Sussex Academy Chemical Safety Plan

Adapted from the Safety Manual for Red Clay Consolidated School District

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Online:
https://www.sussexacademy.org/

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Sussex Academy Chemical Safety Officers

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Foreword

The purpose of this document is to provide a framework for science teachers at Sussex Academy to conduct science instruction in a safe and responsible manner. Safety is everyone's responsibility. Safety procedures, like curriculum and classroom management, must be planned and implemented consistently to become effective. This document will provide the following for the science classroom instructor or administrator:

1. An outline of safe practices for a variety of classroom situations. Included are policies that promote safety and specific cautions against practices that are considered unsafe for schools.
2. A list of procedures and persons responsible for accountability of safe practices as well as information about whom to contact in case of problems.

Safety Philosophy of Sussex Academy

Laboratory inquiry and investigation are the hallmarks of effective science instruction at all levels and all grades. All laboratory work, whether it occurs with chemicals, with electricity, with living organisms, or in a natural outdoor environment, poses some degree of risk.

Sussex Academy provides an effective and consistent safety plan that follows the following format:

1. Ongoing safety training of students and staff throughout the school year.
2. Annual documented training of science students and science instructors before any laboratory instruction begins.
3. Modeling of safe procedures by all Sussex Academy staff.
4. Accountability of hazardous materials used in schools, including communication of hazardous information.

Safety Responsibilities of the Classroom Teacher

Classroom teachers are expected to provide a standard of safety in their teaching environments. This standard of safety is called the Duty of Care. The Council of State Science Supervisors (CSSS) breaks Duty of Care into three basic duties of the science teacher that relate to laboratory safety.

1. Duty of Instruction: adequate instruction before a laboratory activity.
2. Duty of supervision: adequate supervision of students that they behave properly to avoid foreseeable dangers.
3. Duty of maintenance: assurance that the teacher maintains the safest environment possible and that equipment for instruction functions properly.

Guidelines for Duty of Instruction:

1. Safety expectations should be posted in the classroom in a prominent place.
2. Students must be thoroughly instructed in those safety considerations and procedures relevant to the class before any potentially hazardous work begins. This instruction must be accurate, appropriate to setting, appropriate for the maturity of the audience, and current. Teachers should assess understanding of safety rules regularly, and document such instruction in the form of a safety contract.
3. The teacher should identify and clarify any specific hazards involved with individual activities. This instruction should include proper handling and disposal of materials, possible (but realistic) hazards associated with each procedure, ways to prevent hazardous situations, and the necessary course of action if a hazardous situation should occur.

Guidelines for Duty of Supervision:

1. The most effective way to prevent hazards in any classroom is with clear consistent standards of behavior, including consequences for infractions. Misbehavior and horseplay create an unsafe environment for all and must never be tolerated.
2. Students must be supervised by a teacher or other authorized personnel at all times. During laboratory activities, teachers must be able to see any location in the student work area and to move quickly to those areas when safety issues arise.
3. If the teacher is absent from school, laboratory work must not be left as a substitute lesson plan unless the substitute holds or previously has held science certification. If the teacher will be absent for an extended period of time, the long-term substitute must have a science background and be trained in safety practices within the year before taking the assignment.
4. Materials for laboratory exercises should be stored securely away from the student areas when not in use.
5. The level of supervision must be appropriate to the age of the students, the degree of inclusion, and the hazardous nature of the work.
6. The teacher should ensure that students have adequate workspace and that all areas where students are working are accessible by the teacher.
7. Teachers are encouraged to attend training in the use of a fire extinguisher, in first aid, and in cardiopulmonary resuscitation and to renew this training as appropriate.

Guidelines for Duty of Maintenance:

1. All chemicals will be properly labeled. Teachers will follow Flinn Scientific guidelines (http://www.flinnsci.com/Sections/Safety/labChemSafety.asp) for proper use, storage and disposal of all chemicals. Teachers should make every effort to prepare sufficient quantities of working solutions of chemicals to complete a given activity. At the end of the activity, surplus quantities of working solutions should be discarded if they will not be used in a reasonable amount of time (usually within 3 years).

2. Teachers should monitor and arrange for necessary maintenance on apparatus used in student instruction. Defective equipment must either be repaired or discarded if repair is impossible.

3. Teachers and administrators should work together to keep safety equipment functioning properly. Safety equipment (e.g. fire extinguishers, safety showers) should be inspected and serviced annually or after use. Teachers should file written reports for maintenance or correction of any hazards or defects in the physical environment that might compromise safety directly to the administration.

4. Fire extinguishers and safety showers in each school are to be inspected annually. Eyewashes should be tested monthly (or according to manufacturer's specifications). Teachers must communicate with the chief custodian to be sure all fire extinguishers are identified and inspected.

(Source: Science and Safety Making the Connection Council of State Science Supervisors.)

The School Safety Plan and Responsibilities of the Teacher

The most effective way to ensure adequate safety practices in the classroom is for safety instruction to occur throughout the year as an integral part of every activity.

1. Safety officers for the school should be identified early in the school year. These safety officers will be the point of contact in the building for all matters relating to chemical safety and science safety issues.

2. Teachers will introduce the safety program by providing students access to the Laboratory Safety Contract that includes a list of precautions to be used with students in all courses. A printed copy of the safety contract for each student should be kept on file by the teacher that is signed by both the student and the parent. Additional precautions that are specific to a course or a laboratory experiment may be added as needed.

3. Before any actual lab work begins, students should be instructed in emergency procedures, including evacuations.

4. Before beginning any activity, the teacher should review the particular safety rules and procedures most appropriate to the activity and answer all student questions prior to beginning and monitor the students' activities closely.

5. Careful planning is expected for all activities. The following questions can be used to guide safety planning for a particular unit or activity.

What are the hazards?
What are the "worst case" scenarios and how can I prepare for them?
What practices, safety equipment, and protective facilities are prudent and appropriate?
Have I performed a "dry run" of the activity to prepare for any potential problems?
Is there adequate staff support to deal with unforeseen hazards?

6. Teachers should only conduct laboratory exercises that conform to district and state curriculum and instruction guidelines and the Next Generation Science Standards.

7. According to the Hazardous Chemical Information Act, all science teachers must provide training to students of their rights and responsibilities when working with hazardous substances. Teachers will obtain and keep documentation that students have received this instruction. Likewise, under this Act, teachers will be provided with annual training of these same rights and responsibilities.

8. Teachers should only conduct laboratory experiments when a school nurse or medical staff member is present in the building. If teachers are conducting an experiment after the school day (in preparation for later instruction), they should ensure that another teacher is present or nearby that is familiar with the risks associated with the procedure.

9. Teachers must report any injury that occurs as a result of a laboratory exercise, however minor, to the school nurse and to the administration in a timely manner. If a student is injured, the parent/guardian should be contacted by the end of the day. If the incident is serious enough that the student cannot be moved, the teacher must summon the nurse and keep the area around the student clear. All situations requiring first aid must be assessed and treated by the nurse.

10. Laboratory experiments should only occur in locations with adequate space. The amount of recommended space for a given activity may vary, but will depend on the following factors:

The number of persons (students and adults) in the work area
The nature of the activity

The overall design of the classroom
The number, age, and special needs of the students

Teachers should advise administrators when there is insufficient space for safer laboratory instruction. In addition, the work area should be arranged so that the teacher may circulate around the classroom and supervise students. Compartmentalization (creation of small secluded workspaces) hampers the teacher from supervising students properly and can lead to improper and unsafe laboratory behavior going undetected.

11. Teachers must ensure that appropriate laboratory apparel and etiquette are observed. In particular, certain lab activities may require the following:

a. Safety goggles or safety glasses should be worn if there is a danger of projectiles in the lab. Safety goggles should be worn when certain labs with chemicals, glassware, or heat (hot plates or open flame) occur. Goggles that meet ANSI standard Z87.1 are appropriate for all of these situations and are specifically required for certain chemistry labs. Contact lenses are not restricted; however, teachers should determine which students wear contact lenses during lab. If any material gets into the eyes, contact lenses must be removed immediately.
b. Laboratory aprons should be worn during certain chemistry labs.
c. Protective gloves (vinyl or nitrile- never latex) when students will handle microorganisms or preserved specimens. Laboratory workers should not eat, drink, chew gum, or apply cosmetics (this includes lip balm) when working with chemicals or biological materials.
d. If open flames or high-speed motors are used, students with shoulder length hair should secure it behind their shoulders. In these situations, students should also secure loose-fitting clothing and remove or secure dangling jewelry.
e. If a lab exercise is being performed as a teacher demonstration rather than as a lab, teachers will enforce the same safety expectations as they would enforce if students were performing the lab exercise.
f. Teachers are responsible for modeling appropriate laboratory etiquette. Modeling is the most effective teaching method. Also, visitors to the class (including administration) are required to use any precautions or safety equipment (e.g. goggles) required of students.

12. Teachers should be aware of any health concerns of students that laboratory work may affect. These might include allergies, disabilities, temporary or chronic illnesses, or pregnancy. Teachers should work with the school administration, the school nurse, and the students' families to obtain current and accurate information. Because of the increasing frequency and life-threatening nature of latex allergies resulting from airborne latex particles, no activities involving latex balloons or latex gloves will be assigned. This restriction applies to both laboratory work and to teacher demonstrations.

13. Teachers should report any hazardous or potentially hazardous conditions in writing to the head custodian and the administration immediately. Teachers should retain a copy of the report and follow up with the progress of the report as needed until correction has been achieved. Until the hazard has been corrected, the teacher must suspend any laboratory work that could pose a danger to others as a result of the hazard.

14. Teachers must not leave students engaged in laboratory work unsupervised at any time for any reason. If the classroom must be evacuated during laboratory work, the teacher must ensure that no hazardous conditions exist before leaving the room. If the teacher is absent from school, laboratory work must not be left as a substitute lesson plan.

15. Teachers must be sure that all safety equipment in the classroom is well maintained and easily accessible. In particular,

a. Safety showers, eyewashes, and fire extinguishers should be unobstructed at all times.
b. Fume hoods should not be used to store chemicals.

c. Classrooms must have immediate access to a class ABC fire extinguisher and a fire blanket. These should be in a location to allow access in 30 steps or within 15 seconds. Teachers should communicate with the chief custodian about the location of all fire extinguishers. If a fire extinguisher is deployed at any time for any reason, the administration and the chief custodian must be notified immediately with all relevant details.
d. Adequate ventilation appropriate for the laboratory exercise must be maintained. Any work that generates hazardous or noxious gases (note: some hazardous gases are odorless) should be performed in a functional fume hood.
e. Exits from the room must be easily accessible to all students, especially those with assistive devices (e.g. wheelchairs, walkers, crutches). The evacuation procedure must be explained to students before any laboratory work begins (preferably the first day of school), and special evacuation arrangements for students with assistive devices must be outlined and submitted to the administration.

16. Teachers are required to advise students of their rights and responsibilities relating to laboratory safety. Laboratory safety training must precede all laboratory work and become an integral part of the science curriculum. The teacher will obtain and keep documentation that students and parents have been informed of safety expectations.

17. Teachers must ensure that students clean up their work area after completing laboratory activities. In addition, teachers must be sure that students wash their hands after laboratory work or any time they must leave the laboratory area as needed.

18. Teachers must never tolerate inappropriate behavior or unauthorized experiments in the laboratory. One person's misconduct poses a hazard to everybody else in the laboratory. Students who engage in physical horseplay, sabotage of others' work, or unauthorized "experiments" must be removed from the laboratory immediately and properly disciplined according to the procedures in the Sussex Academy Code of Conduct. In addition, the offender's parent/guardian should be informed within 24 hours by the classroom teacher.

19. The school safety plan must be reviewed by all science teachers. Each classroom must post the evacuation procedure from the room and emergency response guide in a prominent place. The emergency response guide will include emergency procedures, special procedures (unique to each classroom situation as needed), and a list of emergency phone numbers.

(*Source: Safety First, 2011)*

Good Samaritan Act

Any person, who in good faith gratuitously renders emergency care at the scene of an accident or emergency to a victim thereof, shall not be liable for any civil damages for any personal injury resulting from an act or omission by the person rendering the emergency care or as a result of any act or failure to act to provide or arrange for further medical treatment or care for the injured person, except acts or omissions amounting to gross negligence or willful or wanton misconduct. The exemptions from civil liability provided by this chapter shall not apply to the administering of such care where the same is rendered for remuneration or with the expectation of remuneration, or is rendered by any person or agent of a principal who was at the scene of the accident or emergency because he or his principal was soliciting business or performing or seeking to perform emergency care services for remuneration.

(*Source: 16 Del. C. 1953, #6801; 58 Del. Laws, c. 105; 59 Del. Laws, c. 361, #1.*)

Responsibilities of the School Safety Officers

1. Act as liaison among science teachers, administration, and facilities staff regarding science safety issues.

2. Maintain the science chemical inventory for the school, including the inventories of chemicals maintained by individual teachers. This inventory is updated regularly and shared with administration. Oversees and approves all chemical orders by the science department.

4. Maintain a supply of Material Safety Data Sheets (MSDS/SDS) for all chemicals in the science chemical inventory. The location of this information is shared with the administration, the chief custodian, and the school nurse.

5. Assist teachers with maintenance requests related to safety equipment.

6. Assist with identifying and coordinating disposal of hazardous wastes.

7. Assist with annual review of the school chemical safety plan.

8. Provide annual safety training for all science teachers before laboratory instruction begins and keep records of training.

Administrators' Responsibilities

The school's administration needs to cooperate fully with science teachers to maintain a safer environment for laboratory investigation.

1. Administrators need to ensure that the facilities for science instruction meet all requirements for safety. Although laboratory investigation is a crucial part of effective science instruction, a safer environment is an absolute prerequisite for laboratory investigation. This includes provision of fire extinguishers, fire blankets, and goggles with sanitizing goggle cabinets. Administrators also need to ensure that chemicals are stored in secure storage facilities with limited access.

2. The number of students in a science classroom and the allotted space for laboratory work are crucial components of laboratory safety. When class sizes in laboratories exceed 24 students, the likelihood of laboratory accidents increases as class size increases (NSTA 2009). As students are scheduled in science classes, administrators need to work with teachers and guidance counselors to ensure that science classes are small enough to allow adequate room for students to move easily and to allow teachers to supervise students safely.

3. Administrators will not schedule science classes to routinely meet in classrooms that are not dedicated to science instruction. If such scheduling is necessary, the affected classes should have access to an appropriate laboratory on those days when students will conduct experiments.

4. Administrators will not schedule teachers of subjects other than science to teach regular classes in science classrooms. If a hazardous situation involving science materials should occur, the teacher may not be equipped to intervene.

5. Administrators must respond to maintenance requests that affect the safety level of the classroom promptly. If there is a delay in processing such requests, the administration should keep the teacher informed. These requests may include repair of eyewashes, stocking of fire extinguishers, and availability of appropriate safety goggles.

6. Administrators need to enforce appropriate disciplinary actions for safety infractions according to the severity of the infraction. If a student's behavior in the science laboratory poses a consistent safety hazard to that student and/or the rest of the class or school community, that student should be removed from science classes and appropriate interventions should be pursued.

(*Source: Safety First, 2011)*

CHEMICAL SAFETY

The following guidelines will be used in connection with science instruction involving chemicals and chemical apparatus.

Delaware Right-to-Know Law
Delaware's Hazardous Chemical Information Act (Right-To-Know Law) requires that all employees and students who may be exposed to hazardous chemicals be provided access to information regarding these chemicals effective January 1, 1985.
The Delaware Right to know law specifies three Rights (that the "employee/student" has) and three Responsibilities (that the "employer/teacher" has). The rights and responsibilities follow one from the other:

The student has the right to know:
1. What materials in their work environment are hazardous in any way.
2. How the materials are dangerous.
3. How to protect themselves against the hazards that the materials pose.

The teachers have the responsibility to:
1. Tell the students about any materials and procedures they will be exposed to that may be harmful to them in any way.
2. Inform the students of the exact nature of the hazards posed.
3. Teach the students how to protect themselves against the hazards posed by materials or procedures that they will be working with.

The chemistry laboratory is potentially the most dangerous place in the school. However, this need not constitute a serious threat if the instructor, laboratory assistants, and students have a thorough knowledge of the potential hazards, exercise prudent care and foresight, and use common sense. Accident prevention must be included in the performance of every task, and safety instruction must be an integral part of the overall program of science instruction.

(*Source: Hazardous Chemical Information Act,* 64 Delaware Laws, c. 344 § 1.)

Specific Considerations for Chemistry Safety

Chemical information
1. All chemicals provided to students for use must be in a clearly labeled container. This rule applies to all chemicals regardless of hazardous nature.

2. Labels on individual reagent containers for student use containing less than 100mL must contain certain identifying information:

- Name or chemical formula of the reagent
- Concentration (if in solution)
- Date of preparation if possible

3. In some cases, reagent bottles may be labeled with a letter or number (for example, if the reagent is an unknown for identification). The teacher will have an identification key for the unknowns and will provide hazard information about the unknowns to the students before work begins. When the lab exercise involving the unknown reagents is over, the bottle will be labeled with the name of the reagent.

4. Before purchasing new chemicals, teachers will check the chemical inventory in their building to assess the need for the purchase. The following will be considered before purchasing chemicals:

- Will amounts be used within 3 years?

- Can the chemical be stored properly? Can the chemical (or waste products from the chemical) be locked away from access by students?
- Can the chemical be disposed of safely?
- Are there appropriate and sufficient safety apparatus and personal protective equipment for using this chemical?
- Is the teacher properly trained to use this material? Is use of this chemical age and grade appropriate for students?

5. Upon receiving new chemicals, teachers will write the date (including year) of receipt and the date the bottle is opened on the manufacturer's label. The teacher will also retain the Safety Data Sheet (SDS) that arrives with the chemical and forward a copy to the Safety Officer.

6. The MSDS/SDS contains detailed information of all hazardous information about a chemical. Manufacturers of chemicals are required by law to ship a current MSDS/SDS with every chemical. The location of the collection of MSDS/SDSs for all chemicals held by the school should be provided to the administration and the school nurse. The collection should be kept in the chemical storage area.

7. Certain chemicals are not permitted for use in K-12 science classrooms. In particular, mercury and mercury compounds must be removed from schools by January 1, 2005. This includes mercury thermometers and mercury barometers. Any of these that are found must never be used in laboratory exercises.

8. Schools and teachers are not to accept donated chemicals from industry or other institutions of learning. Because of evaporation, decomposition, or hygroscopic properties, the purity of such chemicals cannot be guaranteed. Furthermore, transporting such chemicals may constitute a hazard. Any chemical orders should be preapproved by the building Safety Officer.

9. When combining water and any acid, always add small amounts of the acid to the water. Adding water to the acid can result in splashing of the acid, leading to a corrosive and hazardous condition.

10. Glass should be handled with care. All glassware that students handle should be fire polished beforehand whenever possible. Students should use particular care in handling microscope slides and cover slips (which cannot be fire polished). Only teachers should insert glass tubing into rubber stoppers. Pipetting must be done using a bulb or other suction device—mouth pipetting is expressly forbidden.

(*Source: Safety First, 2011, Furr, 2000*)

Chemical Storage

1. Schools must take inventory of all chemicals annually. Inventories should be conducted by at least two adults at a time. Students should not assist in this process. The inventory should contain the following information:

- name of the chemical,
- physical state of the chemical (e.g. crystals, powder, aqueous solution. For solutions, the concentration should be included.)
- amount on hand,
- date purchased (if known)
- location on where the chemical is stored,
- a "sign out/sign in" procedure for when chemicals are used

The inventory should be accessible to all teachers using the stored chemicals, the school nurse, and the administration.

2. Chemicals should be stored in a dedicated room with limited access. Only teachers who use the chemicals for instruction, the custodial staff, and the principal should be granted unlimited access. The

room should be well ventilated, well lighted, and be close to intercom or telephone access to the main office.
3. Chemicals must be stored according to chemical compatibility. The chemical storage pattern described by Flinn Chemical Safety Manual and the National Institute of Occupational Safety and Health (NIOSH) is to be used. http://www.flinnsci.com/Sections/Safety/chemicalSafety/L1070-1074_HS_ChemInvenStor.pdf
4. Certain chemicals (acids, flammables, strong oxidizers) must be stored in specialized cabinets labeled "ACIDS", FLAMMABLES, or STRONG OXIDIZERS. Nitric acid (HNO_3) in any concentration must be stored separately from any organic compounds and from other acids (especially acetic acid).
5. The shelving in the chemical storeroom should be clearly labeled with the families of chemicals stored (e.g. sulfates, halides, carbonates). If any water appears on shelving in the chemical storeroom, the chemicals should be removed from the shelf and the problem identified and corrected immediately.
6. Chemicals should never be stored above eye level nor on the floor. Teachers should not climb ladders or furniture to reach chemicals. If the desired chemical is out of reach, obtain assistance or have the chemical moved.
7. Refrigerators that contain chemicals must never be used for food, and vice-versa. All refrigerators should be inventoried and cleaned as needed. Refrigerators used for storing chemicals must be labeled "NO FOOD."
8. When chemicals are used in student laboratory exercises, the students should not use the stock bottles. Instead, place sufficient chemicals into labeled beakers for student use. Excess chemicals should never be returned to the stock bottle as this could compromise the purity of the stock and possibly cause a dangerous reaction with impurities from the lab. Chemicals should not be stored in classrooms as a general rule.
9. Chemicals and solutions should only be stored in properly labeled containers designed for chemical storage. Homemade bottles (e.g. baby food jars, soda bottles) may not provide adequate protection for the chemical. The integrity of bottle closures should be checked during the chemical inventory and chemicals with compromised closures (e.g. cracked lids, "frozen" ground glass stoppers) should be discarded.
10. Chemicals that are transferred to secondary containers must be labeled with the name of the chemical, the date of transfer, and hazard information.

(Source: *Flinn Chemical & Biological Catalog/Reference Manual*)

Chemical/Waste Disposal

1. Schools should only retain enough of any chemical to be used in 3 years. Unless there are specific plans to use surplus chemicals in a reasonable period of time, they should be discarded.

2. Teachers discarding chemicals need to pay close attention to proper disposal procedures as outlined on the SDS. Additional guidance about disposal of chemicals may be found in the Flinn Chemical and Biological Catalog and Reference Manual.

3. Solid waste should never be discarded in the sink. Even if it is water soluble, the solid can clog the drain.

4. Some chemicals must be discarded using special disposal procedures or a licensed hazardous waste removal company to avoid creating an environmental hazard. Contact the administration for guidance.

5. When disposing of several chemicals at once, be aware that different chemicals may have unexpected reactions when combined in the sink. To avoid these reactions, flush the sink with running water for five minutes after each type of chemical is discarded.

6. If the label has disappeared from a chemical and it cannot be identified, assume it is hazardous. Contact the Safety Officer.

7. Broken glass should be discarded in a labeled box made of hard plastic or corrugated cardboard. The box should be taped shut and disposed of carefully. Again, be mindful of what chemicals (if any) are on

the broken glass before discarding. Students must not attempt to clean up broken glass—they must call for the teacher's assistance.

Other considerations

1. Be sure that any time students work with chemicals, there is adequate ventilation. Many reactions produce unpleasant odors. While these odors may not necessarily be toxic, they could be strong enough to irritate mucous membranes or cause an adverse reaction.

2. Students are never permitted to bring chemicals into the hallways.

3. Teachers should only provide sufficient chemicals for a given experiment and avoid providing excess chemicals to classes. When possible, choose activities that employ micro-quantities of chemicals.

4. Spilled water on the floor is one of the most hazardous chemicals in the lab. Anybody can easily slip in a puddle because it is frequently difficult to see. Impress upon students the need to identify and clean spilled water immediately.

5. Certain laboratory activities in grades K-8 require the use of a tea candle as a heat source. In this situation, students must tie back shoulder length hair and secure dangling clothes or jewelry. Other than these cases, open flames should not be used as a heat source in a lab in grades K-8. Hot plates and water baths should be used for heating in these grades.

6. When heating glassware, it is important to remember that hot glass looks exactly like cool glass. Use appropriate equipment to handle hot glass (e.g. tongs, test tube holders). Safety goggles must be worn in the lab when glassware is used.

7. Lab activities that involve open flames should not be attempted before 9th grade (other than as described previously). When science classes use laboratory gas burners, extreme care must be exercised. The hottest part of the burner is the space immediately *above* the flame. The flame should only be extinguished by turning the gas jet handle (in the "off" setting, the handle is perpendicular to the jet), The teacher must know the location of the master shut-off button for the gas jets in the room. Laboratory burners and hot plates should never be used as a way to heat a cold room.

8. When liquids are heated in a test tube, the opening of the test tube must be pointed away from all others. The teacher should work with students to ensure the optimum work arrangement to allow this to happen.

9. The student workplace must be uncluttered. The only things students should bring to the laboratory workstation are the materials needed to do the activity.

10. Teachers need to prepare designated containers for disposal of wastes according to hazard information. Lesson planning must include proper disposal of all chemicals and refuse. Waste containers should be disposed of promptly—no laboratory waste should be retained beyond the school year, regardless of its hazardous nature.

11. Sometimes chemicals may be identified by a characteristic smell. The only correct way to smell a chemical is to hold it a few inches away from the nose and waft the fumes of the chemical toward the nose. Any other method of smelling a chemical can irritate the mucous membranes of the upper sinuses and the eyes. If the chemical generally has a strong odor, the wafting technique should not be attempted. Taste must never be used to identify a chemical.

(Source: *Safety First, 2011*)

BIOLOGICAL SAFETY

The following guidelines will be followed in connection with science instruction involving biology and life sciences.

Use of animals

1. Live animals can be used in a variety of situations in science classes at all levels. If possible, animals should be obtained from a reliable biological supply center (e.g. Carolina, Wards). Vertebrates from the wild should not be brought into the classroom.

2. The teacher is responsible for providing the animal with appropriate living quarters. This includes ensuring adequate sanitation, protection from adverse conditions, temperature regulation, proper feeding and watering regimens, and provision for offspring. Care must be taken to prevent the animal's escape. If the animal should escape, the administration and the head custodian should be notified immediately and every attempt to recover the animal should be made.

3. If live animals are maintained in a classroom, the teacher must make provisions for the animals feeding and cleaning for when school is closed, especially over several days.

4. If students are required to handle the animals, they should wash their hands before and after handling the animal. Use of alcohol-based hand sanitizer (65 % or more isopropyl alcohol) is recommended after washing. As all animals may bite, students should be thoroughly instructed on safer and humane care of the animal. If a student is bitten, the nurse must be notified (as with any laboratory accident or injury), and the offending animal isolated for further examination.

5. Euthanasia of animals should only be conducted as follows:

a. Euthanasia should only be carried out by an adult and only after the activity had ended. It should not be performed in the presence of students. Euthanasia should not be part of an ongoing laboratory activity.
b. Only invertebrate animals and fish should be euthanized by the teacher. Other arrangements should be made for other vertebrates. Crawfish, aquatic plants, and snails should never be released to the wild. Organisms may only be sent home with students if written consent from parents/guardians has been obtained first.
c. Euthanasia should be performed safely and humanely. Animal corpses should be double bagged and disposed of in an approved manner so that no environmental risk is introduced.
d. Insects must not be euthanized with diethyl ether.

6. Certain live animals must never be used in a science classroom. These include (but are not limited to)

- Stinging insects (bees, wasps, hornets)
- Poisonous spiders
- Disease vectors (mosquitoes, ticks, fleas)
- Venomous snakes (note: non-venomous snakes may be kept in a science classroom with the administration's permission)
- Scorpions
- Aggressive carnivorous fish (piranha)
- Exotic species (plant and animal) known to endanger local ecosystems (e.g. Japanese beetle, Northern Snakehead, kudzu)

Use of preserved animals

1. Animals for dissection must be preserved in a non-formalin containing preservative only. Any animals that have been preserved in formalin or formaldehyde containing preservatives are discarded as a chemical hazard (contact the Safety Officer). Formaldehyde is a suspected carcinogen.

2. Only preserved animals that have been purchased from a biology supply company should be dissected. Never allow students to dissect animal corpses found in the wild. Decaying animal remains should never be dissected, even if they have been appropriately preserved.

3. Dissections should only be performed in rooms with abundant ventilation. The animal should be washed thoroughly with water before cutting. Once the initial incision is made, the internal organs should be rinsed thoroughly with water.

4. Students performing dissections must wear appropriate safety equipment:

a. Laboratory apron
b. Vinyl or nitrile gloves
c. Safety goggles

5. Only scalpels may be used to cut the specimen—bare razor blades provide inadequate control while cutting. Dissecting instruments must be sharp. The teacher must maintain close supervision of students and account for all dissecting apparatus before and after the lesson.

6. Teachers should remind students of possible adverse occurrences during a dissection (dizziness, anxiety, cuts, skin irritation from preservative, cuts, allergic reaction), and assess students for any signs of these occurrences.

7. Teachers are advised to use effective grouping strategies during dissections. Only one group member should handle the specimen and dissecting instruments at a time.

8. Incisions should always be made away from the student and away from other group members.

9. Some students are unable to participate in animal dissections for a variety of different reasons. Students must be given the option of completing an alternate activity for full credit in lieu of a dissection. This alternate activity must address the same science standards and be of comparable rigor to the dissection.

10. All dissected parts must remain in the dissecting tray until they are discarded. Before performing a dissection, the teacher should consult with custodial services for directions on proper disposal of remains.

Use of plants

Plants and plant parts provide a convenient and rich source of living data for laboratory science. Certain safety protocols apply to using plants in science instruction.

1. Before starting any work involving plants or plant products, teachers need to determine what allergies students may have. Students should never work with any material for which they have exhibited an allergic reaction. Teachers should be aware of the symptoms of an allergic reaction (see http://www.aaaai.org/patients/publicedmat/tips/whatisanaphylaxis.stm)

2. Laboratory exercises involving horticulture performed in the classroom should be done with commercially purchased potting soil. Naturally occurring soils frequently contain molds, parasites, stinging insects, or other hazardous impurities. Therefore, investigations with naturally occurring soils must be supervised carefully by the teacher.

3. Cultivated plants should be well cared for and given plenty of room to grow. Sick or overcrowded plants tend to become breeding grounds for molds, which can present an allergic or respiratory hazard in the classroom. Bringing plants (including seeds) from the wild for cultivation is discouraged because of the risk of disseminating molds. Plants and seeds should be purchased commercially. If plants or soils develop visible mold, the moldy parts should be removed immediately and discarded in a sealed plastic bag to prevent further contamination.

4. When working with flowering plants, take care to avoid dispersing large amounts of pollen. This can trigger an allergic reaction in some people even if such a reaction has never occurred before.

5. Plants that are known to be poisonous or extremely allergenic should never be brought into a classroom. When students conduct laboratory investigations outside, they should be instructed to recognize potentially hazardous plants growing indigenously, such as poison ivy, poison oak, stinging nettle, and jimsonweed. Students should never taste any plant or fungus growing outside. Many plants are extremely poisonous if ingested (e.g. toadstools, buttercup, azalea). In addition, plants may have been sprayed with insecticides, or have been exposed to animal waste. Any incidence of jimsonweed growing on or near school property should be reported to the administration and the Delaware Department of Natural Resources and Environmental Control (DNREC) immediately.

6. Any and all tobacco demonstrations, including those relating to the components of tobacco smoke, are forbidden.

(*Source: Safety First, 2011*)

Use of microorganisms

1. Microorganisms used for study in the K-12 science laboratory must be Biosafety Level 1 and be obtained through commercial vendors. Random sampling of school environments to obtain representative microorganisms is not to be practiced. The consequences of culturing a human pathogen warrant that environmental culturing of microorganisms should be discontinued. Microorganisms should never be cultured from a human or animal source (e.g. throat culture). Whenever possible, the least hazardous microorganism should be used for a procedure (e.g. *Saccharomyces cerevisiae* can be used to demonstrate the streak plate method of inoculation and smear preparation).

2. Correct aseptic technique must be demonstrated and modeled before students work with microorganisms. Students should practice all techniques with sterile materials before handling microorganisms.

3. The following terms apply to control of microorganisms:

- Sterilization: killing all living organisms in an environment, including microbial spores
- Disinfection: killing most (not necessarily all) microorganisms (usually from skin or an inanimate surface)
- Sanitization: reduction of numbers of microorganisms to safer levels (i.e. kitchen sanitization)

4. Culture media that are used to grow microorganisms must be steam sterilized at 121° C and 15 psi for at least 15 minutes before use. Equipment for culturing may be sterilized in the same way or by incineration. Culture media that have supported growth of microorganisms should be sterilized at 121° C and 15 psi for at least 30 minutes before disposal. If this is not possible, the cultures must be saturated with chlorine bleach for 60 minutes before disposal. NOTE: immersion in bleach is considered disinfection, not sterilization. Students are not permitted to operate steam sterilizers (autoclaves or pressure cookers). This applies to student aides as well as other students.

5. Culture media must be clearly labeled with the type of media (this can be done with color coded caps on culture tubes and stickers on Petri plates as long as a legend is readily accessible), the source of the inoculum, name of the organism (if known), the student's name, and date of inoculation. If the sterility of the culture medium is questionable, it should be considered contaminated and sterilized immediately.

6. Students working with microorganisms should wear appropriate apparel at all times. This includes safety goggles, lab aprons, and vinyl or nitrile gloves. Because this work may involve using laboratory burners, hair that reaches the shoulder should be tied back. Students must wear closed toed shoes when working with microorganisms.

7. If a culture is spilled on student belongings, the contaminated items must be disinfected. Saturating the items with chlorine bleach for 10 minutes constitutes adequate disinfection. Students should never clean up culture spills. The area of the spill should be restricted until the teacher can decontaminate it.

8. If a culture spill occurs on a student's skin, the student should wash the affected area for five minutes with antimicrobic soap. The school nurse must examine the area immediately.

9. If the culture spill occurs in the eyes or any mucous membrane, the affected area should be rinsed using the eyewash for 15 minutes. The nurse must be brought to the classroom immediately to assess the incident.

10. If a culture or Petri plate containing colonies of microorganisms is observed by students, the closure should be sealed with tape or paraffin wrap. Because of the risk of dropping or breaking culture tubes and Petri plates, teachers should not pass cultures around the classroom for inspection. Rather, the cultures should be set up at lab stations and students should move from station to station to inspect the cultures.

11. Any culture that develops mold (evidenced by powdery or cottony growth called hyphae) should be taped closed and discarded immediately. Molds and mold spores can cause severe respiratory symptoms. They spread quickly throughout a school and are difficult to remove.

12. Inoculating loops and needles must be sterilized in a laboratory burner until they glow orange for five seconds before and after inoculation. Because of the possibility of creating contaminated aerosols, the loop or needle must be cooled for approximately ten seconds before use. Students should not cool a hot loop or needle by immersing it into a sterile part of an agar plate. Alcohol burners pose a fire hazard and should not be used.

13. Glass spread bars ("hockey sticks") should be steam sterilized in a sealed bag and used once before disinfection in chlorine bleach. The practice of dipping the bar in 70 % isopropyl alcohol then flaming it is not a reliable sterilization procedure and it creates a fire hazard.

14. Biohazardous waste requiring sterilization must be placed in a bag with a biohazard label. The bag should be sealed and sterilized when it is half full. The biohazard bag should be sealed when not in use and sterilized within a week from when waste is first introduced to it.

15. Because of the possibility of infectious conjunctivitis ("pink eye"), microscope eyepieces should be disinfected by wiping with 70 % isopropyl alcohol after each use. Students suffering from infectious conjunctivitis should not come to school until cleared by a physician.

16. Refrigerators that contain specimens used for scientific study must never be used for food, and vice-versa. All refrigerators should be inventoried monthly and cleaned as needed.

17. Teachers will not conduct laboratory activities that involve drawing blood or involve other human body fluids.

18. Teachers may conduct laboratory exercises involving microscopy of epithelial cheek cells. Only toothpicks or (preferred) clean wood splints may be used to obtain cells. Any items used to collect cells are considered contaminated—students must not drop these in the trashcan or lay them on the lab bench. Sampling devices must be decontaminated (immersion in 10 % bleach solution overnight) or sterilized before being discarded. Glass slides used to view epithelial cheek cells should be decontaminated in 70 % isopropyl alcohol for ten minutes prior to being discarded.

(Source: *Safety First, 2011, Flinn Chemical & Biological Catalog/Reference Manual, 2005)*

PHYSICAL SCIENCE SAFETY

Heat and Fire

1. Tea candles may be used in some laboratory activities in middle school science classes. No other forms of open flames should be used as a heat source in any procedures before ninth grade. Candles should only be lit with spark lighters.

2. Safety goggles must always be worn in a laboratory where a heat source is used.

3. Students must be instructed that heat sources, hot glassware, and live steam can cause severe burns on exposed skin. If open test tubes are being heated, they should be pointed away from all others.

4. Only borosilicate (e.g. Pyrex™ or Kimax™) glassware should be heated. Heated glassware must never be handled with bare hands, regardless of how long it has been heated. Use tongs or insulated gloves. Never heat cracked glassware, as the item is likely to shatter along the crack.

5. Shoulder length hair must be tied back whenever an open flame is used (including lit tea candles). Never leave any flame unattended.

6. Bunsen burners should be lit with spark lighters, not matches or butane lighters. The gas line should be inspected for cracks or holes before use. The spark lighter should be ready to use as soon as the gas jet is engaged, to prevent harmful accumulation of gas in the room. Burners should only be extinguished by turning off the gas jet.

7. The teacher must know the location of the automatic shutoff valve for gas. Hot plates and gas jets should be checked at the end of laboratory work to be sure they are in the “off” position. Because hot plates take a certain period of time to cool off enough to be safely handled, teachers are advised to use signs to indicate that a hot plate has recently been used and may still be hot.

Electricity

1. Prior to using any electrical equipment, teachers should carefully read the manufacturer's instructions. Teachers conducting labs or demonstrations with electrical equipment should be familiar with the dangers of electrical shock and its treatment. The best treatment is to avoid the situation through good safety procedures.

2. When working with electrical equipment, only tools with properly insulated handles should be used. Metal articles such as rulers, pencils, pens, or probes should never be used to examine circuits. Students should remove rings, bracelets and any jewelry that might contact a live circuit when doing electrical work.

3. All electrical equipment having voltages exceeding 50V should be grounded or be made of approved "double insulated" design. Grounded appliances are equipped with a three-prong plug and should never be operated with the ground plug removed or inoperative. This type of plug should not be used with a common two-prong receptacle. All receptacles should be grounded in science classrooms.

4. The use of extension cords in the laboratory should be minimal. They should be considered a temporary measure and sufficient receptacles installed to replace them in permanent or frequent applications. When used, they should be of three prong grounded design unless used with "double insulated" equipment. Since grounded extension cords can be used with all equipment, it is recommended that they be the only type used in science labs. Since electrical resistance increases with the length of the cords and because of the dangers of creating a physical hazard in the classroom, extension cords should be as short as possible. Extension cords should be taped to the surface where they are used to prevent them from dangling or from becoming a tripping hazard.

5. Batteries: When working with batteries students should be advised of the dangers involved. Few students are initially aware of the dangers that can be created by cells in series (high voltage) or in parallel (high current). Teachers should be aware of the number of batteries available and of the potential

for unauthorized experimentation. The following cautions should be reviewed with the students as appropriate to the activity.

a) Experiments in electricity should be designed so that the total voltage is less than 50 volts.

b) Short circuits create a fire hazard due to the high currents present.

c) Store batteries separately from any other items to prevent accidental short circuits.

d) Batteries must be recycled separately from other waste in accordance with state and local laws.

6. Any time students are creating a circuit, they should draw a diagram first to allow the teacher to identify possible short circuits. If possible, turn off all power when working on electrical equipment. The power leads should be the last connection made when assembling equipment and the first disconnected when disassembling equipment.

Light/electromagnetic radiation

1. Lasers: The Federal Government has issued Laser performance standards and lasers are classified by power output. The manufacturer's cautions should be followed. The helium-neon lasers of class I and II commonly found in schools are believed to offer no hazard to human skin but could cause eye damage at power levels above 1.0 milliwatt. In demonstrations, particular care must be taken so that neither the direct beam nor any mirror-like reflections strike the observer's eye since the beam could be focused onto the retina. Students should never be permitted to carry or use personal laser pointers except when they are part of a lesson and supervised by the teacher.

2. Sunlight: Direct vision of the sun for even short periods of time can cause eye damage. Mirror-like reflections may also cause injury to the eyes. Sunglasses and exposed photographic film do NOT provide sufficient filtering power to reduce sunlight to safer levels. In fact, they may increase the injury caused by the sun by dilating the pupils of the eye while not blocking sufficient light, particularly in the Ultraviolet range. If experiments are done to observe the sun, they should project an image on white paper using a lens or "camera obscura" or using an appropriate solar telescope. Measurements or observations can be made on the paper. Students should be educated on the dangers of staring at an eclipse of the sun (partial or total).

3. Ultraviolet radiation: Proper shielding or goggles certified for ultraviolet protection are required. The teacher should be aware that a wide UV spectrum exists and that protective glasses must be matched to the source.

(Source: *Safety First, 2011*)

OTHER CONSIDERATIONS

Many other issues and considerations relevant to science safety are likely to arise in any given teaching situation. Teachers and administrators are encouraged to discuss and explore these and other safety concerns in department meetings, faculty meetings, and in other appropriate discussion forums. Teachers also need to maintain a regular ongoing discussion about safety with their students throughout the year. If particular problems or concerns develop, teachers are encouraged to speak to their building safety officer or the administration.
Science teachers who wish to conduct new or unusual laboratory investigations with their classes must first discuss their plans with the building safety officer and the administration to determine if the activity can be performed safely in the school setting.

SCIENCE/STEM DEPARTMENT SAFETY CONTRACT

The department safety contract can be found online at
https://www.flinnsci.com/api/library/Download/80efae9513b548d6999c31d38ac36abe

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