. Heat and cold resistant gloves are available if needed.										
71. If loud demonstrations are conducted, hearing protection is worn.										

Inspection Questions	Science Room Numbers									
LABORATORY VENTILATION	ENTER CODES BELOW									
72. Does your laboratory have a ventilation system to remove hazardous chemical vapors?										
73. Has the room's ventilation been tested with an anemometer to measure airflow rates or an Indoor Air Quality (IAQ) monitor to measure carbon dioxide levels?										
74. There is an exhaust or purge fan available for exhausting laboratory fumes. The fan is able to provide a complete air change in 5–10 minutes or less.										
75. The laboratory ventilation system is tested every year.										
76. The laboratory ventilation exhaust system is vented directly to the outside of the building.										
77. The laboratory ventilation exhaust system stack is at least 8 feet above the roof line and away from all fresh air returns.										
Notes:										

Inspection Questions	Science Room Numbers									
CLASSROOM CHEMICAL STORAGE	ENTER CODES BELOW									
78. Chemicals are never stored in the classroom or laboratory unless they are in student reagent bottles or in a low concentration solution.										
TRAFFIC FLOW AND FLOORING	ENTER CODES BELOW									
79. Clear traffic paths are provided in the classroom, laboratory, and preparation/storage areas. All traffic paths are free of clutter.										
80. Evacuation procedures are established, practiced, and posted in the classroom.										
81. Flooring is nonreactive with chemicals (i.e., no carpeting or rugs). Tile floors are covered with a non skid wax.										
82. Exits are large enough for occupant load (minimum, width no less than 28 inches).										
83. Aisles are wide and do not have dead ends.										
84. If a floor drain is present it is capped to prevent spills from entering the sewer system.										
Notes:										

Inspection Questions	Science Room Numbers									
GAS CYLINDERS	ENTER CODES BELOW									
85. Large gas cylinders (greater than 12” high) are firmly secured to the wall and are always in a holder or clamped tightly in placed while being used.										
86. Gas cylinders are capped, supported to prevent rolling or tipping and placed away from heat sources or open flames.										
LABORATORY TABLES AND STOOLS	ENTER CODES BELOW									
87. Tabletops are free of sharp edges and have chemical-resistant tops.										
88. Stools are not used when laboratory activities are being performed.										
EMERGENCY COMMUNICATION	ENTER CODES BELOW									
89. A telephone with an outside line is located in the science department and emergency telephone numbers are posted by it.										
Notes:										

Inspection Questions	Science Room Numbers									
SAFETY DATA SHEETS	ENTER CODES BELOW									
90. SDS are available for every chemical stored and used at the school to assess the hazards of the chemicals.										
91. The SDS are stored in an accessible location within the science areas.										
REFRIGERATOR	ENTER CODES BELOW									
92. No food or drinks are stored in the science department refrigerator.										
93. Refrigerator is properly maintained and labeled.										
CLASS SIZE/TEACHER SUPERVISION	ENTER CODES BELOW									
94. Student/Teacher ratio never exceeds 34:1										
95. The classroom/laboratory has no blind spots where students are unsupervised by the teacher from all points in the room.										
Notes:										

Inspection Questions	Science Room Numbers									
BIOLOGICAL WASTE	ENTER CODES BELOW									
96. Written procedures and policies are established for handling and disposal of biological waste										
97. All biohazardous material has been identified, labeled and properly stored.										
98. Are bloodletting and other bodily fluid experimentations prohibited?										
99. Do you prohibit the handling of dangerous pathogens by students?										
HYGIENE	ENTER CODES BELOW									
100. Is disinfectant soap available for student use?										
GLASSWARE	ENTER CODES BELOW									
101. Are broken glass containers available? Are they clearly labeled?										
102. Is there a glassware drying rack available?										
103. When glassware is used with a vacuum or subjected to temperature extremes or mechanical stress, is it shielded or wrapped to protect from possible shattering?										

Inspection Questions	Science Room Numbers									
ELECTRICAL SAFETY										
104. Plugs and cords to all electronic equipment are in good shape; they do not have splices, cracks, exposed wires or frayed insulation.										
105. All electrical outlets have been tested and are properly wired and grounded.										
106. Outlets within 3 feet of a water source have ground fault interrupters.										
107. Are there a sufficient number of electrical outlets available to eliminate the use of extension cords?										
108. If electrical cords are used, they have a 3-prong plug and contain 18-gauge wire or heavier. They also do not block traffic aisles										
109. No multiple plug adapters are used.										
Notes:										

Inspection Questions	Science Room Numbers									
INGRESS AND EGRESS	ENTER CODES BELOW									
110. Exits to all classrooms, laboratories, storage and preparation areas are marked and readily visible.										
111. Exits are unobstructed.										
112. Exits are wide enough for occupant load (minimum width: 28 inches).										
113. Non-exits are clearly marked.										
114. More than one exit is provided in each laboratory and chemical preparation/storage area.										
115. Exit doors open outward to provide rapid evacuation in an emergency.										
116. Access to the preparation/storage areas is limited to the science staff only and is clearly marked with words such as “Authorized Personnel Only-Students Keep Out.”										
117. Doors have self return hardware and automatically shut and lock.										
118. Laboratories and preparation/storage areas are kept locked at all times when not in use.										

Inspection Questions	Science Room Numbers									
119. Keys to the science rooms are only available to science staff and administration.										
120. Fire doors are used to separate the chemical storage area from the rest of the school.										
WASTE RECEPTACLES	ENTER CODES BELOW									
121. Adequate waste receptacles are available and are clearly labeled identifying the type of waste it will accept.										
122. Waste containers are sturdy, inspected for leaks and cracks, compatible with waste placed in them, and kept closed when not in use.										
123. Hazardous waste records are kept showing the initial date of storage and the chemicals involved.										
LIGHTING	ENTER CODES BELOW									
124. The room is well-lighted (50–100 foot candles per square foot).										
125. Battery-operated emergency lighting systems are provided in rooms that have no windows to facilitate safe evacuation during a power failure. This includes all storage or preparation rooms.										
126. Emergency lighting is checked every year.										

Inspection Questions	Science Room Numbers									
SMOKE DETECTORS/ALARMS/SPRINKLERS	ENTER CODES BELOW									
127. There is a functioning smoke/fire detector in the chemical stores area and it is tested annually.										
128. If the detector is operated by battery are the batteries changed every year?										
129. The detector/alarm is connected to another detector so school personnel outside the chemical storage area can hear the alarm.										
130. There is a functioning fire alarm pull box in the science area.										
131. A 12” clearance is maintained near all ceiling sprinkler heads.										
CHEMICAL STOREROOM VENTILATION	ENTER CODES BELOW									
132. The chemical storeroom does not “stink” when you walk into it.										
133. The chemical storeroom ventilation provides at least four air changes per hour.										
134. The chemical storeroom ventilation is pulled up from the floor level.										

Inspection Questions	Science Room Numbers									
135. The chemical storeroom ventilation is vented directly to the out-of-doors.										
136. Ventilation exhaust stacks mounted on the roof are eight feet higher than the fresh air intake vents.										
137. Chemical storeroom ventilation is inspected and tested once a year.										
Notes:										
CHEMICAL STORAGE SHELVING	ENTER CODES BELOW									
138. Shelves are securely attached to the wall.										
139. Shelves are constructed of wood (not particleboard) and the center is not sagging.										
140. Shelf support brackets are inspected regularly for structural damage.										
141. Shelves have raised front lips to prevent chemical containers from rolling off.										
142. Shelf aisles are at least three feet wide and have no long dead ends.										
Notes:										

Inspection Questions	Science Room Numbers									
CHEMICAL HANDLING	ENTER CODES BELOW									
143. A cart is provided for chemical transport of chemicals from the storage area to the laboratory.										
144. Chemicals are always returned to the chemical storeroom at the end of the day.										
145. Safety shields are available and used to protect students from potentially dangerous experiments or demonstrations.										
146. All flammable liquids are kept away from open flames or spark-producing apparatus.										
147. A stable and sturdy step stool or ladder is provided for reaching items on upper shelves.										
CHEMICAL INVENTORY	ENTER CODES BELOW									
148. A complete and current chemical inventory is available showing the name of the chemical, its storage location, and the amount on hand.										
149. Accurate records of radioactive materials are maintained.										
Notes:										

Inspection Questions	Science Room Numbers									
CHEMICAL CONTAINERS/LABELING	ENTER CODES BELOW									
150. All chemical containers are clearly labeled with the name of the chemical, its concentration, how it can affect you, and organs affected.										
151. Student chemical bottles are correctly labeled when transferred from an original container.										
152. Chemical container labels are replaced immediately when damaged or missing.										
153. Chemicals are date labeled upon receipt from the manufacturer.										
154. Chemical containers are inspected annually for leakage or deterioration. Chemicals are not kept in containers that are in poor condition.										
155. Bulk chemicals are never packaged into smaller package sizes unless the chemical is placed in small bottles for student use.										
156. Plastic, metal and PVC coated glass bottles are required to be provided from chemical suppliers in lieu of plain glass containers.										
Notes:										

Inspection Questions	Science Room Numbers									
CHEMICAL STORAGE	ENTER CODES BELOW									
157. Chemical shelves are not overcrowded or loaded beyond capacity. Chemical bottles are stored neatly without being stacked on top of one another.										
158. No chemicals are stored on the floor.										
159. All chemical containers are securely capped and sealed.										
160. All chemicals are stored under lock and key.										
161. The chemical storage area is kept cool and dry (50–80 °F).										
162. All peroxide forming chemicals are identified and marked with the date received.										
163. Severely poisonous chemicals are given special protection and are stored in a locked cabinet.										
164. Sodium, lithium, and potassium metals are always stored under light, dry mineral oil.										
165. Volatile carcinogenic chemicals have been eliminated from the science program.										
166. Corrosive chemicals (acids and bases) are stored in appropriate chemical storage cabinets.										

Inspection Questions	Science Room Numbers									
167. Nitric acid is stored separately from acetic acid.										
168. All flammable liquids are stored in NFPA-certified chemical safety storage cabinets and away from heat or flame.										
169. The flammables cabinet is not vented.										
170. Severely dangerous chemicals are only kept in small quantities (no more than a three-year supply).										
171. No chemicals are kept beyond the manufacturers shelf life.										
172. No excessive quantities of chemicals are stored.										
173. All chemicals are stored according to the **Suggested Shelf Storage Patterns** in Section 4d of the *Appendix*.										
174. The school has adopted a purchasing philosophy that when buying chemicals-safety and chemical disposal are as important as cost.										
Notes:										

Inspection Questions	Science Room Numbers									
CHEMICAL DISPOSAL	ENTER CODES BELOW									
175. Chemicals are disposed of on a regular basis and chemical wastes are disposed of according to FEDERAL, STATE, AND MUNICIPAL guidelines.										
MISCELLANEOUS	ENTER CODES BELOW									
176. The science office is not located in the chemical storage area.										
177. Laboratory sinks have rubber mats in the bottom of the sink basin.										
178. Good housekeeping—All laboratories and storage areas are maintained in a neat, orderly condition and equipment is stored in its proper place and safely secured to prevent theft.										
179. Pipet bulbs are available for pipetting.										
180. During laboratory exercises book bags, coats and other unrelated materials are kept away from the lab area.										
181. Science staff are the only ones who open incoming chemical shipments.										

Inspection Questions	Science Room Numbers									
182. Animals, if used, are treated humanely.										
183. Plants with poisonous oils or saps are never used.										
RULES, POLICIES AND SAFETY MANUALS	ENTER CODES BELOW									
184. A district wide or science department safety manual is available.										
185. The district or school has a written chemical hygiene plan and all science teachers are trained.										
186. Every student experiment or demonstration has been reviewed for possible safety problems prior to use by the students.										
187. Administrators are aware of safety programs used in the science department and are committed to providing a safe teaching environment.										
188. Any unsafe or hazardous conditions are immediately reported to the science safety officer or to the school administrator in writing.										
Notes:										

Inspection Questions	Science Room Numbers									
189. The school administration, upon hearing of an unsafe or hazardous condition, quickly rectifies the problem.										
190. Teachers promote a positive attitude toward safety and are good safety role models.										
191. Only certified science teachers supervise student laboratory activities.										
192. Students receive safety training prior to their first laboratory activity.										
193. The teacher explains and students receive, read and sign a safety contract. Students are then tested on their understanding of the safety rules they have learned.										
194. Only those students receiving a score on their safety test that demonstrates adequate understanding of laboratory safety are allowed to enter the laboratory.										
195. If safety rules are violated, penalties are defined and carried out without bias or discrimination.										

Inspection Questions	Science Room Numbers									
196. Documentation of safety rules discussed with students is recorded in the teacher's daily lesson plan book.										
197. Teachers include a safety discussion as part of every pre-laboratory instruction.										
198. Laboratory safety rules and posters are posted on the walls.										
199. Lab technicians and student aids have received special safety training relative to the tasks they are to perform.										
200. Teachers are instructed in emergency procedures including evacuation, eyewash, shower use, fire extinguishers and spill control.										
201. All visitors are instructed to follow safety rules.										
202. All building custodians and maintenance personnel are advised of the potential dangers in the science department.										
203. Accident report forms are available and used anytime someone is injured or when an "event" or spill occurs.										

Inspection Questions	Science Room Numbers									
204. Teachers and students read all chemical labels prior to use. Teachers also understand the hazards of a chemical before it is used.										
205. Food and beverages are never allowed in the laboratory.										
206. Long hair and loose clothing are restricted in the laboratory.										
207. Mouth pipetting is never allowed and glassware is not used for drinking.										
208. Students are never left unattended in the science area.										
209. A comprehensive safety inspection (like the one you are doing now) is conducted every year.										

Notes/Comments:

Codes	
N	No
Y	Not Applicable
NA	Yes
DNO	Did Not Observe

g. Checklist of Collectible Documents with Timelines

Check	Document	On file with:	Time Frame:
☐	Safe and Humane Treatment of Animals Student Contract	Science Teachers	Annually—Beginning of the School Year
☐	Students Safety Contracts including Parental Signature	Science Teachers	Annually—Beginning of the School Year
☐	Student Dissection Opt-Out including Parental Signature	Science Teachers	Annually—Before the first dissection of the School Year
☐	Science Department Conference/ Science Teacher Meeting Agenda	Assistant Principal	Annually – Beginning of the School Year
☐	Chemical Hygiene Plan and Hazard Communication Plan	Chemical Hygiene Officer	Annually—Beginning of the School Year
☐	Chemical Inventory Form and Safety Data Sheets	Chemical Hygiene Officer	Continuously Updated
☐	Laboratory Safety Plan	Principal	Annually—In conjunction with the School Safety Plan
☐	Facility Inventory Form (FIF) for Hazardous Chemicals	RTK/Site Safety Officer	Annually—March 1st
☐	Certificate of Fitness	Certificate of Fitness Holder	Annually—Beginning of the School Year
☐	Bloodborne Pathogens Training	Bloodborne Pathogens Site Employee Safety Administrator	Annually—Beginning of the School Year
☐	*Science Safety Manual*—Sign off sheet and collection of hazard assessment records	Assistant Principal	Annually—Beginning of the School Year
☐	FDNY Permits	Assistant Principal	Annually—Beginning of the School Year
☐	D-14 Certificates for all staff overseeing laboratory operations that use hazardous chemicals	Assistant Principal	Annually—Beginning of the School Year
☐	D-15 Certificates for staff member(s) overseeing storage and handling of hazardous chemicals	Assistant Principal	Annually—Beginning of the School Year
☐	SH 900 Annual Report	Site Safety Officer	Annually—February 1

h. D-15 Certification Holder Scenarios

Per FDNY regulations, all schools that have laboratories that use hazardous chemicals or preparation or stock rooms that store hazardous chemicals must have at least one staff member who possesses the FDNY's D-15 Certificate of Fitness to Supervise the Storage and Handling of Chemicals in K–12 School Laboratories. See this link for more information about the D-15 Certificate of Fitness training process and responsibilities of D-15 Certificate of Fitness holders. Study materials for the person designated to complete this certificate of fitness are also available on the FDNY website.

The table on the following page describes four possible scenarios for holding of the D-15 Certificate of Fitness in NYCDOE schools. Schools that have a lab specialist on staff typically choose Scenario 1, in which the lab specialist holds the D-15 Certificate of Fitness.

Schools that do not have a lab specialist on staff may elect Scenario 2, 3, or 4. Schools may have an administrator complete D-15 training to hold the D-15 certificate of fitness, or may have a science teacher complete D-15 training and hold the D-15 certificate of fitness. In these circumstances, the principal should designate the staff member who will be the school's D-15 Certificate of Fitness holder.

Schools without a lab specialist may also elect to not have anyone complete D-15 training or hold a D-14 certificate of fitness; however, these schools may not store hazardous chemicals, nor may they plan and implement laboratory activities that use hazardous chemicals. Schools without a D-15 holder may engage in scientific investigations that do not use hazardous chemicals (e.g., green chemistry investigations that are limited to household materials).

Scenario	D-15 CoF Holder	D-15 Guidance for This Scenario
1.	Lab Specialist	The Lab Specialist completes D-15 training and is the holder of the D-15 Certificate of Fitness.
2.	Assistant Principal or other Administrator	The Assistant Principal (or other administrator designated by the principal) completes D-15 training and is the holder of the D-15 Certificate of Fitness.
3.	Science Teacher	A science teacher who possesses NY State Permanent or Professional certification in Biology, Chemistry, Physics, Earth Science, or Middle School General Science completes D-15 training and is the holder of the D-15 Certificate of Fitness.
4.	No D-15 Holder	Schools that do not have a D-15 certificate holder cannot store or do investigations with hazardous chemicals. This may be an appropriate option for middle schools or schools that are not offering chemistry, or who are teaching a Regents-level chemistry course using only Green Chemistry materials and resources.

i. Laboratory Risk Assessment Tool for Hazard Assessments

Laboratory Risk Assessment Tool

The Stanford Laboratory Risk Assessment Tool provides a framework for risk assessment that maps onto the scientific method, melding with the process researchers already use to answer scientific questions.

This tool allows researchers to systematically identify and control hazards to reduce risk of injuries and incidents. It is strongly recommended to conduct a risk assessment prior to conducting an experiment for the first time.

The risk assessment process involves rating the risk of the experiment, from "low" to "unacceptable" risk. Consult with your PI/supervisor and EH&S if your risk rating is "high" or "unacceptable" to redesign the experiment and/or implement additional controls to reduce risk.

Procedure:	
Lab Group:	
Completed By:	Date:

EXPLORE

Identify your research question and approach. What are you trying to measure or learn? What is your hypothesis? What approach or method will you use to answer your question? Are there alternative approaches?

Research Question(s)
Approach(es) or Method

Identify the general hazards (check all that apply). Perform background research to identify known risks of the reagents, reactions, or processes. Review protocols, Safety Data Sheets (SDSs), and safety information for hazardous chemicals, agents, or processes. Review accident histories within your laboratory/department and Lessons Learned at Stanford or other institutions.

Hazardous Agents			
Physical Hazards of Chemicals	**Health Hazards of Chemicals**	**Ionizing Radiation**	**Biohazards**
☐ Compressed gases	☐ Acute toxicity	☐ Irradiator	☐ BSL-2 Biological agents
☐ Cryogens	☐ Carcinogens	☐ Radionuclide	☐ BSL-3 Biological agents
☐ Explosives	☐ Eye damage/ irritation	☐ Radionuclide sealed source	☐ Human cells, blood, BBP
☐ Flammables	☐ Germ cell mutagens	☐ X-ray machine	☐ NHPs/cells/blood
☐ Organic peroxides	☐ Nanomaterials	**Non-Ionizing Radiation**	☐ Non-exempt rDNA
☐ Oxidizers	☐ Reproductive toxins	☐ Lasers, Class 3 or 4	☐ Animal work
☐ Peroxide formers	☐ Respiratory or skin sensitization	☐ Lasers, Class 2	☐ High risk animals (RC1)
☐ Pyrophorics	☐ Simple asphyxiant	☐ Magnetic fields (e.g., NMR, MRI)	
☐ Self-heating substances	☐ Skin corrosion/ irritation	☐ RF/microwaves	☐ Other (list):
☐ Self-reactive substances	☐ Specific target organ toxicity	☐ UV lamps	
☐ Substances which, in contact with water, emit flammable gases	☐ Hazards not otherwise classified		

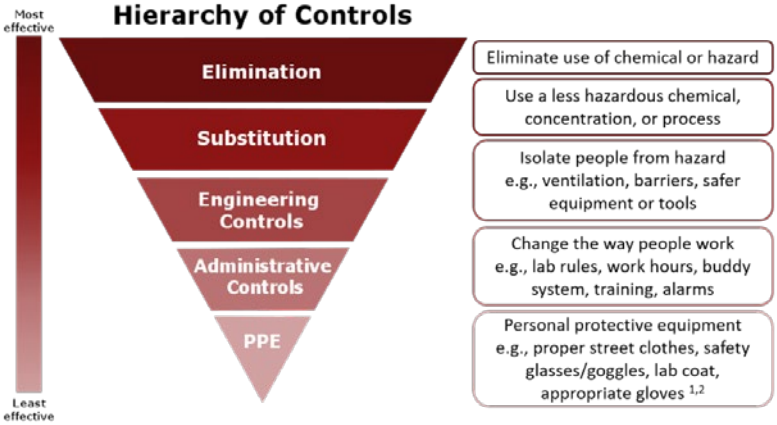
Hazardous Conditions or Processes		
Reaction Hazards	**Hazardous Processes**	**Other Hazards**
☐ Explosive	☐ Generation of air contaminants (gases, aerosols, or particulates)	☐ Hand/power tools
☐ Exothermic, with potential for fire, excessive heat, or runaway reaction	☐ Heating chemicals	☐ Moving equipment/parts
☐ Endothermic, with potential for freezing solvents decreased solubility or heterogeneous mixtures	☐ Large mass or volume	☐ Electrical
☐ Gases produced	☐ Pressure > atmospheric	☐ Noise > 80 dBA
☐ Hazardous reaction intermediates/products	☐ Pressure < atmospheric	☐ Heat/hot surfaces
☐ Hazardous side reactions	☐ Scale-up of reaction	☐ Ergonomic hazards
		☐ Needles/sharps
		☐ Other (list):

Field Hazards		
Environmental Hazards	**Site Hazards**	**Task/Equipment Hazards**
☐ Foul weather	☐ Uneven/slippery surfaces	☐ Driving/vehicle operation/ traffic
☐ Temperature extremes	☐ Heights/drop-offs	☐ Lifting/carrying
☐ Intense sunlight	☐ Falling objects	☐ Digging/trenching
☐ Darkness/low light	☐ Tight spaces/overhangs	☐ Hand tools/power tools
☐ Altitude	☐ Boating/swimming/water hazards (waves, tides, current, depth)	☐ Sharp objects
☐ Smoke/dust	☐ Navigation challenges	☐ Strenuous physical activity
☐ Fire	☐ Limited communication	☐ Mental demands (e.g., long days, high stress environment, language barriers)
☐ Animals/insects	☐ Remote area/limited medical services	☐ Other (list):
☐ Plants/allergens	☐ Personal security issues, risk of harassment or violence, U.S. State Department active travel alert	
☐ Hygiene/water-borne and food-borne illness		
☐ Vector-borne or other endemic diseases (list):		

PLAN

Outline the Procedure. List the steps or tasks for your procedure and the hazard/potential consequences of each. Include set-up and cleanup steps or tasks. Define the hazard controls to minimize the risk of each step using the hierarchy of controls starting with the most effective (i.e., elimination, substitution, engineering controls, administrative controls, and personal protective equipment). List the hazard control measure you would use for each step or task (e.g., run at a micro scale, work in a fume hood, wear face shield and goggles).

Steps or Tasks	Hazard	Hazard Control Measure(s)



A hierarchy of controls should be applied starting with the most effective controls (i.e., elimination and substitution) at the top of the graphic and moving down. While personal protective equipment (PPE) should always be used, it should be considered the last line of defense from potential hazards.

For guidance on selection of Personal Protective Equipment (PPE), use Stanford's Laboratory PPE Assessment Tool.

For guidance on selection of chemical-resistant gloves, see Stanford's Laboratory Chemical Glove Selection Guide.

Select the appropriate PPE and safety supplies for the procedure (check all that apply).

Laboratory PPE/Safety Supplies	
☐ Appropriate street clothing (long pants, closed-toed shoes) ☐ Gloves; indicate type: ☐ Safety glasses ☐ Safety goggles ☐ Face shield and googles ☐ Lab coat ☐ Flame-resistant lab coat ☐ Other (list):	☐ Fire extinguisher ☐ Eyewash/safety shower ☐ First aid kit ☐ Spill kit ☐ Specialized medical supplies (e.g., calcium gluconate for hydrofluoric acid and amyl nitrite for cyanides)

Field PPE/Safety Supplies	
☐ Proper clothing (long pants, long sleeve shirt, warm layers, rain/wind protection, sun protection, hat etc.) ☐ Proper footwear (list): ☐ Communication device ☐ Eye protection (safety glasses and/or sunglasses) ☐ Work gloves ☐ Hardhat ☐ Hearing protection ☐ First aid kit ☐ Map (and GPS)	☐ Sunscreen ☐ Anti-animal devices (e.g., bear bell, whistle, bear canister) ☐ Personal floatation device ☐ Fall protection ☐ Road flares ☐ Safety vests ☐ Extra food, water/water treatment method ☐ Personal medications ☐ Other (list all):

Identify the appropriate training (check all that apply). Identify the general safety and procedure based/specific training appropriate for your procedure.

General Safety Training		
General/Chemical Safety ☐ General Safety & Emergency Preparedness (EHS-4200) ☐ Chemical Safety for Laboratories (EHS-1900) ☐ Compressed Gas Safety (EHS-2200) ☐ Cryogenic Liquids and Dry Ice Safety (EHS-2480) **Biosafety** ☐ Biosafety (EHS-1500) ☐ Bloodborne Pathogens (EHS-1600) and Refresher (EHS-1601)	**Radiation Safety** ☐ Radiation Safety and Radiation Safety Hands-On (EHS-5250 and 5251) ☐ Radiation Safety SAIF (Small Animal Imaging Facility) (EHS-5255) ☐ Sealed Sources, Non-Irradiator (EHS-5265) ☐ Research Cabinet X-ray or Irradiator (EHS- 1755) and Refresher (EHS-1756) ☐ Irradiator Security Training (EHS-4780) and Refresher (EHS-4781) ☐ Laser Safety (EHS-4820) and Refresher (EHS-4821)	**Field Safety** ☐ CPR ☐ Wilderness First Aid ☐ SCUBA certification/ diving safety ☐ Driving safety ☐ Other (list):

Job Specific Training		
☐ Lab/job-specific training ☐ Lab SOP(s) to review (list)	☐ Emergency plans or field evacuation plans ☐ Equipment SOP(s) to review (list):	☐ Other (list):

CHALLENGE

Question your methods. What have you missed and who can advise you? Challenge your hazard **control measures by asking "What if…?" questions. "What if" questions should challenge you to** find the gaps in your knowledge or logic. Factors to consider are human error, equipment failures, and deviations from the planned/expected parameters (e.g., temperature, pressure, time, flow rate, and scale/concentration).

What If Analysis
What if…? Examples: there is a loss of cooling? …valves/stopcocks are left open/closed? … there is unexpected over-pressurization? …a spill occurs? …the laser is misaligned? …weather conditions change? **Then…** …there may be a runaway reaction. …there may be an unexpected splash potential. …the reaction vessel may fail. …there may be a dermal exposure. …there may be an eye injury. …routes may be inaccessible.
What if…? **Then…**
What if…? **Then…**

Assign a risk rating to the experiment. Based on your procedure outline and the what if analysis, determine the risk rating for the experiment or procedure.

Risk Rating:

_____

Risk Rating Table[1]

		Severity of Consequences - Personnel Safety			
		No Injuries	Minor	Moderate to life impacting	Life threatening from single exposure
Likelihood of Occurrence	(Almost) Certain	Low	High*	Unacceptable*	Unacceptable*
	Likely	Low	Medium	High*	Unacceptable*
	Possible	Low	Medium	High*	High*
	Rare	Low	Low	Medium	High*

[1]The Risk Rating is subjective. The primary goal is for researchers to pause, think about risk, and differentiate unacceptable and high-level risk steps from those with a lower level risk. This will help drive additional consultation and control measures where needed.

Revise plan if the risk rating is too high. Are these risks acceptable? Use the table below to determine the action to take based on the risk rating. What are the highest risk steps? What more can you do to control the risks? Return to planning and use the hierarchy of controls to design a safer experiment.

Risk Rating Action Table

Hazard Risk Rating	Action
Unacceptable*	STOP! Additional controls needed to reduce risk. **Consult with PI and EH&S** (650-723-0448).
High*	Additional controls recommended to reduce risk. **Consult with PI and EH&S** (650-723-0448).
Medium	Ensure you are following best practices. Consult with peers, PI, or EH&S, as needed.
Low	Perform work within controls.

PI/Supervisor Approval: _____

Signature required for High risk ratings.

NOTE: *Unacceptable risk rating experiments* **may not proceed**.

Introduce further controls to reduce risk.

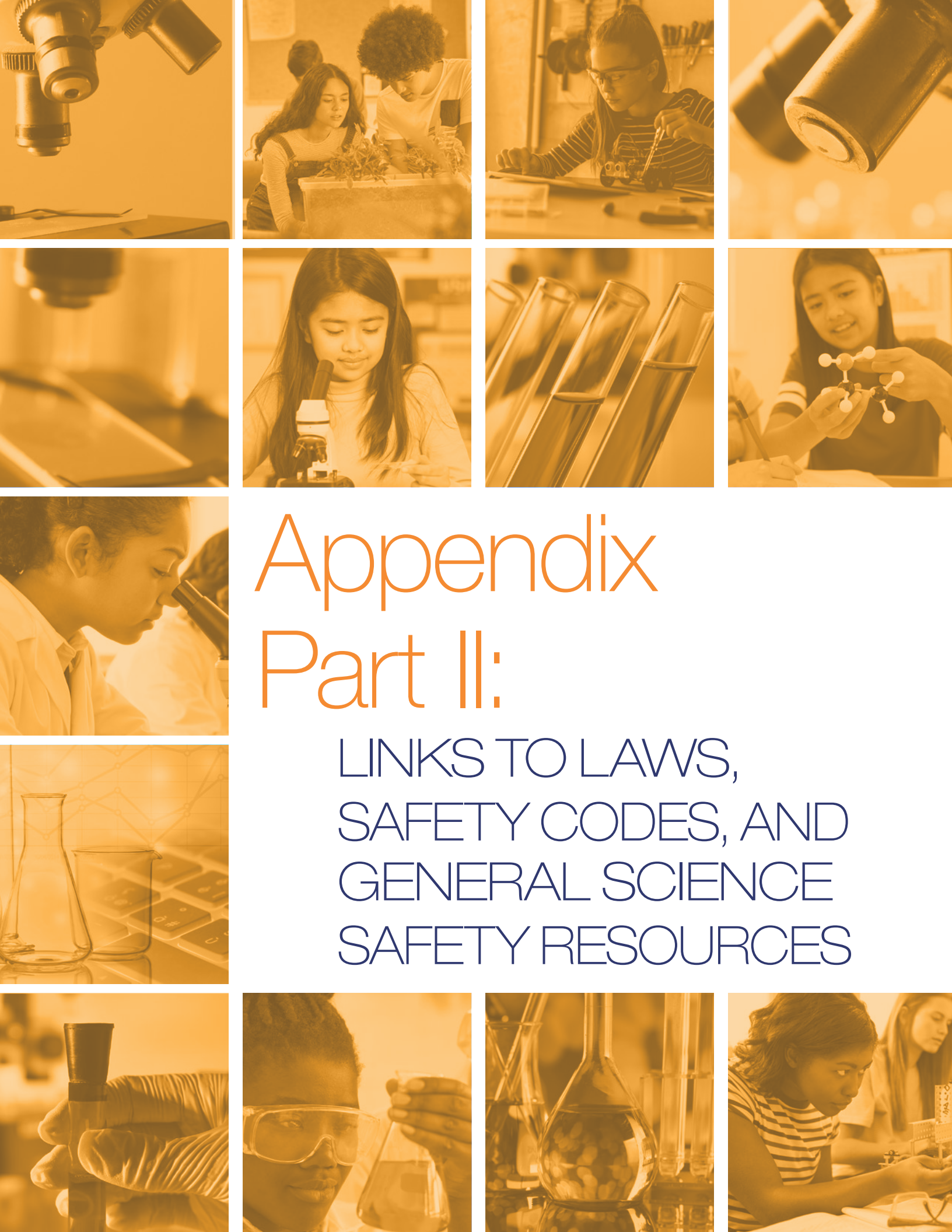
ASSESS

Perform a trial run. How you can test your experimental design? Can you do a dry run of the procedure without hazardous chemicals/reagents/gases to familiarize yourself with equipment and demonstrate your ability to manipulate the experimental apparatus? Can you run the procedure with a less hazardous material? Can you test your experimental design at a smaller scale? If your procedure requires multiple people, would a table top exercise be useful?

Trial Run
Trial Run Procedure:
Did the trial go as expected? ☐ Yes ☐ No
Experimental design changes needed (if any):

Perform and evaluate. Run your procedure using the appropriate controls you've identified. Evaluate controls and hazards as you work. Critique the controls and process you used by answering the following questions. If changes to controls are needed, update your risk assessment tool and re-evaluate any time you revise your process (e.g., changes in scale, reagent, equipment, or conditions that might increase the hazard/risk). Share your assessment with your colleagues for the next iteration of the experiment.

Evaluate Your Procedure
What went well?
Did the controls perform as expected?
Did anything unexpected occur?
Did a hazard manifest itself that was not previously identified?
Were there any close-calls or near misses that indicate areas of needed improvement?
Did something go exceptionally well that others could learn from?
I plan to evolve my procedure by...



Appendix Part II:

LINKS TO LAWS, SAFETY CODES, AND GENERAL SCIENCE SAFETY RESOURCES

a. National, State, and Local Codes

The New York City Department of Education is composed of over 1.1 million students, 1800 schools and 85,000 teachers. The school buildings are located in all five boroughs which cover roughly 304 square miles.

For our science laboratories to meet the standards of safety to function well, the following governing bodies have developed laws, codes, rules and regulations for the protection of all who utilize and learn in this environment, below is a list of the agencies and the policies that have been referenced in this document.

International

Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

International Agency for Research on Cancer (IARC)

International Labor Organization (ILO)

Organization of Economic Cooperation and Development (OECD)

United Nations Sub-Committee of Experts on the Transportation of Dangerous Goods (UNECE)

International Building Code (IBC)

National

American Chemical Society (ACS)

American National Standards Institute (ANSI)

American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

Code of Federal Regulations (CFR)

Environmental Protection Agency (EPA)

National Fire Protection Association (NFPA)

National Institute for Occupational Safety and Health (NIOSH)

National Science Teachers' Association (NSTA)

National Toxicology Program (NTP)

Occupational Safety and Health Administration (OSHA)

a. Occupational Safety Laws and Regulations

b. Personal Protection Equipment (PPE)

c. Safety Data Sheets (SDS)

State

New York State Division of Safety and Health (DOSH)

New York State Division of Building Standards and Codes (BSC)

New York State Department of Education (NYSED)

New York State Public Employee Safety and Health Bureau (PESH)

Local

The Fire Department of New York City (FDNY)

New York City Department of Education (NYCDOE)

Rules of the City of New York (RCNY)

New York City Codes, Rules and Regulations (NYCRR)

New York City Fire Codes (FC) or (NYCFC)

Right-To-Know (RTK)

Certificate of Fitness (CoF)

b. List of FDNY Codes and Rules for Non-Production Chemistry Laboratories

The operation of a non-production chemical laboratory is required to comply with the following fire department code and rule sections:

- Non-production chemical laboratories: [Fire Code Section 2706]
- Former laboratory rule for pre-existing (prior to 2008) laboratories [Rule Section 4827-01(g)(2)]
- Standard on fire protection for laboratories using chemicals: [NFPA 45, 2004 edition for new lab design requirements (post 2008) and NFPA 45, 2015 edition for all other general requirements]
- General requirements for the storage, handling and use of hazardous materials: [Fire Code Chapter 2703]
- Compressed gases: [Fire Code Sections 3003-3005]
- Cryogenic liquids: [Fire Code Sections 3203-3205]
- Flammable and combustible liquids: [Fire Code Sections 3403, 3404.3]
- Flammable gases: [Fire Code Section 3503]
- Flammable solids: [Fire Code Section 3603]
- Highly toxic and toxic materials: [Fire Code Sections 3703.1, 3704.1, 3704.2]
- Organic peroxides: [Fire Code Section 3903]
- Oxidizers: [Fire Code Section 4003]
- Pyrophoric materials: [Fire Code Section 4103]
- Unstable (Reactive) materials: [Fire Code Section 4303]
- Water-reactive solids and liquids: [Fire Code Section 4403]

C. Guidelines for New York City Community Right-to-Know Laws

The following school-related items were abstracted from the compliance package of the New York City Community Right-to-Know Guidelines for Reporting (NYCCRTK).

The purpose of the Right-to-Know (RTK) regulations is to protect the public from dangers associated with hazardous substances, extremely hazardous substances (EHS) and regulated toxic substances.

Instructions for complying and reporting is now on a web-based system at:
http://www.nyc.gov/html/dep/html/businesses/tier2.shtml

Compliance is Mandatory Due Date; March 1st

- Report any hazardous substances stored or used at the facility that are present—or above their individual threshold reporting quantifies at any one time during the reporting year. (Consult the **NYC Hazardous Substance List** included in the compliance package you will find online.)
- Report a mixture according to the type(s) and quantities of hazardous components present in that mixture.
- Submit an updated **Safety Data Sheet (SDS)** for every hazardous substance and mixture you report on the **Facilities Inventory Form (FIF)** to the Department of Environmental Protection, the Fire Department, and the State Emergency Response Commission (SERC). Safety Data Sheets are submitted ONLY ONE TIME to the SERC for each substance present.
- Label all hazardous material containers with chemical names and Chemical Abstract Service (CAS) numbers. This includes the labeling of hazardous ingredients present in mixtures.

Who Must Report Hazardous Substances?

The owner or operator of a facility must report all hazardous substances present in a quantity equal to or greater than a threshold reporting quantity. For New York City Department of Education schools, the principal is considered the owner/operator who is responsible for reporting hazardous substances; however, in most cases, principals authorize the school custodian to complete this report and to submit it to the NYCDOE Division of School Facilities. The reporting is due every year on March 1st.

If you maintain the chemical inventory on a computer, you can submit a computer printout provided that your report follows the format of the **Facility Inventory Form (FIF)**. A link to the Facility Inventory Form can be found at https://www1.nyc.gov/nycbusiness/description/facility-inventory-form-fif--community-righttoknow-program.

Make sure you include all the information that would otherwise be provided on the FIF. For mixtures, the ingredients should be listed under the chemical name along with a CAS number and the concentration. Remember to number the pages, include the reporting period, and have an original signature of the responsible party of the facility.

Questions about reporting of hazardous substances can be directed to the NYCDOE's Division of School Facilities.

d.

New York City Department of Education Chemical Hygiene Plan and New York City Department of Education

Hazard Communication Plan

The New York City Department of Education maintains updated copies of its **Chemical Hygiene Plan** and **Hazard Communication Plan** on the Employee Safety and Health section of the DOE Infohub (https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health). Templates for these plans are maintained by the NYCDOE Office of Occupational Safety and Health (OOSH), which can be reached at 718-935-2319.

e. Safety Telephone Numbers and Websites

General Safety Hotlines and Resources

Poison Control National Hotline
1-800-222-1222

American Chemical Society
1155-16 St. NW
Washington D.C. 20036
www.acs.org

American Chemical Society Health and Safety Referral Service
800-227-5558
8 a.m.—5 p.m., Monday – Friday
(not an emergency service)

American Chemical Society Chemical and Lab Safety for High School Labs
https://www.acs.org/content/acs/en/chemical-safety/teach-and-learn/high-school.html

National Institute for Occupational Safety & Health (NIOSH)
www.cdc.gov/niosh

Professional Associations and Safety Resources

American Association of Chemistry Teachers
https://teachchemistry.org/

AACT Safety Resources
https://teachchemistry.org/classroom-resources/safety

American Association of Physics Teachers
https://www.aapt.org/

AAPT Safety in Physics Education
https://www.aapt.org/Resources/loader.cfm?csModule=security/getfile&pageid=21155&searchID=35364&pageNum=1

Council of State Science Supervisors
www.csss-science.org

National Association of Biology Teachers
www.nabt.org

NABT Health and Safety Resources
https://nabt.org/Resource-Links-Health-and-Safety

National Science Teaching Association
www.nsta.org

NSTA Safety Resources
https://www.nsta.org/topics/safety

New York City Safety and Right-to-Know Resources

New York City Department of Environmental Protection (NYCDEP)
59-17 Junction Blvd.
Flushing, N.Y. 11373-5107
718-595-4659
https://www1.nyc.gov/html/dep/html/home/home.shtml

New York City Department of Education Health and Safety Resources

New York City Department of Education
Office of Occupational Safety and Health (OOSH)
65 Court Street, Room 706
Brooklyn, NY 11201
718-935-2319
https://infohub.nyced.org/nyc-doe-topics/human-resources/employee-safety-and-health

New York City Department of Education
Division of School Facilities
44-36 Vernon Boulevard
Long Island City, NY 11101
https://www.opt-osfns.org/nycdsf/

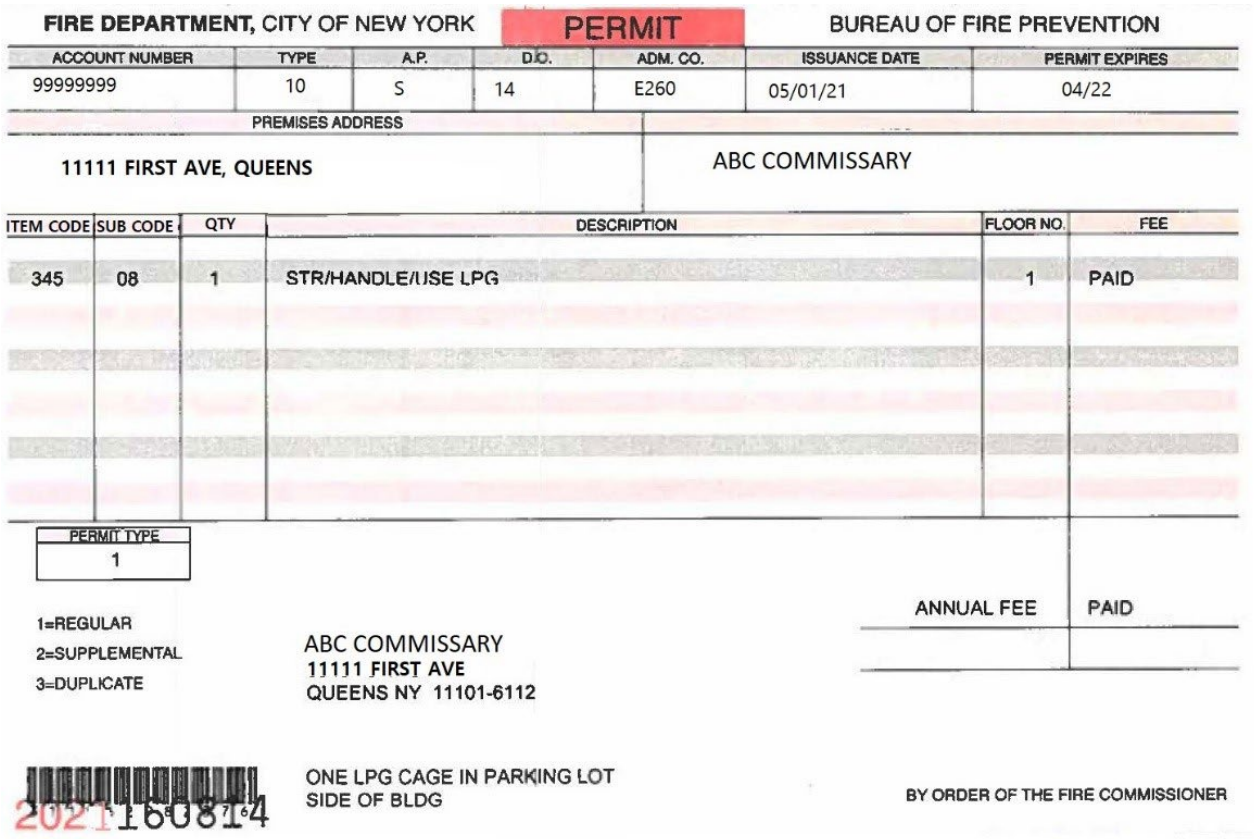
For Chemical Spill or Release

For Chemical Removal, Mercury Removal, Servicing of Acid Neutralization

Bernard Orlan, Division of School Facilities, Environmental Health &Safety
Phone: 718-361-3808
Fax: 718-610-3138
Email: borlan@schools.nyc.gov

f. Sample FDNY Permit

This is a screenshot of a sample FDNY permit.



FIRE DEPARTMENT, CITY OF NEW YORK — **PERMIT** — **BUREAU OF FIRE PREVENTION**

ACCOUNT NUMBER	TYPE	A.P.	D.O.	ADM. CO.	ISSUANCE DATE	PERMIT EXPIRES
99999999	10	S	14	E260	05/01/21	04/22

PREMISES ADDRESS	
11111 FIRST AVE, QUEENS	ABC COMMISSARY

ITEM CODE	SUB CODE	QTY	DESCRIPTION	FLOOR NO.	FEE
345	08	1	STR/HANDLE/USE LPG	1	PAID

PERMIT TYPE: 1

1=REGULAR
2=SUPPLEMENTAL
3=DUPLICATE

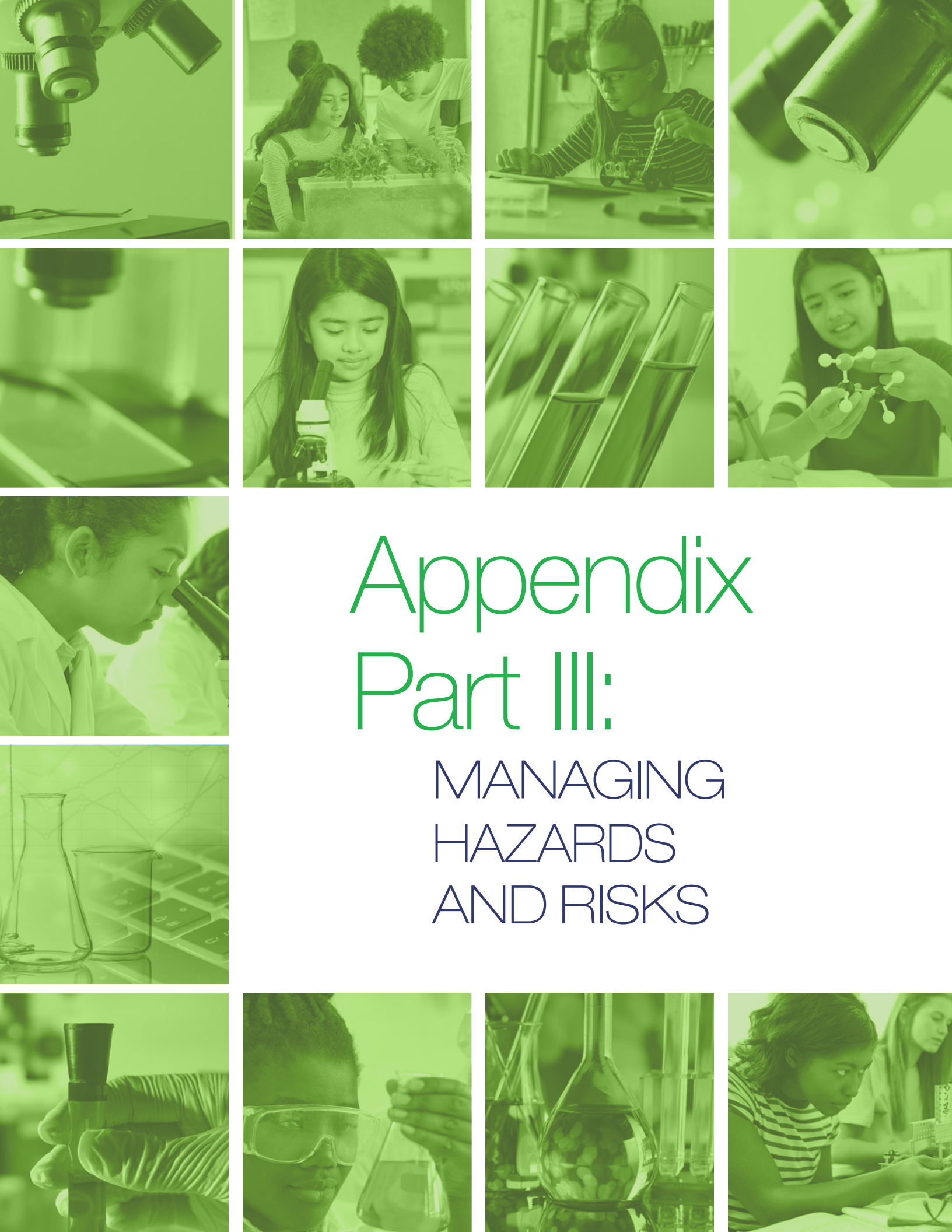
ANNUAL FEE: PAID

ABC COMMISSARY
11111 FIRST AVE
QUEENS NY 11101-6112

2021160814

ONE LPG CAGE IN PARKING LOT
SIDE OF BLDG

BY ORDER OF THE FIRE COMMISSIONER



Appendix Part III:

MANAGING HAZARDS AND RISKS

a.

Steps to a Safe and Clean Laboratory:

Managing Chemical Inventory and Disposal

1. A chemical inventory should be conducted yearly in order to determine your supply needs and to guarantee the safety of your laboratories. Conduct your inspection by following the attached **Chemical Storage** protocol that can be found in the *Laboratory Specialists* section of the *Science Safety Manual.* Following the protocol will enable you to both rearrange the chemicals and decide which ones should be removed.

2. Decide which chemicals need to be discarded before rearranging the remaining stock. These chemicals to be discarded should include:
   - Unlabeled chemicals
   - Explosive chemicals
   - Carcinogenic chemicals
   - Old chemicals in excessive amounts
   - Chemicals that exhibit:
     - Bulging containers
     - Liquids in solids
     - Solids in liquids
     - Darkening or clouding of solutions
     - Spotting on solids
   - Chemicals that have been on-site for 5 years or more

3. Identify the chemicals you want removed using colored self-adhesive labels. Do not remove the chemicals yourself; merely attach the colored "dots."

4. List these chemicals on the PO-18 Chemical Removal Request Form, which can be obtained from your custodian.

5. Make two copies of the list. Keep the original for your own records, give one copy to the assistant principal and the other to the custodian.

6. The custodian will prepare a work order PO-18 using the Trade Code 75 and attach the list of the chemicals.

7. The custodian will then fax the PO-18 form listing the chemicals to the Division of School Facilities via the Passport System and request a pick-up.

8. The chemicals you are keeping should be rearranged according to the Chemical Storage protocol and listed on the attached Chemical Inventory Form (See *Appendix*, page 222)

b. Eye Protection Requirements

Special Circular No. A-732 (October 1, 1979)

Regulation of the Chancellor

1. This regulation incorporates the regulations of the Commissioner of Education that pertain to eye safety devices (Section 141.10). Goggles are to be worn by all pupils, teachers, and visitors observing or engaging in the activities which involve the following:
   - Hot solids, liquids, or molten metal; or
   - Milling, sawing, turning, shaping, cutting, or stamping of any solid materials; or
   - Heat treatment, tempering, or kiln firing of any metal or other materials; or
   - Gas or electric arc welding; or
   - Repairing or servicing of any vehicle; or
   - Caustic or explosive chemicals or materials.
2. Eye safety devices within the meaning of this regulation include face shields, goggles, safety glasses, welding helmets, hoods and other specialized equipment. Such devices must meet the American National Standard Practice for Occupational and Educational Eye and Face Protection, 287.1-2014, promulgated by the American National Standards Institute, Inc.
3. Teachers involved in the above categories shall ensure that children under their jurisdiction use the goggles provided for them in all of the listed processes and any other activities that might create a hazardous condition for their eyes. Those eye protective devices listed by ShopDOE are acceptable under this regulation.

OSHA Standard CFR Part 29, 1910.133 (2015) "The use of appropriate eye protection when exposing to eye or face hazards from…liquid chemicals, acids or caustic liquids, chemical gases or vapors.

An important obligation of science teachers is to provide students with safe, appropriate eye protection. All safety goggles need to comply with ANSI 87.1—2015. Only safety goggles marked with —Z87.1|| should be purchased; the —Z87.1|| mark will appear on the frame or the lens. As a responsible teacher, you must select eyewear that provides you and your students with the most suitable protection for the hazards of your science activities.

Protection of the eyes is essential in any laboratory activity. Eye protection is required for (but not limited to) the following instances:

- When chemicals, glassware, or heating sources are being used
- When working with materials or equipment under stress, pressure, or force that might cause fragmentation or flying particles
- When an activity generates projectiles, uses elastic materials under stress (e.g., springs, wires, rubber, glass), or causes collisions
- When dust or fumes are present (eye protection reduces the dust or fumes reaching the eye)
- When using preserved specimens; eye protection is a must in any laboratory activity in biology, chemistry, or physics.

Effective eye protection must include adequate instruction on the hazards of the particular activity and the precautions to be taken to reduce the risk of injury.

Chemical-splash goggles should be the standard for eye protection when chemicals, glassware, a heating source, or preserved specimens are being used.

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 teacher specifically states that the activity or demonstration does not require the use of eye protection.

Recommendation for Shared Goggles

After use, shared goggles, including the straps should be disinfected using the 'Lysol Dip" method, in which goggles are immersed in a solution of Lysol or other approved disinfectant for 15 minutes; then goggles are rinsed with water and allowed to air dry. Lens paper can be used to remove any water spots. While this procedure should be sufficient to prevent environmentally transmitted disease, ideally, goggles will also be sterilized in a UV-C goggle sanitizer cabinet following their having been cleaned in disinfectant solution.

C. Glove and PPE Options

Glove Selection Guide

As with any personal protective equipment, it is important to select gloves that are appropriate for the chemical hazards. One type of glove does NOT protect against all types of chemicals!

The following glove selection chart is offered to help assess the general chemical resistance of various glove materials. We assume the gloves will be worn to protect against incidental contact of chemicals with skin. The glove selection chart does not replace the need for hazard assessment for avoiding contact with corrosive or irritating chemicals.

Glove Materials	General Uses
Latex (disposable)	Dilute aqueous solutions of mild irritants, such as inorganic salt solution, alcohols
Nitrile (disposable)	Dilute acid and base solutions, aliphatic hydrocarbons, alcohols
Nitrile (heavy duty)	Corrosive or caustic acids and bases, aqueous halogens, aliphatic and aromatic hydrocarbons, alcohols and ethers, some chlorinated organics
Neoprene	Corrosive and oxidizing acids, caustic alkali, hydrocarbons, alcohols
Butyl	Acid and bases, alcohols, ethers, ketone, and esters

**Chemical resistance of gloves is measured in three ways: degradation, breakthrough time, and permeation rate. For heavy-duty or long- term use you must consider not only the glove material but also the thickness, size and fit of the gloves.*

d. Substances Identified as Human Carcinogens by NIOSH

CAUTION: *The chemicals listed in the NIOSH list that follows are those that have substantial evidence of carcinogenicity. Further, each substance listed here may have additional health hazards. This list is published by The National Institute of Safety and Health (NIOSH) and is updated periodically on their website at https://www.cdc.gov/niosh/topics/cancer/npotocca.html.*

Many reputable scientific organizations publish current comprehensive test results. TRI produces a table that reviews current NTP, IARC and OSHA results.

These substances are NOT recommended for use or storage in schools unless an absolute need is determined, and appropriate use and storage safety procedures are instituted. If it is determined that there is a definite need to use one of these carcinogenic chemicals, and that no acceptable alternative chemicals exist, obtain additional information on the risk involved so that you and your administration can make an informed decision about whether to proceed with the use of this chemical. Information on many carcinogenic chemicals can be obtained from the National Institute of Safety and Health (NIOSH) or the Consumer Product Safety Commission (CPSC).

You can access a list of NIOSH Criteria Documents at https://www.cdc.gov/niosh/pubs/criteria_date_desc_nopubnumbers.html.

REMEMBER: *Some carcinogens are more potent than others and risk increases with level and duration of exposure.*

REMOVAL: Carcinogenic chemicals for which there is not a current demonstrated need should be removed from the school. These substances should be safely stored until a chemical pick up is arranged. Once removed, the substances should not reenter the school. Instructions should be added to the procedures for ordering chemicals to make sure that, once removed, these chemicals are not reordered.

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) was developed to harmonize classifying and labeling of chemicals internationally, including carcinogens. GHS was developed through the cooperation of the International Labor Organization (ILO), the Organization for Economic Cooperation and Development (OECD), and the United Nations Sub-Committee of Experts on the Transport of Dangerous Goods [UNECE, 20 2009]. The United States was part of this international agreement on classification and labeling, and the U.S. version has been codified by OSHA as part of its Hazard Communication Standard 22 [77 Fed. Reg. 17574-17896, 2012]. The GHS carcinogen categories align to varying extents with the NTP, EPA, IARC, and other carcinogen classification systems.

Hazardous Chemicals to Avoid

Elemental mercury may no longer be purchased or used in schools as of September 4, 2004, according to the Environmental Conservation Law, Article 27, and Title 21.

As per the Drug Enforcement Administration (DEA); 21 CFR Parts 1309 and 1310 (Rules-2007), handing regulated iodine materials (iodine crystals and iodine chemical mixtures that contain greater than 2.2 percent iodine) are required to register with DEA and are subject to the import/export notification requirements of the controlled Substances Act (CSA) and are required to maintain records of all regulated transactions involving iodine regardless of size. Crystal Iodine is commonly found in chemical storage rooms of high schools. Make sure you know the federal regulations.

Lugol's Iodine that is used as a starch indicator in Living Environment and biology laboratories does not require DEA registration so long as it contains less than 2.2% iodine.

The lists of hazardous chemicals that follow are not intended to be complete nor representative of the chemicals found in every high school science storeroom. The lists are intended to serve as an overview of chemicals of known hazards which should be avoided whenever possible. Chemicals are listed in no particular order under a heading. The information stated in the following tables is based on the Safety Data Sheet (SDS) posted on the Flinn Scientific website.

National Institute for Occupational Safety and Health (NOISH) List of Human Carcinogens (2014)

http://www.cdc.gov/niosh/topics/cancer/npotocca.html

A

Acetaldehyde
2-Acetylaminofluorene
Acrylamide
Acrylonitrile
Aldrin
4-Aminodiphenyl
Amitrole
Aniline and homologs
o-Anisidine
p-Anisidine
Arsenic and inorganic arsenic compounds
Arsine
Asbestos
Asphalt fumes

B

Benzene
Benzidine
Benzidine-based dyes
Beryllium
Butadiene
tert-Butyl chromate; class, chromium hexavalent

C

Cadmium dust and fume
Captafol
Captan
Carbon black (exceeding 0.1% PAHs)
Carbon tetrachloride
Chlordane

Chlorinated camphene

Chlorodiphenyl (42% chlorine); class polychlorinated biphenyls

Chlorodiphenyl (54% chlorine); class polychlorinated biphenyls

Chloroform

Chloromethyl methyl ether

Bis (Chloromethyl) ether

B-Chloroprene

Chromium, hexavalent [Cr(VI)]

Chromyl chloride; class, chromium hexavalent

Chrysene

Coal tar pitch volatiles; class, coal tar products

Coke oven emissions

D

DDT (dichlorodiphenyltrichloroethane)

Di-2-ethylhexyl phthalate (DEHP)

2,4-Diaminoanisoleo

o-Dianisidine-based dyes

1,2-Dibromo-3-chloropropane (DBCP)

Dichloroacetylene

p-Dichlorobenzene

3,3'-Dichlorobenzidine

Dichloroethyl ether

1,3-Dichloropropene

Dieldrin

Diesel exhaust

Diglycidyl ether (DGE); class, glycidyl ethers

4-Dimethylaminoazobenzene

Dimethyl carbomoyl chloride

1,1-Dimethylhydrazine; class, hydrazines

Dimethyl sulfate

Dinitrotoluene

Dioxane

E-G

Environmental tobacco smoke

Epichlorohydrin

Ethyl acrylate

Ethylene dibromide

Ehtylene dichloride

Ethylene oxide

Ethyleneimine

Ethylene thiourea

Formaldehyde

Gallium arsenide

Gasoline

H-K

Heptachlor

Hexachlorobutadiene

Hexachloroethane

Hexamethyl phosphoric triamide (HMPA)

Hydrazine

Kepone

M

Malonaldehyde

Methoxychlor

Methyl bromide; class, monohalomethanes

Methyl chloride

Methyl iodide; class, monohalomethanes

Methyl hydrazine; class, hydrazines

4,4'-Methylenebis(2-chloroaniline) (MBOCA)

Methylene chloride

4,4-Methylenedianiline (MDA)

N

α-Naphthylamine (alpha-naphthylamine)

β-Naphthylamine (beta-naphthylamine)

Nickel, metal, soluble, insoluble, and inorganic; class, nickel, inorganic

Nickel carbonyl

Nickel sulfide roasting

4-Nitrobiphenyl

p-Nitrochlorobenzene

2-Nitronaphthalene

2-Nitropropane

N-Nitrosodimethylamine

P

Pentachloroethane; class, chloroethanes

N-Phenyl-b-naphthylamine; class, b-naphthalene

Phenyl glycidyl ether; class, glycidyl ethers

Phenylhydrazine; class, hydrazines

Propane Sultone

B-Propiolactone

Propylene dichloride

Proplyene imine

Propylene oxide

R-S

Radon

Rosin core solder, pyrolysis products (containing formaldehyde)

Silica, crystalline cristobalite

Silica, crystalline quartz

Silica, crystalline tripoli

Silica, crystalline tridymite

silica, fused

Soapstone, total dust silicates

T

Tremolite silicates

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) (dioxin)

1,1,2,2-Tetrachloroethane

Tetrachloroethylene

Titanium dioxide

o-Tolidine-based dyes

o-Tolidine

Toluene diisocyanate (TDI)

Toluene diamine (TDA)

o-Toluidine

p-Toluidine

1,1,2-Trichloroethane; class, chloroethanes

Trichloroethylene

1,2,3-Trichloropropane

U-Z

Uranium, insoluble compounds Uranium, soluble compounds

Vinyl bromide; class, vinyl halides

Vinyl chloride

Vinyl cyclohexene dioxide

Vinylidene chloride (1,1-dichloroethylene); class, vinyl halides)

Welding fumes, total particulates

Wood dust

Zinc chromate; class, chromium hexavalent

e. Explosives

Explosive materials should not be in schools under any circumstances. If any of the chemicals listed in the table below are discovered, they will need to be removed as soon as possible. School staff involved with this process will need to adhere to all cautionary procedures for removal of explosives.

NOTE: *This is not a comprehensive list of all possible explosive chemicals. This table has been taken from List of Explosive Compounds, University of Pennsylvania Standard Operating Procedures at https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-explosive.*

REMOVAL: Explosives should be removed by trained fire or police bomb squads, or other qualified officials. Limit movement of containers of such chemicals in order to minimize the chance of detonation. Appropriate care should be exercised in the storage and handling of these materials.

List of Potentially Explosive (PEC) Chemicals[1]

acetyl peroxide
acetylene
ammonium nitrate
ammonium perchlorate
ammonium picrate
Ba/Pb/Hg azide
benzoyl peroxide
bromopropyne
butanone peroxide
cumene peroxide
diazodinitrophenol
dinitrophenol
dinitrophenylhydrazine
dinitroresorcinol
dipicryl amine
dipicryl sulphide
dodecanoyl peroxide
ethylene oxide
Hg fulminate
lauric peroxide
MEK peroxide
nitrocellulose
nitrogen trifluoride
nitroglycerine
nitroguanidine
nitromethane
nitrourea
picramide
picryl chloride
picryl sulphonic acid
propargyl bromide
sodium dinitrophenate
succinic peroxide
tetranitroaniline
trinitroaniline
trinitroanisole
trinitrobenzoic acid
trinitrocresol
trinitronaphthalene
trinitroresorcinol
Urea nitrate

f. Chemical Removal Form for Explosives

This is the chemical removal form for potentially explosive chemicals including shock-sensitive, friction-sensitive, water-sensitive or air-sensitive chemicals and other detonables.

Substance	CAS NO.	Record of Removal	Who, Where Taken, Date
Benzoyl Peroxide	94-36-0		
Carbon Disulfiide[1]	75-15-0		
Diisopropyl Ether[2]	108-20-3		
Ethyl Ether[2]	60-29-7		
Picric Acid[3]	88-89-1		
Perchloric Acid	7601-90-3		
Potassium Metal[2]	7440-09-7		

g. List of Banned Substances, Equipment, and Experiments

Alcohol, Propane, and Butane Burners:	Alcohol, propane, and butane burners are not allowed in New York City Department of Education laboratories or demonstration or preparation rooms. Use alternative heat sources (see Heat-Generating Sources page 70) instead.
Carcinogens and Mutagens:	See Substances Identified as Human Carcinogens by NIOSH page 185 for information and links about chemicals known to be carcinogens.
Explosives:	Explosives are prohibited in all New York City Department of Education school settings. See Explosives page 189 for instructions on how to arrange for removal of any explosives found in your school building.
Formaldehyde and Formalin:	Due to its being a carcinogen, formaldehyde and all specimens preserved in formaldehyde or formalin should be removed from schools. For more information, see Fluid-Preserved Specimens on page 108.
Mercury:	Elemental mercury is a neurotoxin and should be removed. See Hazardous Chemicals on page page 191 for information about mercury and mercury removal.
Rainbow Experiment:	The "Rainbow" flame test experiment is banned from all New York City Department of Education schools. More information about the Rainbow Experiment at its hazards can be found at the U.S. Chemical Safety and Hazard Investigation Board's October 2014 Safety Bulletin. Teachers may elect to use a safer alternative, such as the American Chemical Society's revised Flame Test, or may opt to use a video demonstration of a flame test.
Rocket Fuel:	Solid and liquid rocket fuels are banned from all New York City Department of Education schools and investigations. See the Physics safety precautions section page 111 for more information on rocket safety.
Volcano Demonstrations Using Ammonium Dichromate:	Although some texts suggest an experiment involving ammonium dichromate that dramatically simulates the effects of a volcano, this experiment should **never** be performed in the classroom. Ammonium dichromate is highly toxic.

A comprehensive list of banned chemicals can be found in the charts on the following page.

FLINN Scientific Typical Banned Chemical List

Adapted from Science Teachers' Association of Ontario document "Safer Use of Chemicals" ISBN 1-894592-25-2

Please consult your local State Department of Education Guidance Documents and/or Chemical Hygiene Plan for adherence to chemical policies. Restricted Components are typically governed by strict rules for the safe use, transport and storage as strong oxidizers.

Restricted Component	Hazards	Suitability	Comments
Ammonium Nitrate	Strong oxidizing agent	Restricted	Quantity ordered per year, or on site, not to exceed 1 kg at any time. May self-ignite/detonate when in contact with powdered metals and some organic materials such as urea and acetic acid.
Hydrogen Peroxide, 30% (higher % not permitted)	Corrosive liquid, oxidizing material	Restricted	Quantity ordered per year, or on site, not to exceed 4 L at any time. Avoid contact with a combustible materials, organic materials, metals, acids, alkalis. Do not store above 8°C (refrigerate). Store in light-resistant container.
Nitric Acid, 68% or higher	Corrosive liquid, oxidizing material	Restricted	Quantity ordered per year, or on site, not to exceed 1L at any time. Separate from acids, alkalines, reducing agents and combustibles. Reacts with water to produce heat, and toxic, corrosive fumes of nitrogen oxides. Do not store above 23°C.
Nitromethane	Flammable liquid, flash point = 35°C, unstable, toxic	**Banned**	Highly explosive in presence of open flames and sparks, of heat, of oxidizing materials. Safer, more stable alternatives are available.
Potassium Chlorate	Strong oxidizing agent, toxic	Restricted	Quantity ordered per year, or on site, not to exceed 1 kg at any time. Never add water to this compound. Extremely reactive or incompatible with reducing agents, combustible materials, and organic materials. For demonstration purposes by teacher - not for student use.

Restricted Component	Hazards	Suitability	Comments
Potassium Nitrate	Strong oxidizing agent	Restricted	Quantity ordered per year, or on site, not to exceed 1 kg at any time. No contact with easily oxidizable substances, it may react rapidly enough to cause ignition, violent combustion, or explosion. It increases the flammability of any combustible substance. Hygroscopic so keep container tightly closed.
Potassium Perchlorate	Dangerously reactive material, unstable	**Banned**	Keep away from heat, sources of ignition, combustible materials, oxidizing materials, strong bases, direct sunlight or strong incandescent light. Safer, more stable alternatives are available.
Sodium Chlorate	Strong oxidizing agent	Restricted	Quantity ordered per year, or on site, not to exceed 1 kg at any time. May explode from heat or contamination. May react explosively with hydrocarbons (fuels). May ignite combustibles (wood, paper, oil, clothing). Keep container in a cool, well-ventilated area and separate from acids, alkalies, reducing agents and combustibles. For demonstration purposes by teacher - not for student use.
Sodium Nitrate	Strong oxidizing agent	Restricted	Quantity ordered per year, or on site, not to exceed 1 kg at any time. Keep container tightly closed. Keep container in a cool, well-ventilated area and separate from acids, alkalies, reducing agents and combustibles. Contact with combustible or organic materials may cause fire.

Chemical	Hazards	Suitability	Comments
Acetaldehyde (Ethanal)	Flammable, carcinogen	Banned	Suspected carcinogen. Highly volatile. Dangerous fire and explosion risk. May form explosive levels of peroxides in storage.
Acetamide (Ethanamide)	Toxic, carcinogen, mutagen	Banned	Suspected carcinogen and mutagen.
Acetyl Chloride (Ethanoyl chloride)	Reactive, explosive	Banned	Reacts violently with water producing phosgene gas. Forms an explosive mixture with air.
Acrylamide (Propenamide)	Extremely toxic, carcinogen	Banned	Causes paralysis of central nervous system. For DNA electrophoresis, agarose works in most cases.
Acrylic Acid	Toxic, carcinogen	Banned	Suspected carcinogen. Prone to hazardous polymerization.
Acrylonitrile (Vinyl Cyanide)	Extremely toxic, flammable , carcinogen, mutagen	Banned	Suspected carcinogen and mutagen. Designated substance Reg 490/09
All metals in powder or dust form	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Aluminum, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Aluminum Chloride, Anhydrous	Corrosive, reactive, explosive	Banned	Violent reaction with water. Large volumes of toxic HCl gas can be produced.***aluminum chloride hydrates permitted***

Chemical	Hazards	Suitability	Comments
Aluminum Dichromate	Extremely toxic carcinogen	Banned	Carcinogenic by inhalation.
Aluminum Fluoride	Extremely toxic	Banned	Toxic by inhalation or if swallowed.
Aluminum Nitrate, Anhydrous	Oxidizing agent, harmful, irritant, reactive, explosive	Banned	May react violently as a result of shock or friction. ***aluminum nitrate hydrates permitted***
Aluminum Sodium Fluoride (Synthetic Cryolite) see Sodium Aluminum Floride	Extremely toxic	Banned	Poisonous by ingestion. Large doses or overexposure may cause severe nausea, vomiting, diarrhea, abdominal burning and cramp-like pains. Contact with skin and eyes may cause irritation. Inhalation may cause irritation to mucous membranes and respiratory tracts.
Ammonium Chromate	Toxic, harmful, irritant, oxidizing agent	Banned	Moderately toxic by ingestion. Strong irritant.
Ammonium Dichromate	Extremely toxic, oxidizing agent, carcinogen	Banned	Known carcinogen, environmental risk
Ammonium Fluoride	Corrosive, extremely toxic	Banned	Corrosive to body tissues. Toxic by ingestion and inhalation.
Ammonium Nitrite	Reactive, explosive, oxidizing agent, toxic	Banned	Mutagen, possible teratogen, may be toxic to blood, cardiovascular system, smooth muscle, environmental risk.

Chemical	Hazards	Suitability	Comments
Ammonium Perchlorate	Oxidizing agent	Banned	Used in making explosives, pyrotechnic compositions, jet and rocket propellants.
Ammonium Persulfate (Ammonium Peroxydisulfate)	Oxidizing agent, harmful, irritant	Banned	Fire or explosion hazard if mixed with metals, non-metals, cloth, paper or wood. Decomposes slowly and pressure may build up in container.
Aniline (Aminobenzene, Phenylamine)	Extremely toxic, carcinogen	Banned	Possible carcinogen and mutagen, toxic if swallowed or in contact with skin, environmental risk.
Antimony and antimony compounds	Extremely toxic	Banned	Extremely toxic, may cause burns to skin, lungs upon inhalation. May be fatal if inhaled or ingested.
Aqua Regia (Nitro-hydrochloric acid)	Extremely corrosive, oxidizing agent	Banned	Extremely toxic, may cause burns to skin, lungs upon inhalation. May be fatal if inhaled or ingested.
Arsenic and arsenic compounds	Extremely toxic, carcinogen	Banned	Known carcinogen. Designated substance Reg 490/09
Asbestos - all forms (including ascarite)	Toxic, carcinogen	Banned	Known carcinogen. Designated substance Reg 490/09
Atropine Sulfate	Extremely toxic	Banned	The substance is toxic to lungs, the nervous system, mucous membranes.
Azides - all forms	Extremely toxic, reactive, explosive	Banned	Substances decompose explosively on heating, shock, or friction.

Chemical	Hazards	Suitability	Comments
Barium metal	flammable,irritant	Banned	In contact with water releases flammable gases. Contact with skin and eyes may cause irritation. Inhalation may cause irritation to mucous membranes and respiratory tract.
Barium Chlorate	Oxidizing agent	Banned	Strong oxidizing agent. Fire risk in the presence of organic material.
Barium Chromate	Toxic, carcinogen	Banned	Carcinogenic by inhalation. If a precipitate is formed in a reaction it should not be isolated and dried.
Barium Cyanide	Extremely toxic	Banned	Extremely toxic.
Barium Dioxide		Banned	See Barium Peroxide
Barium Fluoride	Toxic	Banned	Hazardous if ingested or inhalated. Contact with skin and eyes may cause irritation. Inhalation may cause irritation to mucous membranes and respiratory tract.
Barium Oxide	Toxic, corrosive	Banned	Hazardous if ingested or inhalated. Contact with skin and eyes may cause irritation. Inhalation may cause irritation to mucous membranes and respiratory tract.
Barium Perchlorate	Oxidizing agent, toxic	Banned	Strong oxidizing agent. May explode with friction.
Barium Peroxide (Barium Dioxide)	Oxidizing agent, harmful, irritant	Banned	Reacts vigorously with water to give a corrosive solution. The reaction with metal powders and organic compounds is explosive.

Chemical	Hazards	Suitability	Comments
Benzene	Flammable, toxic, carcinogen	Banned	Known carcinogen. Designated substance Reg 490/09
Benzoyl Peroxide	Flammable, harmful, irritant	Banned	Both flammable and explosive. May explode spontaneously upon heating or friction or when dry. Reacts violently with strong bases. Irritates eyes, skin and respiratory tract.
Beryllium and beryllium compounds	Extremely toxic, carcinogen	Banned	Extremely toxic. Suspected carcinogen, environmental risk.
Bismuth, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Bromine, liquid	Extremely toxic, oxidizing agent reactive, explosive, corrosive	Banned	Very hazardous substance. Highly toxic. Extremely corrosive.
Bromoethane		Banned	See **Ethyl Bromide**
Cadmium and cadmium compounds	Toxic, carcinogen	Banned	Most are either known or suspected carcinogens. Environmental risk.
Carbolic Acid		Banned	See Phenol
Carbon Disulfide	Flammable, toxic, carcinogen	Banned	Dangerous fire and explosion risk. Suspected carcinogen
Carbon Tetrachloride (Tetrachloromethane)	Carcinogen, toxic	Banned	Suspected carcinogen. Environmental risk

Chemical	Hazards	Suitability	Comments
Carnoy's Solution, fixative	Toxic,flammable	Banned	Contains chloroform, a suspected carcinogen.
Chloramphenicol	Toxic, carcinogen	Banned	Suspected carcinogen.
Chlorine Gas cylinder	Extremely toxic	Banned	Extremely toxic.
Chloroform (Trichloromethane)	Toxic, carcinogen	Banned	Suspected carcinogen
Chloroethene	Flammable, toxic	Banned	See Vinyl Chloride. Designated substance Reg 490/09
Chromic Acid, cleaning mixture	Oxidizing agent toxic, corrosive, carcinogen	Banned	This mixture of concentrated sulfuric acid and potassium dichromate, which has been traditionally used for cleaning glassware, reacts violently with organic compounds. Commercial detergents are much safer. Environmental risk.
Chromium and chromium (VI) compounds	Oxidizing agent toxic, corrosive, carcinogen	Banned	All are known or suspected carcinogens, MOE substance of concern, environmental risk
Cobalt Metal, powder	Reactive, explosive, carcinogen	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard. Carcinogen.
Cobalt (II) Carbonate	Harmful, irritant, carcinogen	Banned	Possible carcinogen. Environmental risk
Cobalt (II) and (III) Oxide	Harmful, irritant, carcinogen	Banned	Possible carcinogen.

Chemical	Hazards	Suitability	Comments
Colchicine	Extremely toxic, mutagen	Banned	Extremely toxic. Possible mutagen.
Collodion	Flammable, harmful, irritant	Banned	Dangerous fire risk. Body tissue irritant.
Congo Red	Carcinogen, mutagen	Banned	Possible carcinogen and mutagen.
Copper, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Cryolite		Banned	See **Sodium Aluminum Fluoride**
Cyanides, in general (but not ferro or ferri)	Extremely toxic	Banned	Extremely toxic.
DDT	Toxic, carcinogen	Banned	Suspected carcinogen. Environmental risk
1,2-Dibromoethane (Ethylene Dibromide)	Toxic, carcinogen	Banned	Suspected carcinogen. Environmental risk
1,2-Dichloroethane (Ethylene Dichloride)	Flammable, toxic, carcinogen	Banned	Suspected carcinogen. Environmental risk
Dichlorobenzidine	Toxic, carcinogen	Banned	Suspected carcinogen. Environmental risk
Dichloromethane (Methylene Dichloride)	Harmful, irritant, carcinogen	Banned	Possible carcinogen. Narcotic in high concentrations. Very volatile.

Chemical	Hazards	Suitability	Comments
Diethyl Ether (Ethyl Ether/Ethoxyethane)	Flammable, harmful, irritant	Banned	Dangerous fire and explosion risk. Causes respiratory paralysis.
Diethyl Phthalate	Harmful, irritant, teratogen	Banned	Possible teratogen.
Dimethyl Sulfate	Extremely toxic, carcinogen	Banned	Suspected carcinogen.
Dimethyl Sulfoxide	Mutagen	Banned	Readily penetrates the body through the skin and all organs. Mutagenic.
Dinitrophenol	Extremely toxic.	Banned	Readily absorbed through skin.
2,4-Dinitrophenylhydrazine	Extremely toxic.	Banned	Extremely toxic.
1,4-Dioxane (Diethylene Oxide)	Flammable, carcinogen	Banned	Possible carcinogen. Forms explosive peroxides. MOE identified environmental concern
Ethanal		Banned	See **Acetaldehyde**
Ethanamide		Banned	See **Acetamide**
Ethyl Bromide (Bromoethane)	Flammable, harmful, irritant, carcinogen	Banned	Possible carcinogen.
Ethyl Carbonate	Flammable, carcinogen	Banned	Possible carcinogen.

Chemical	Hazards	Suitability	Comments
Ethyl Chloride (Chloroethane)	Flammable, harmful, irritant, carcinogen	Banned	Possible carcinogen.
Ethylene Dibromide		Banned	See **1,2-Dibromoethane**
Ethylene Dichloride		Banned	See **1,2-Dichloroethane**
Ethylene Oxide Gas cylinder	Flammable, compressed gas, carcinogen, mutagen	Banned	Designated substance Reg 490/09
Ethylene Trichloride		Banned	See Trichloroethylene
Ethyl Ether		Banned	See Diethyl Ether
Ethyl Iodide (Iodoethane)	Flammable, harmful, irritant, carcinogen	Banned	Suspected carcinogen. Sensitive to light.
FAA Solution	Flammable, toxic		Contains formaldehyde a suspected carcinogen.
Fluorine Gas cylinder	Extremely toxic, corrosive, compressed gas	Banned	May be fatal if inhaled. Causes severe respiratory, skin and eye burns.
Formaldehyde, 37-41% Solution (Methanal)	Toxic, carcinogen	Banned	Suspected carcinogen. Strong irritant. Toxic by ingestion, inhalation and skin absorption.

Chemical	Hazards	Suitability	Comments
Formalin, 10% Formaldehyde Solution	Harmful, irritant, carcinogen	Banned	Suspected carcinogen. Strong irritant. Toxic by ingestion, inhalation and skin absorption.
Gallic Acid	Harmful, irritant, teratogen	Banned	Possible teratogen.
Gluconic Acid	Extremely toxic	Banned	Inhalation may be fatal.
Hydrazine	Toxic, flammable, carcinogen	Banned	Suspected carcinogen. Environmental risk.
Hydrofluoric Acid	Extremely corrosive	Banned	Extremely corrosive.
Hydrogen Sulfide Gas cylinder	Flammable, extremely toxic, compressed gas	Banned	Offensive stench, toxic by inhalation, environmental risk.
Ethylene Trichloride		Banned	See **Trichloroethylene**
Ethyl Ether		Banned	See **Diethyl Ether**
Ethyl Iodide (Iodoethane)	Flammable, harmful, irritant, carcinogen	Banned	Suspected carcinogen. Sensitive to light.
FAA Solution	Flammable toxic	Banned	Contains formaldehyde a suspected carcinogen.
Fluorine Gas cylinder	Extremely toxic, corrosive, compressed gas	Banned	May be fatal if inhaled. Causes severe respiratory, skin and eye burns.

Chemical	Hazards	Suitability	Comments
Formaldehyde, 37-41% Solution (Methanal)	Toxic, carcinogen	Banned	Suspected carcinogen. Strong irritant. Toxic by ingestion, inhalation and skin absorption.
Formalin, 10% Formaldehyde Solution	Harmful, irritant, carcinogen	Banned	Suspected carcinogen. Strong irritant. Toxic by ingestion, inhalation and skin absorption.
Gallic Acid	Harmful, irritant, teratogen	Banned	Possible teratogen.
Gluconic Acid	Extremely toxic	Banned	Inhalation may be fatal.
Hydrazine	Toxic, flammable, carcinogen	Banned	Suspected carcinogen. Environmental risk.
Hydrofluoric Acid	Extremely corrosive	Banned	Extremely corrosive.
Hydrogen Sulfide Gas cylinder	Flammable, extremely toxic, compressed gas	Banned	Offensive stench, toxic by inhalation, environmental risk.
Hydroquinone (Benzene-1,4-Diol)	Toxic, irritant	Banned	Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Possible carcinogen and mutagen. Environmental risk.
Iron Metal, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard. **iron filings permitted**
Isocyanates	Harmful, irritant	Banned	Designated substance Reg 490/09 - permitted purchase/use determined by the board

Chemical	Hazards	Suitability	Comments
Lead Metal	Extremely toxic, carcinogen	Banned	Lead as a powder is extremely toxic by inhalation and ingestion. Possible carcinogen as a fume or dust. Environmental risk. Designated substance Reg 490/09. ** A small amount of elemental lead is permitted as part of the teaching materials related to radioactivity.**
Lead (II) Chromate	Toxic carcinogen	Banned	Suspected carcinogen. Environmental risk.
Magnesium Metal, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Manganese Metal, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Mercury and mercury compounds	Extremely toxic	Banned	Highly toxic. Environmental risk. Mercury is a designated substance Reg 490/09
Methanal		Banned	See **Formaldehyde**
Methylbenzene		Banned	See **Toluene**
Methylene Chloride			See **Dichloromethane**
Millon's Reagent	Extremely toxic, corrosive	Banned	A solution of mercury (II) nitrate in concentrated nitric acid. Environmental risk. Use less hazardous alternatives for protein determination e.g., Albustix, Sakaguchi test or Cole's modification of Millon's reagent.
Nickel Metal, powder/dust	Reactive, irritant, corrosive	Banned	Dust is flammable. It is a carcinogen by inhalation; also a sensitizer, causing nickel rash.

Chemical	Hazards	Suitability	Comments
Nickel (II) Oxide	Toxic, carcinogen	Banned	Known carcinogen. Environmental risk.
Nitrocellulose	Reactive, explosive	Banned	Explosion risk.
Nitrogen Dioxide Gas cylinder	Extremely toxic, compressed gas	Banned	Very toxic by inhalation and severe irritant to respiratory system, eyes and skin.
Pentane	Flammable, harmful, irritant	Banned	Narcotic in high concentrations. Environmental risk. Use hexane or heptane as a safer alternative.
Perchloric Acid	Oxidizing agent, corrosive	Banned	Extreme explosion hazard.
Perchloroethylene		Banned	See **Tetrachloroethylene**
Phenol (Carbolic acid)	Toxic, harmful, irritant	Banned	Very toxic by skin absorption. Strong skin irritant.
Phosphorus Pentoxide (Phosphorus (V) Oxide)	Corrosive	Banned	Severely corrosive substance.
Picric Acid (2,4,6- Trinitrophenol)	Reactive, explosive	Banned	Explosion risk.
Potassium Cyanide	Extremely, toxic, corrosive	Banned	Very hazardous in case of skin contact (permeator), of ingestion, of inhalation. Hazardous in case of skin contact (irritant), of eye contact (irritant). Corrosive to eyes and skin. Oral LD50: Acute: 5 mg/kg. Environmental risk.
Propenamide		Banned	See **Acrylamide**

Chemical	Hazards	Suitability	Comments
Pyridine	Flammable, harmful, irritant	Banned	Flammable liquid, toxic - oral, dermal, ingestion.
Radioactive elements and compounds	Toxic, radioactive	Banned	Radioactive elements and compounds are very toxic. Radioactive substances used for teaching purposes are permitted.
Semicarbazide Hydrochloride	Extremely toxic	Banned	Extremely toxic; may be fatal if swallowed. Readily absorbed through skin.
Silica		Banned	Designated substance Reg 490/09 - permitted purchase/use determined by the board
Sodium Aluminum Fluoride (Cryolite)		Banned	See **Aluminum Sodium Fluoride**
Sodium Arsenite	Extremely toxic, carcinogen, mutagen	Banned	Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of inhalation. Carcinogen and mutagen.
Sodium Azide (Sodium Trinitride)	Extremely toxic, reactive, explosive	Banned	Extremely toxic. Substances decompose explosively on heating, shock, concussion or friction.
Sodium Cyanide	Extremely toxic	Banned	Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator). Corrosive to eyes and skin. ORAL LD50: 6.44 mg/kg.
Sodium Trinitride		Banned	See **Sodium Azide**
Sulfur Dichloride Oxide		Banned	See **Thionyl Chloride**

Chemical	Hazards	Suitability	Comments
Sulfur Dioxide Gas cylinder	Toxic, harmful, irritant	Banned	Intensely irritating to the eyes and respiratory tract.
Sulfurous Acid	Toxic, corrosive, mutagen	Banned	Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion. Mutagenic.
Tetrachloroethylene (Tetrachloroethene/Perchloro ethylene)	Harmful, irritant, carcinogen	Banned	Possible carcinogen. MOE identified environmental concern.
Tetrachloromethane		Banned	See **Carbon Tetrachloride**
Thiocarbamide		Banned	See **Thiourea**
Thionyl Chloride (Sulfur Dichloride Oxide)	Corrosive, extremely toxic	Banned	Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.
Thiourea	Extremely toxic, carcinogen	Banned	Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation. Environmental risk.
Thorium and thorium compounds	Toxic, radioactive	Banned	The metal is radioactive and very toxic. Radioactive substances used for teaching purposes are permitted.
Tin, powder	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.

Chemical	Hazards	Suitability	Comments
Toluene (Methylbenzene)	Flammable, harmful, irritant	Banned	Poisonous by skin absorption. Chronic effects include anemia and dermatitis.
1,1,1-Trichloroethane (Methyl Chloroform)	Toxic	Banned	Damages the ozone layer. Environmental risk.
Trichlorethylene (Trichloroethene/Ethylene Trichloride)	Toxic, carcinogen	Banned	Suspected carcinogen. MOE identified environmental concern.
Trichloromethane		Banned	See **Chloroform**
2,4,5-Trichlorophenoxyacetic Acid	Harmful, irritant, carcinogen, mutagen	Banned	Herbicide. Possible carcinogen and mutagen.
1,1,2-Trichloro Trifluoroethane (TTFE)	Toxic	Banned	Damages the ozone layer. Environmental risk.
Trifluoroacetic acid	Extremely corrosive	Banned	Extremely hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.
Uranium and uranium compounds	Extremely toxic, radioactive	Banned	The metal is radioactive and very toxic, especially by inhalation of dust. Radioactive substances used for teaching purposes are permitted.
Vanadium Pentoxide	Toxic, teratogen, mutagen	Banned	Suspected teratogen and mutagen.

Chemical	Hazards	Suitability	Comments
Vinyl Chloride monomer (Chloroethene)	Flammable, toxic	Banned	Designated substance Reg 490/09. MOE identified environmental concern.
Xylidene	Toxic, carcinogen	Banned	Used in the preparation of dyes.
Zinc, dust	Reactive, explosive, irritant	Banned	Fine metal powders may form an explosive mixture with air. May be ignited by friction, heat, sparks or flames. Inhalation hazard.
Zinc Chromate	Toxic, carcinogen	Banned	Known carcinogen. Environmental risk.

GHS Pictograms

GHS Pictogram	Hazard Classification	Explanation
none	**Biohazardous**	A substance that contains bacteria or viruses that can cause disease in humans
	**Compressed Gas**	A substance under high pressure contained in a cylinder which may explode or burst when heated, dropped or damaged.
	**Carcinogen**	A substance that may cause cancer, if breathed in, swallowed or absorbed via the skin.
	**Corrosive**	A substance that may destroy living tissue on contact, causing burns. Materials causing burns when in contact with skin for three minutes or less are classified as **extremely corrosive**. Materials causing burns when in contact with skin for a more prolonged period are classified as **corrosive**.
	**Dangerous for the environment**	Substances that are toxic to aquatic and/ or non-aquatic organisms and may cause long-term adverse effects to the environment.
	**Dangerously reactive**	Substances which may react violently causing explosion, fire or release of toxic gases when exposed to light, heat, vibration or extreme temperatures.
	**Flammable**	A substance is classified as **extremely flammable** if it has a flash point lower than 22.8C and a boiling point lower than 37.8C. It is classified as **highly flammable** if it has a flash point below 22.8C and a boiling point at or above 37.8C. It is classified as **flammable** if it has a flash point below 37.8C.

GHS Pictogram	Hazard Classification	Explanation
	**Harmful Irritant**	A substance similar to a toxic one but with less severe health risks OR a substance (including a dust) that behaves in a similar way to corrosives but, instead of destroying living tissue, causes significant inflammation (reddening) through immediate, prolonged or repeated contact with the skin or a mucous membrane (e.g., eyes, lungs, etc).
	**Mutagenic**	A substance that can cause mutations in the genetic material of a cell exposed to it.
	**Oxidizing agent**	A substance that may give rise to a vigorous reaction or explosion when in contact with combustible or flammable substances.
	**Teratogen**	A substance that can cause defects in the offspring (usually via the placenta after absorption by the mother during pregnancy).
	**Toxic**	A substance that in very small quantities may cause death or damage to health when breathed in, swallowed or absorbed via the skin. A substance is classified as **extremely toxic** if a single exposure to the substance may be fatal or cause serious or permanent toxic effects. It is classified as **toxic** if repeated exposure is needed to cause permanent damage to health.

GHS—Hazard Pictograms and correlated exemplary Hazard Classes				
Physical Hazards				
 Explosives	 Flammable Liquids	 Oxidizing Liquids	 Compressed Gasses	 Corrosive to Metals
Health Hazards				**Environmental Hazards**
 Acute Toxicity	 Skin Corrosion	 Skin Irritation	 CMR[1], STOT[2], Aspiration Hazard	 Hazardous to the Aquatic Environment

1 carcinogenic, germ cell mutagenic, toxic to reproduction

2 specific target organ toxicity

h.

NYCDOE IRB:

Additional Information on Human Subjects Research

What is human subjects research?

"Human subjects research" (HSR) is defined as those activities that meet the criteria articulated in applicable U.S. DHHS regulations to be considered as both "research" and as involving "human subjects". [1]

Research:	A systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.
Clinical Trial:	A research study in which one or more human subjects are prospectively assigned to one or more interventions (which may include placebo or other control) to evaluate the effects of the interventions on biomedical or behavioral health-related outcomes.
Human Subject:	A living individual about whom an investigator (whether professional or student) conducting research: 1) obtains information or biospecimens through intervention or interaction with the individual, and uses, studies, or analyzes the information or biospecimens; or 2) obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens.
Intervention:	Both physical procedures by which information or biospecimens are gathered (for example, venipuncture) and manipulations of the subject or the subject's environment that are performed for research purposes.
Interaction:	Communication or interpersonal contact between investigator and subject.

Private Information:	Information about behavior that occurs in context in which an individual can reasonably expect that no observation or recording is taking place, and information which has been provided for specific purposes by an individual and which the individual can reasonably expect will not be made public (for example, a student record).
Identifiable Private Information:	Private information for which the identity of the subject is or may readily be ascertained by the investigator or associated with the information.
Identifiable Biospecimen:	Biospecimen for which the identity of the subject is or may readily be ascertained by the investigator associated with the biospecimen.[2]
Engaged:	The NYC DOE is considered engaged in a particular human subjects research project when NYC DOE employees, students, or other affiliates, including, but not limited to, volunteers and contractors, obtain, for the purposes of the research project, (1) data about the subjects of the research through intervention or interaction with them; (2) identifiable private information about the subjects of the research; or (3) the informed consent of human subjects for the research.
Public Health Authority:	An agency or authority of the Unites States, a state, a territory, a political subdivision of a state or territory, an Indian tribe, or a foreign government, or a person or entity acting under a grant or authority from or contract with such public agency, including the employees or agents of such public agency or its contractors or persons or entities to whom it has granted authority, that is responsible for public health matters as part of its official mandate.

Activities Deemed Not to be Research:

Scholarly and journalistic activities (e.g., oral history, journalism, biography, literary criticism, legal research, and historical scholarship), including the collection and use of information, that focus directly on the specific individuals about whom the information is collected.

NOTE: *Studies using participant observation and ethnographic methods, in which investigators gather information from individuals in order to understand their beliefs, customs, and practices, where the findings apply to the larger studied community or group (and not just the individuals from whom the information was obtained), however, are considered to be research.*

Public health surveillance activities, including the collection and testing of information or biospecimens, conducted, supported, requested, ordered, required, or authorized by a public health authority.

Such activities are limited to those necessary to allow a public health authority to identify, monitor, assess, or investigate potential public health signals, onsets of disease outbreaks, or conditions of public health importance (including trends, signals, risk factors, patterns in diseases, or increases in injuries from using consumer products).

Such activities include those associated with providing timely situational awareness and priority setting during the course of an event or crisis that threatens public health (including natural or man-made disasters).

Collection and analysis of information, biospecimens, or records by or for a criminal justice agency for activities authorized by law or court order solely for criminal justice or criminal investigative purposes.

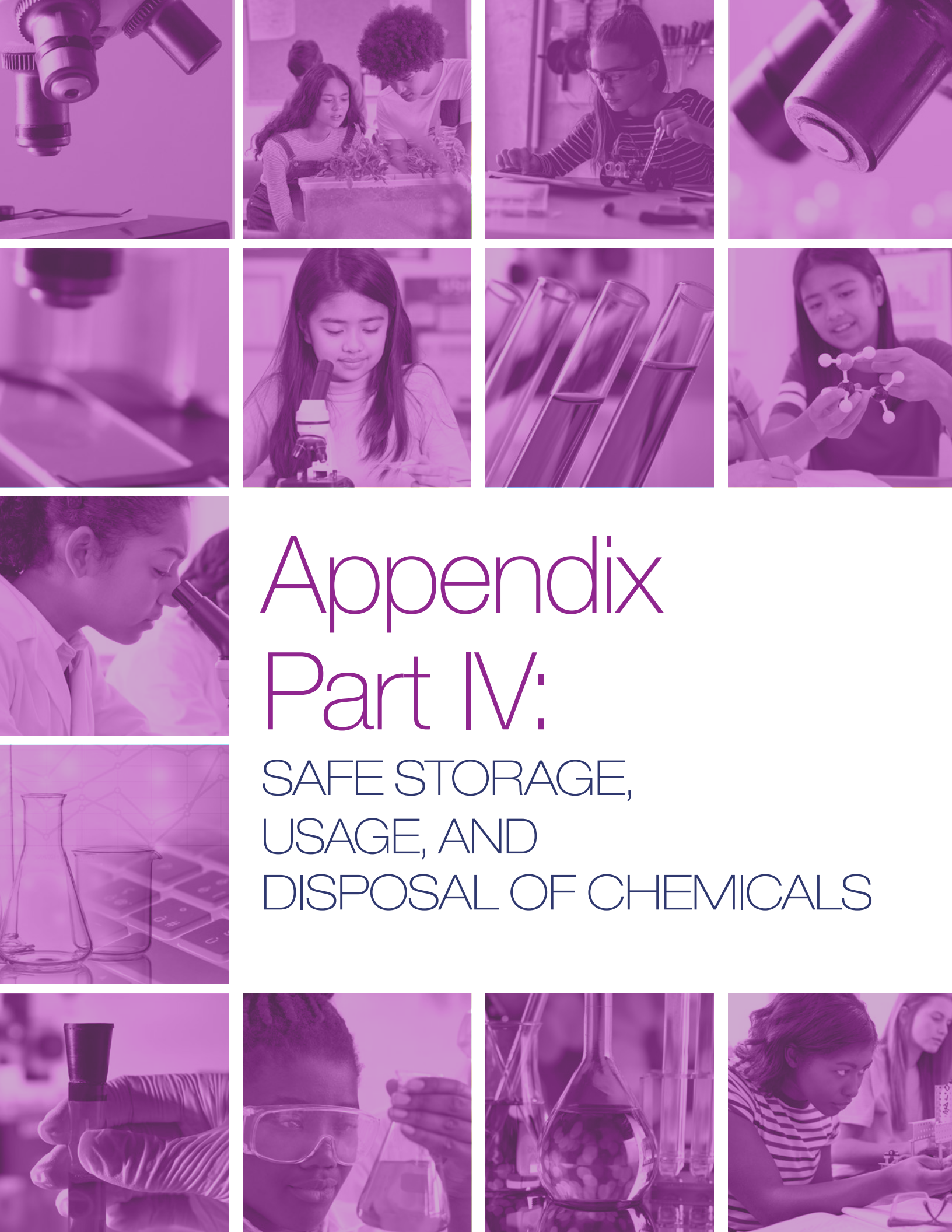
Authorized operational activities (as determined by a federal agency) in support of intelligence, homeland security, defense, or other national security missions.

General Notes:

1. The NYC DOE IRB does not review nor approve any research subject to U.S. FDA regulations.
2. The NYC DOE IRB does not allow researchers to collect biospecimens or other physiological data (e.g., saliva samples, blood samples, heart rate, height/weight, blood pressure, body mass index, etc.) from NYC DOE students, school-staff or non-school based staff.
3. **a.** The NYC DOE IRB applies OHRP Guidance on Engagement of Institutions to determine NYC DOE's engagement in all research, regardless of funding.

   b. While the NYC DOE does not consider itself engaged in research carried in or on NYC DOE schools, students, school-based and non-school based staff by external researchers, it requires all researchers external to the NYC DOE to seek prospective NYC DOE IRB ethics review and approval of all human subjects research procedures to be carried out in, with, or about NYC DOE schools, students, parents, school-based and non-school based staff.

   c. Research conducted in School-Based Health Centers (SBHCs): Research conducted solely with students enrolled in SBHCs does not fall under the purview of the NYC DOE IRB; rather, these studies are reviewed by the DOHMH's IRB.



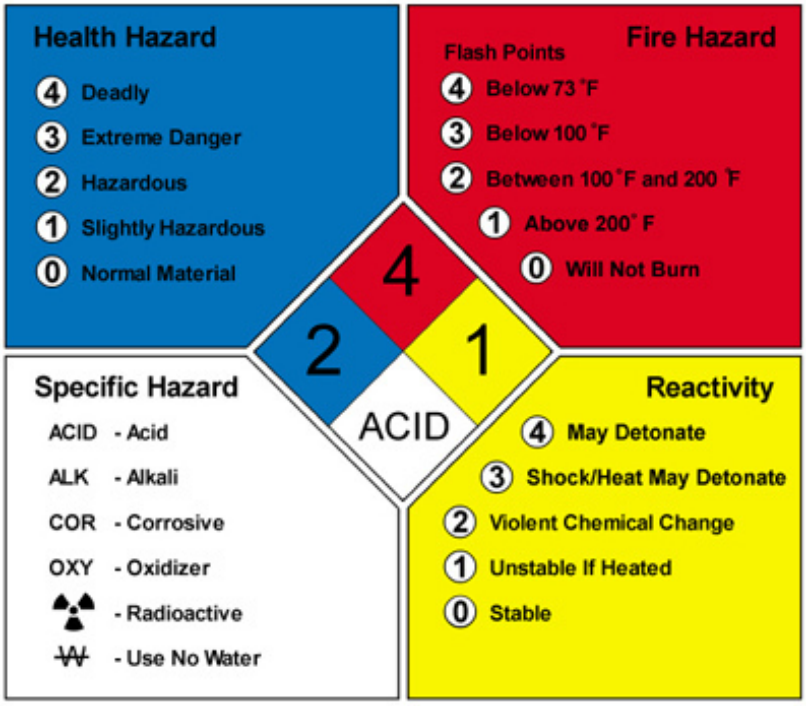
Appendix Part IV:

SAFE STORAGE, USAGE, AND DISPOSAL OF CHEMICALS

a. Chemical Container Labels

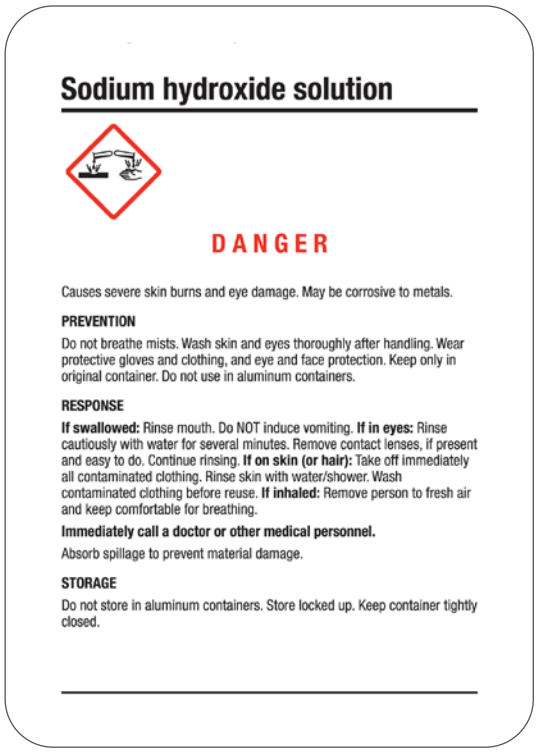
OSHA has adopted new hazardous chemical labeling requirements as a part of its recent revision of the Hazard Communication Standard, 29 CFR 1910.1200 (HCS), bringing it into alignment with the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS). These changes will help ensure improved quality and consistency in the classification and labeling of all chemicals and will also enhance worker comprehension. As a result, workers will have better information available on the safe handling and use of hazardous chemicals, thereby allowing them to avoid injuries and illnesses related to exposures to hazardous chemicals.

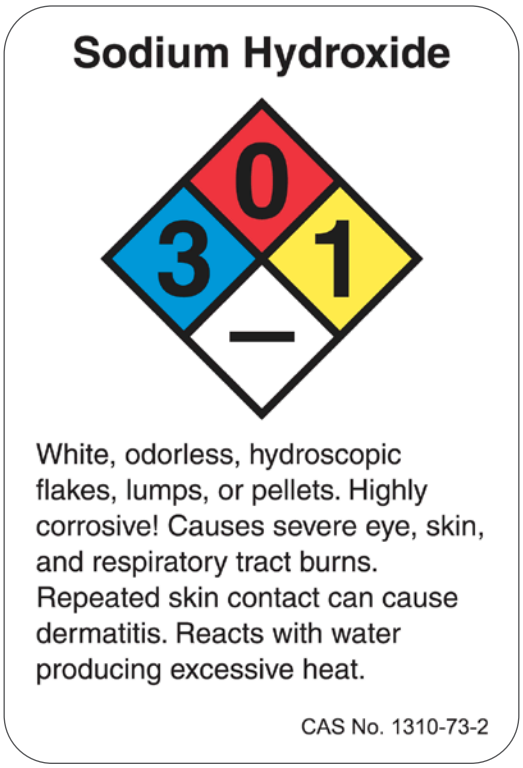
All hazardous chemicals shipped after June 1, 2015, must be labeled with specified elements including pictograms, signal words and hazard and precautionary statements.



Hazard Rating	Explanation of Diamond Coding
4: Extreme	Blue: Health
3: Severe	Red: Flammability
2: Moderate	Yellow: Instability
1: Slight	White: Special Hazard
0: Minimal	Zero: Least Hazardous Four: Most Hazardous

Sample Container Labels:





New York City FDNY Signage

FC2706-01 (d) (1) Signage. The entrance to *each laboratory unit door* shall have a conspicuously posted sign, constructed of metal or other durable material, with RED letters on a white background which shall be located in the area of the mid-point of the height of the door. Such sign shall read as follows:

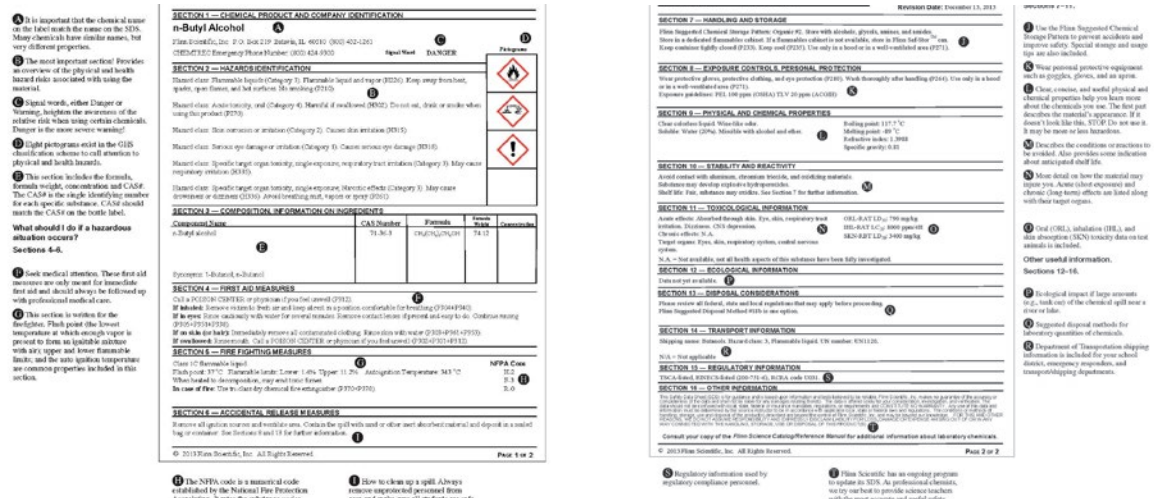
LABORATORY (1 ½ “)

CAUTION: HAZARDOUS MATERIALS (3/4”)

Signage for purchase can be found at http://www.safetysign.com/safety-signs or with other similar companies.

The following slides from Flinn Scientific provide additional details on Global Harmonizing System labeling assets.

Typical 16 section GHS compliant SDS



What is GHS?

Developed by the United Nations, GHS (Global Harmonized System) :

- Defines and classifies the hazards of chemical products
- Provides health and safety information on labels and Safety Data Sheets (SDS's)
- Goal of GHS:
- That the same set of rules for classifying hazardous products; the same format and content for labels and SDS's, will be adopted and used around the world

1. OSHA GHS

Introducing the GHS Pictograms -

Exploding bomb
(for explosion or reactivity hazards)

Flame
(for fire hazards)

Flame over circle
(for oxidizing hazards)

Gas cylinder
(for gases under pressure)

Corrosion
(for corrosive damage to metals, as well as skin, eyes)

Skull and crossbones
(can cause death or toxicity with short exposure to small amt)

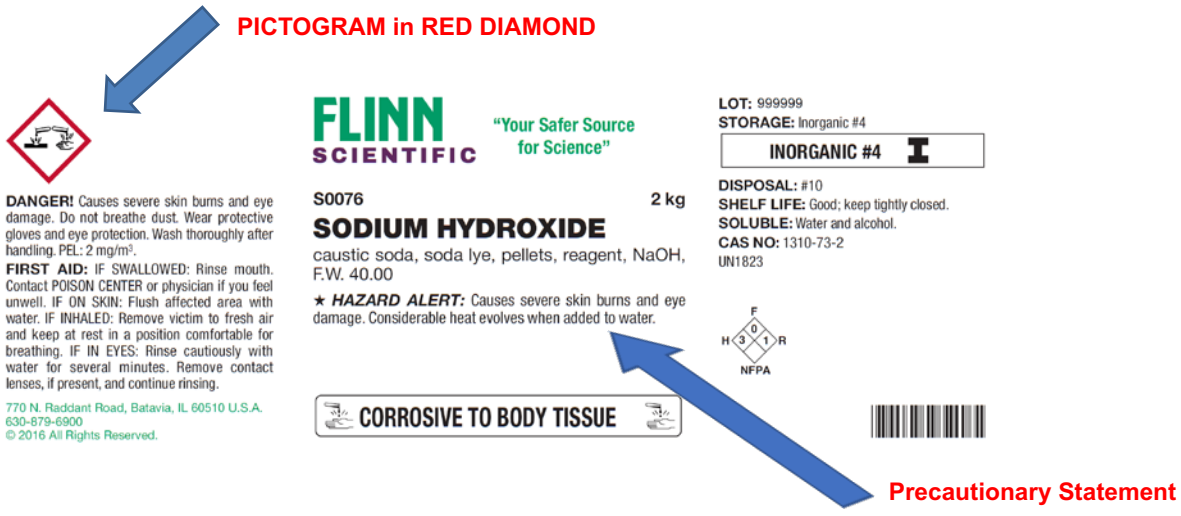
Health hazards
(may cause or suspected of causing serious health effects)

Exclamation mark
(may cause less serious health effects or damage ozone layer)

Environment*
(may cause damage to the aquatic environment)

Biohazardous infectious material**
(for organism or toxins that can cause disease)

Typical Manufacturer Label for Sodium Hydroxide Pellets (NaOH)



Labelling Requirements

- New bottles of chemicals ordered from trusted suppliers will already have compliant GHS labelling.
- There is a prescribed format for labelling chemicals from the United Nations (GHS) and for updating existing older bottles in your lab.
- Different options exist to retrofit the labels on the bottles

Chemical Product Labels

Always read the label on a chemical bottle to obtain and review basic safety information concerning the properties of a chemical. It is the responsibility of teachers to be fully aware of the hazards and risks of all chemicals they are using.

Labelling Requirements

- Existing bottles of chemicals require a GHS compliant label – 30mL dropper bottles or a 2.5L bottle. **No exemptions!**
- You can create an overlay label and adhere it over the existing supplier label. This is to standardize communication on the chemical labels.
- Solutions made in the lab require a label as well. *Ex Made a 0.1M HCl solution from a 3M stock bottle.* Both vessels require a current GHS label for compliance and adherence to the CHP & OSHA.

Chemical Inventory Form

Print or Type all information **(Sample information in red)**

School/Division **31R345**		Name of Person Completing the Form **Jane Smith**			Physical State	Quantity	Container Type	Units of Measure	# of Employees Routinely Exposed	Frequency of Use	SDS on File?
Address **123-45 Court Street, Brooklyn, NY 11245**			Title **Teacher**								
Department **Science**	Room **123**	Work Phone **(718) 123-4567**		Date **1/2/2021**							
1. Product Trade Name	**2.** Manufacture's Name & Address	**3.** Exact Storage Location	**4.** Warnings on Label	**5.** Other Identifying Information	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
Calcium Chloride	**Aldon Corporation**	**First Inorganic Shelf**	**safety glasses, gloves and an apron**	CAS # **10043-54-4**	**S**	**32**	**N**	**oz**	**10**	**0**	**Yes**
				CAS #							
				CAS #							
				CAS #							
				CAS #							

Physical State – Item 6	**Container Type – Item 8**			**Units of Measure – Item 9**	**Frequency of Use – Item 11**
S – Solid or Powder	**A** – Above ground tank	**F** – Can	**M** – Glass bottles or Jugs	**C** – Cubic feet for gas	**S** – Sometimes
L – Liquid	**B** – Below ground tank	**I** – Fiber drum	**N** – Plastic bottles or Jugs	**lb** – Pounds for solids	**O** – Often
G – Gas	**C** – Tank inside building	**J** – Bag	**O** – Tote Bin	**oz** – Ounces for solids	**N** – Never
P – Pure	**D** – Steel drum	**K** – Box	**R** – Other	**G** – Gallons for liquid	
M – Mixture	**E** – Plastic or non-metallic drum	**L** – Cylinder		**fl** – Fluid ounces for liquid	

C. Specific Chemical Incompatibilities

Some examples of incompatible chemicals are shown in the table below. The chemicals in the right column should not be allowed to come in contact the chemicals in the left column. The SDSs should be consulted regarding specific incompatibilities. When you dilute corrosives, especially for concentrated strong corrosives, always add the corrosive material to water slowly while stirring; never the reverse. The exothermic reaction from the dilution can cause the water to flash to steam resulting in possible thermal and chemical burns due to splashing.

Sources:
FDNY Certificate of Fitness D-14 Study Materials
https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d14-noe-study-materials.pdf

FDNY Certificate of Fitness D-15 Study Materials
https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-d15-noe-study-materials.pdf

Chemical	Chemicals Incompatible With
Acetic acid	Chromic acid, ethylene glycol, hydroxyl containing compounds, nitric acid, permanganates, peroxides
Acetone	Concentrated nitric and sulfuric acid mixtures
Acetylene	Bromine, copper (tubing), bromine, chlorine, fluorine, iodine, silver, mercury and their compounds
Alkali and alkaline earth metals (lithium, sodium, potassium)	Carbon dioxide, or other chlorinated hydrocarbons, halogens, powdered metals (e.g., aluminum or magnesium), water
Ammonia (anhydrous)	Bromine, calcium hypochlorite, mercury, halogens, calcium hypochlorite, hydrogen fluoride, iodine,)
Ammonium nitrate	Acids, chlorates, finely divided organic or combustible materials powdered metals, flammable liquids, nitrates, sulfur
Aniline	Hydrogen peroxide, nitric acid
Azides	Acids
Bromine	Ammonia, acetylene, butadiene, butane, hydrogen, finely divided metals, methane, propane (or other petroleum gases), sodium carbide, turpentine Chromic acid and chromium

Chemical	Chemicals Incompatible With
Calcium oxide	Water
Carbon (activated)	All oxidizing agents, Calcium hypochlorite
Chromic acid and chromium	Acetic acid, alcohol, camphor, flammable liquids in general, glycerol naphthalene
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromatic acid, halogens, hydrogen peroxide, nitric acid, sodium peroxide
Hydrogen peroxide	Acetone, alcohols, aniline, chromium, combustible materials, copper, iron, most metals or their salts, nitromethane, organic materials
Hypochlorites	Acids, activated carbon
Nitrates	Sulfuric acid
Nitrites	Potassium or sodium cyanide
Oxygen	Flammable liquids, solids, or gases; grease, hydrogen, oils
Peroxides, Organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus pentoxide	Water
Potassium, Sodium	Carbon dioxide, , water
Potassium permanganate	Benzaldehyde, ethylene glycol, glycerol, sulfuric acid
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Acetic anhydride, benzaldehyde, , Ethyl or methyl alcohol, ethyl acetate, ethylene glycol, furfural, glacial acetic acid, glycerin, methyl acetate
Sulfides	Acids
Sulfuric acid	Chlorates, perchlorates, permanganates, and water, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Water	Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, sulfuric acid, sulfur trioxide

d. Suggested Shelf Storage Patterns

OSHA (Standard 29, Part 1910.1450 App. A)—NCR Recommendation for Chemical Hygiene in the Laboratory

Suggested Shelf Storage Pattern—Inorganic

Inorganic #10 Sulfur, Arsenic, Phosphorus Pentoxide
Inorganic #2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates, Oxalates, Phthalates, Oleates
Inorganic #3 Amides, Nitrates (not Ammonium Nitrate), Nitrites, Azides (Store Ammonium Nitrate away from all other substances—**ISOLATE IT!**)
Inorganic #1 Metals & Hydrides (Store away from any water.) (Store flammable solids in flammables cabinet.)
Inorganic #4 Hydroxides, Oxides, Silicates, Carbonates, Carbon

Inorganic #7 Arsenates, Cyanides, Cyanates (Store away from any water.)
Inorganic #5 Sulfides, Selenides, Phosphides, Carbides, Nitrides
Inorganic #8 Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates
Inorganic #6 Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Peroxides, Hydrogen Peroxide
Miscellaneous

Inorganic #9 Acids, except Nitric (Acids are best stored in dedicated cabinets)

Suggested Shelf Storage Pattern—Organic

Organic #2
Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides (Store flammables in a dedicated cabinet.)
Organic #3
Hydrocarbons, Oils, Esters, Aldehydes (Store flammables in a dedicated cabinet.)
Organic #4
Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide (Store flammables in a dedicated cabinet.)
Organic #5
Epoxy Compounds, Isocyanates
Organic #7
Sulfides, Polysulfides, etc.

Organic #8
Phenols, Cresols
Organic #6
Peroxides, Hydroperoxides
Organic #1
Acids, Amino Acids, Anhydrides
Organic #9
Dyes, Stains, Indicators (Store alcohol-based solutions in flammables cabinet.)
Miscellaneous

Store severe poisons
in locked Poison Cabinets

FLINN SCIENTIFIC Chemical Storage Pattern

Organic Storage Codes

- **O1** – Acids, Amino Acids, Anhydrides, Peracids
- **O2** – Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides
- **O3** – Hydrocarbons, Esters, Aldehydes, Oils
- **O4** – Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide
- **O5** – Epoxy Compounds, Isocyanates
- **O6** – Peroxides, Hydroperoxides, Azides
- **O7** – Sulfides, Polysulfides, Sulfoxides, Nitriles
- **O8** – Phenols, Cresols
- **O9** – Dyes, Stains, Indicators
- **OM** – Organic Miscellaneous

Inorganic Storage Codes

- **I1** – Metals, Hydrides
- **I2** – Acetates, Halides, Iodides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens
- **I3** – Amides, Nitrates (except Ammonium Nitrate, store as I8), Nitrites, Azides
- **I4** – Hydroxides, Oxides, Silicates, Carbonates, Carbon
- **I5** – Sulfides, Selenides, Phosphides, Carbides, Nitrides
- **I6** – Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide
- **I7** – Arsenates, Cyanides, Cyanates
- **I8** – Borates, Chromates, Manganates, Permanganates
- **I9** – Acids (except Nitric) (Nitric Acid is isolated and stored by itself.)
- **I10** – Sulfur, Phosphorus, Arsenic, Phosphorous Pentoxide
- **IM** – Inorganic Miscellaneous

Chemical Families and Corresponding Storage Codes

Acetates — **I2**
Acids, Inorganic (except Nitric) — **I9**
(Nitric Acid is isolated and stored by itself.)
Acids, Organic — **O1**
Alcohols — **O2**
Aldehydes — **O3**
Amides (inorganic) — **I3**
Amides (organic) — **O2**
Amines — **O2**
Amino Acids — **O1**
Anhydrides — **O1**
Arsenates — **I7**
Arsenic — **I10**
Azides (inorganic) — **I3**
Azides (organic) — **O6**
Borates — **I8**
Bromates — **I6**
Carbides — **I5**
Carbon — **I4**
Carbonates — **I4**
Chlorates — **I6**
Chlorites — **I6**
Chromates — **I8**
Cresols — **O8**
Cyanates — **I7**
Cyanides — **I7**
Dyes — **O9**
Epoxy Compounds — **O5**
Esters — **O3**
Ethers — **O4**
Ethylene Oxide — **O4**
Glycols — **O2**
Halides — **I2**
Halogenated Hydrocarbons — **O4**
Halogens — **I2**
Hydrides — **I1**
Hydrocarbons — **O3**
Hydrogen Peroxide — **I6**
Hydroperoxides — **O6**
Hydroxides — **I4**
Hypochlorites — **I6**
Imides — **O2**
Imines — **O2**
Indicators — **O9**
Iodates — **I6**
Iodides — **I2**
Isocyanates — **O5**
Ketenes — **O4**
Ketones — **O4**
Manganates — **I8**
Metals — **I1**
Miscellaneous (inorganic) — **IM**
Miscellaneous (organic) — **OM**
Nitrates — **I3**
(except Ammonium Nitrate, store as I8)
Nitrides — **I5**
Nitriles — **O7**
Nitrites — **I3**
Oils — **O3**
Oxides — **I4**
Peracids — **O1**
Perchlorates — **I6**
Perchloric Acid — **I6**
Permanganates — **I8**
Peroxides (inorganic) — **I6**
Peroxides (organic) — **O6**
Phenols — **O8**
Phosphates — **I2**
Phosphides — **I5**
Phosphorus — **I10**
Phosphorous Pentoxide — **I10**
Polysulfides — **O7**
Selenides — **I5**
Silicates — **I4**
Stains — **O9**
Sugars — **O2**
Sulfates — **I2**
Sulfides (inorganic) — **I5**
Sulfides (organic) — **O7**
Sulfites — **I2**
Sulfoxides — **O7**
Sulfur — **I10**
Thiosulfates — **I2**

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AP6196

e. Maximum Quantities of Storable Combustibles

Listed below are maximum quantities of combustibles and dangerous chemicals which may be stored in public schools:

Volatile Flammable Liquids (Soluble)	
Acetone	2.5L
Alcohol, Denatured	10 L
Alcohol, Methyl	1L (500mL ideally)
Non-Volatile Flammable Liquids (Soluble)	
Glycerine	2.5kg
Combustible Fiber and Powders (Vegetable)	
Lycopodium	500g
Dangerously Corrosive Acids	
Glacial Acetic Acid, 17.4M	2.5L
Nitric Acid	500mL
Sulfuric Acid, 18M	2.5L
Peroxides	
Hydrogen Peroxide, U.S.P.	2.5L
Other Hydrogen Peroxides over 3 percent, not to exceed 15 percent	1L
Chlorates	
Potassium Chlorate	500g

Permanganates	
Potassium Permanganates	500g
Nitrates	
Barium Nitrate	500g
Strontium Nitrate	500g
Cobalt Nitrate	500g
Copper Nitrate	500g
Iron Nitrate, Ferric	1kg
Potassium Nitrate	1kg
Silver Nitrate	500g or 1L solution
Sodium Nitrate	2kg
Other Metallic Nitrates	500 mL (ideally)

f.

Chemical Spills

Responding to Laboratory Chemical Spills

No matter what precautions are taken, sooner or later an accidental chemical spill is likely to occur in your laboratory. A responsible science teacher will take steps to prevent spills, make sure proper safety equipment is available to contain and control a spill, and understand how to use the safety equipment.

Spill Control Equipment

Each laboratory should have proper spill control equipment including fire blankets, spill control materials, and a mercury spill control kit. A 100% wool fire blanket is an excellent spill control device because it will help contain and control a spill and its vapors. If a spill occurs and no spill control materials are available, simply throw the fire blanket over the spill. The blanket will begin to absorb the liquid, contain the vapors, and enable a person to walk over the spill without slipping.

Spill control materials should consist of three components; sand, an absorbing agent, and a neutralizer. Spill control materials should be capable of handling a spill from the largest bottle used in your laboratory, which is usually a 2.5-L acid bottle. Sand is used to contain a spill, provide traction, and prevent the spill from rapidly spreading across a smooth floor. The absorbent contains and absorbs the liquid spill so it is easier to clean up, transport, and dispose. Neutralizer is usually a base such as sodium carbonate or calcium hydroxide and is used to neutralize inorganic acid spills. If strong bases are used in your laboratory, it is wise to keep a supply of citric acid on hand to neutralize the base. A 2.5-kg bottle of citric acid is large enough to neutralize the entire contents of almost any bottle of base.

If mercury or mercury thermometers are used in your classroom, mercury spill control materials should be available. Mercon™ spill control spray, wipes, and sponges are available from Flinn Scientific and are ideal for cleaning up mercury spills. Sprinkling zinc dust on the spill area can also clean up small droplets of mercury. Zinc dust reacts with mercury to form a very stable and safe amalgam that is easy to handle and safe to dispose of in the trash.

To save money, a homemade spill control kit is easily prepared using three 5-gallon plastic buckets. Fill the first 5-gallon bucket with 30 pounds of clean, dry sand (available as play sand at a discount or hardware store). Fill a second 5-gallon bucket with a 20-lb bag of unodorized kitty litter or oil absorbent. Fill the last bucket with 30 lbs of sodium carbonate, anhydrous, also known as soda ash. Soda ash is available at industrial chemical, building supply, and swimming pool supply distributors. Label each bucket with the contents and cover the top with plastic wrap to keep the contents fresh and so the containers aren't used as garbage cans. Place a plastic broom, plastic dustpan, and several large heavy-duty plastic garbage bags near the spill control kit for cleanup and disposal.

Spill Control Procedures and Training

A written contingency plan on how to handle chemical spills should be part of every school's **Chemical Hygiene Plan**. The following procedure is an example of a contingency plan.

1. Quickly assess the spill, its hazards, and the danger to yourself and your students and take appropriate action. If the spilled chemicals are unknown, assume the worst and evacuate.
2. Notify other laboratory personnel of the accident and, if necessary, evacuate the area. The safety of you and your students is always the top priority. Restrict all unprotected personnel and students from the spill area.
3. If the spilled chemical is volatile, ventilate the area or evacuate. If the spilled chemical is flammable, remove all ignition sources.
4. Tend to any injured or contaminated person and, if necessary, request help. If the chemical is splashed into an eye or onto skin, immediately irrigate using an eyewash or shower. If the chemical is splashed on your clothes, there may be time to first contain the spill with a fire blanket or spill control materials and then treat yourself. Remember, if a safety shower is used near a chemical spill, the water may expand the spill area and make the situation worst.
5. Take steps to contain and limit the spill if this can be done without risk of injury or contamination. Be sure to wear personal protection equipment such as chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. To contain a spill, gently pour sand or an absorbent material around the spill and onto the spill. Placing a fire blanket over the spill also works well. The object of this step is to prevent the spill from spreading, begin to absorb the liquid, and contain some of the vapors.
6. Neutralize the spill if necessary. Use a solid base such as sodium carbonate, sodium bicarbonate, or soda ash to neutralize an acid. Use citric acid powder to neutralize a base spill. The neutralizer needs to be mixed well with the sand and absorbent to come in contact will all the spilled material.
7. Clean up the spill. Use a plastic dustpan and plastic broom to sweep up the now solid mass and place it into large, heavy-duty garbage bags for disposal.
8. Dispose of contaminated materials properly.
9. Call in emergency personnel if at any time your safety or your students' safety is in jeopardy.

For more information on laboratory safety, chemical hazards, or the storage and disposal of chemicals, review a current edition of the ***Flinn Scientific Catalog/Reference Manual***. For more information on spill prevention, please request Flinn *SafetyFax* #10311.

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Materials for *Responding to Laboratory Chemical Spills* are available from Flinn Scientific, Inc.

Catalog No.	Description
SE102	E-Z Pour Spill Control Kit
SE103	E-Z Pour Acid Neutralizer, bottle
SE104	E-Z Pour Absorbent, bottle
SE105	E-Z Pour Sand, bottle
SE107	E-Z Pour Base Neutralizer, bottle
S0005	Sand, 25 lbs
SE101	Absorbent, Super Sorb®, 20 lbs
SE106	Neutralizer, 25 lb
AP1663	Polypropylene Broom
AP1662	Polypropylene Dustpan
SE121	Absorbent Chemical Pads
AP8771	Mercon™ Mercury Spill Control Kit
Z0005	Zinc Dust, 500 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

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g. Hazardous Waste Management

Hazardous waste is any material regulated by the Environmental Protection Agency (EPA) under their solid waste guidelines. Under the Resource Conservation and Recovery Act (RCRA) (1976, 1984, 2016) hazardous waste includes chemicals on one of several regulatory lists or chemicals categorized as **Ignitable**, **Corrosive**, **Reactive** or **Toxic**.

Most school waste can be placed in one or more of the categories above. Use the SDS to help with classification or call your regional DEC office (718) 482-4996 to categorize the waste.

RCRA categories are defined as follows:

Ignitable: Substances that give off vapors that can ignite. This group includes flammable solvents.

Corrosive: Substances that destroy living tissue as well as equipment on contact. Acids and bases are included in this category.

Reactive: Substances that are not stable under certain conditions. Different substances may have violent reactions due to chemical incompatibilities, exposure to air, water or oxygen. These violent reactions may include the generation of large amounts of heat, gas and/or an explosion. Water reactive metals such as sodium and potassium are included in this category.

Toxic: Substances that are health hazards when inhaled, ingested or in contact with skin. Cyanide and sulfide compounds are included in this category.

Hazardous waste must be disposed of in compliance with local, state and federal laws and therefore must be stored in appropriate containers until the waste can be picked up by a licensed transporter. (Procedure to follow)

The New York City Department of Environmental Protection (NYC DEP) regulates the disposal of hazardous waste under the Federal Resource Conservation and Recovery Act (RCRA). The New York State Department of Environmental Conservation (NYS DEC) enforces these regulations.

To simplify hazardous waste management, prepare in advance for the chemical waste that will be generated for a particular lab activity. Have appropriate, properly labeled containers for the particular chemical waste in front of each lab class so students can place the waste from their experiment in the container. These containers should be metal, plastic or plastic-coated glass. Glass jars and bottles should be enclosed in a non-breakable secondary container.

Chemical waste that is waiting for a chemical pick-up must be stored in a safe place. Unless there is an emergency mercury pick-up, non-emergency chemical waste may be stored until the end of the school year and then removed from the school as one chemical pick-up request.

Storage containers must be appropriate for the type of waste. These containers must be clearly labeled with information that includes the identity of the substance, hazard or toxicity of the contents and date the particular substance became waste. Records of chemical waste and pick-ups must be kept for 3 years.

Follow protocol for chemical pick-up.

1. Notify the assistant principal and custodian.
2. Use chemical removal request form to list type of chemicals, amount and room location.
3. The custodian will complete a PO-18 and attach the list of chemicals being removed from the school.
4. The custodian will use a Trade Code 75 on the PO-18, Crew #IN27.
5. The custodian will scan and email the information to Bernard Orlan at BOrlan@schools.nyc.gov via the passport system.

Planning for the future will minimize hazardous waste:

- Substitute less hazardous chemicals for more hazardous ones, when possible.
- Order chemicals in quantities consistent with the manner in which they are used.
- Time order chemicals with short shelf lives.
- Never mix hazardous and non-hazardous waste. It will increase the total volume of hazardous waste that must be picked up and increase cost of disposal.

Always follow safe storage and disposal procedures for hazardous waste:

1. Store different chemical waste substances separately in labeled containers. The labels should list the specific hazards and the date the substance became waste.
2. Aqueous solutions of strong acids and bases neutralized to a pH range of 5–9 can be disposed of by pouring them down the drain. However, if they are contaminated with other toxic chemicals such as heavy metal salts, they must be stored for hazardous pick up.
3. Alkali metals such as potassium and sodium must be stored under mineral oil in a clearly-identified locked cabinet.

4. Magnesium and other pyrophoric metals must be stored in tightly sealed metal containers.
5. Mercury is prohibited in schools. Waste mercury must be stored in tightly sealed bottles or jars and must be removed immediately following chemical disposal protocol.
6. If you have any chemicals that you cannot identify due to poor labeling, the best action to take is NO action. Leave the chemical alone until you are ready for a chemical pick up. The transporters will classify the unknown substance and pack it for disposal. In some instances the transporters may send a sample for chemical analysis.
7. It is important to keep records of the chemical waste you have on hand and those chemicals that have been picked up. Records should include a description or name of the waste, the amount, the date it became waste, and how it was disposed of. Keep records for three years.
    - Make as many copies as needed Email to: BOrlan@schools.nyc.gov
    - Attach the form(s) to a PO 18 request
    - Use Trade Code 75—Crew #DHS4—job type EB on the PO 18.
    - Keep a copy for your records

New York City—forms for Facilities with Chemicals

Chemical Inventory Form:
http://www.uft.org/files/attachments/chemical-inventory_0.pdf

Chemical Removal Form:
http://www.uft.org/files/attachments/chemical-removal-form.pdf

Disposition of Obsolete Equipment:
http://www.uft.org/files/attachments/disposition-of-equipment-form.pdf

Inventory of Mercury and Mercury-Containing Devices in Science Rooms:
http://www.uft.org/files/attachments/mercury-inventory-form.pdf

NYC Department of Education

Division of Teaching and Learning

Science SAFETY MANUAL

GRADES 6–12