

# Safety

## General Safety Considerations

*Students must be at the proper developmental level and possess adequate motor skills for individual use of laboratory materials and tools as well as be able to follow the safety rules. Lab safety rules should be clear, simply written, and posted in the classroom.*

1. Wear eye protection, aprons, and gloves when necessary.
2. No playing or running in lab areas.
3. No throwing of objects of any kind.
4. Clean up all work areas and dispose of materials properly.
5. Keep work areas neat and organized.
6. Never use a hand tool when others are standing within your safety zone.
7. Don't wear loose or baggy clothing or jewelry when using tools.
8. Tie back dangling, long hair when using tools.
9. Wash hands with soap after using lab materials.
10. Never touch a spinning or rotating tool.
11. Never taste any substance or object without permission from your teacher.

## FACILITY DESIGN

### Classroom Management

*Safe conditions in the science, technology, or engineering classroom depend upon how the teacher manages materials, workstations and student behavior. Advance preparation and organization of materials are vital to a successful hands-on program. In addition, students should be instructed in behavior that promotes safety for themselves and their classmates in the learning environment.*

1. Safety rules must be clearly written, discussed with students, and posted in the classroom.
2. A safety contract should be required for appropriate age levels.
3. Students should be taught safe use and transport of tools and materials. This information should be appropriately assessed.
4. Stations where students pick up and return tools and materials should be clearly marked and kept as neat as possible.
5. Safety precautions should be reviewed with students when presenting a new lesson.
6. The teacher should make every effort to become aware of possible hazards as a part of preparation for any activity. Frequently, safety measures are found in written teacher guides.
7. Administration and parents should be notified if any student behaves in a manner that puts him/herself or other students at risk.

### Laboratory / Physical Setting

1. Safe teaching and learning conditions begin with organized classroom facilities. This means that proper attention must be paid to adequate space, appropriate furnishings, properly installed electrical outlets, sinks, lighting, ventilation and storage.
2. Furniture, workstations and mobile lab carts should be appropriately sized and adequately spaced. Forty-five to 60 square feet (4.2-5.6 square meters) of working space per student should be provided. Class size should not exceed 24 students.

## Safety

3. The American Disabilities Act (ADA) requires that handicapped and disabled students be provided an additional 20 square feet (1.9 square meters) of work space per student.
4. Furniture and lab equipment should be in good condition.
5. There should be designated and appropriate storage areas for materials which do not block walkways and exits. These areas should be secure to prevent student access.
6. Adequate and properly grounded electrical outlets should be spread out around the room.
7. The room and lab stations should be well-lit.
8. Fire extinguisher(s) should be fully charged and readily available, and staff should be trained to use them. Fire blankets should be within easy reach.
9. Fire doors and exits should meet current building codes.
10. A working telephone and/or intercom should be available in each room for emergencies.
11. Ventilation should provide for regular air exchange within the room.
12. Lab safety rules clearly written and posted.
13. Classes should include no more than 24 students per teacher. If three or more students are identified as "special needs," a paraprofessional or other responsible adult should be provided for additional supervision.
14. The teacher should have a clear view of all work areas.
15. Protective clothing and eye protection should be available as needed.
16. The classroom teacher should be involved in any plans for room/building renovations to insure proper facilities, storage and utilities.
17. Students should be supervised by an adult at all times.

### Storage

*The following recommendations will provide for safe and adequate storage:*

1. Storage should be kept neat and clean.
2. Storage areas should not block walkways and work spaces.
3. Shelves must be adequate to support loads.
4. Heavier items should be stored on secure lower shelves.
5. Stored tools and lab materials should be inaccessible to students.
6. Storage of chemicals requires special guidelines:
  - a. All chemicals must be clearly labeled (contents, strength, date purchased, precautions) and stored in original containers.
  - b. Chemicals should not be stored past the manufacturer's suggested shelf life.
  - c. MSDS sheets for purchased lab-grade chemicals must be filed within easy reach of chemical containers.
  - d. Flammables and corrosives should be stored separately in a fire-proof storage area.

---

## MATERIALS

### Materials To Avoid in an Elementary Program

1. Aerosols with organic propellants
2. Alcohol burners
3. Bacterial cultures
4. Body fluids

## Safety

5. Certain glues (e.g., “instant,” epoxy, airplane)
6. Common allergens (e.g., pollens, animal furs, peanut products, mold)
7. Flammable liquids (e.g., methyl alcohol, carbon disulfide, ether)
8. Formaldehyde-preserved animal specimens
9. Mercury thermometers (replace with alcohol-filled thermometers)
10. Nail polish remover
11. Oil-based paint thinners and turpentine
12. Organic-based craft dyes
13. Organic paint strippers
14. Plant parts other than tuber, holly berries
15. Poisonous plants (e.g., poison ivy, mistletoe, poinsettia, azalea, tulip bulb, potato)
16. Poisonous animals (e.g., spiders, stinging insects, centipedes, millipedes, some snakes and lizards)
17. White-out type solutions
18. Strong acids (e.g., undiluted hydrochloric, nitric, sulfuric; boric acid powder)
19. Strong bases (e.g., undiluted ammonia, sodium hydroxide (lye), chlorine bleach)
20. Anything harmful if ingested, if age appropriate

### Disposal of Materials

1. Many materials used in an elementary lab program can be disposed of in classroom trashcans and sinks. However, special procedures should be followed for some materials.
2. The Environmental Protection Agency (EPA) and the American Chemical Society (ACS) list the following disposal methods:
  - Provide a separate, labeled container for broken glass and other sharp objects.
  - Regulations governing what materials will be accepted at sanitary landfills and your local sewer system vary. Call your local codes enforcement office for this information.
  - Hazardous wastes require special handling. Contact EPA or call your local codes enforcement office for this information.
  - Recycling or reuse of materials should be promoted whenever possible.
  - Sink disposal of solid materials (e.g., soil, clay, plaster) should be avoided.
  - All liquid chemicals that are safe for classroom sink disposal should be diluted before being poured into drains. Consult the appropriate MSDS sheet whenever possible.

*If you are not sure if a waste is hazardous, contact a local/state hazardous waste management agency, your state or regional EPA office, fire marshal's office, or your state's Department of Education.*

---

## TOOLS and EQUIPMENT

*Hands-on, inquiry-based science, technology, or engineering instruction requires the safe use of lab materials and tools by students, individually and in groups.*

1. Students must be at the proper developmental level and possess adequate motor skills for individual use of tools and lab materials. Instruction and supervision must be provided by a qualified instructor.
2. Tools should be the proper size for the age and size of the students.

## Safety

3. Wherever possible a jig or vise should be used to hold materials, allowing students to have both hands free.
4. Each hand tool and piece of lab equipment should be introduced by the teacher, including its proper use and safety precautions.
5. Students should demonstrate safe tool and equipment use to the instructor before working independently.
6. Lab equipment and 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).
7. A teacher who is uncertain about the safe use of a particular tool or material with students should first consult with someone having the appropriate expertise.

---

### SAFETY EQUIPMENT

*All students and teachers are required to wear eye protection whenever using materials that can damage the eyes. Goggles should meet the standards of the American National Standards Institute (ANSI), including chemical splash goggles to be worn whenever potentially harmful chemicals are a part of the lesson. If students in different classes will share goggles, they must be sterilized between uses by dipping in a disinfectant solution or treatment in a sterilizing ultraviolet light cabinet. Protective aprons and disposable gloves should be provided and worn by teachers and students whenever appropriate.*

---

### DEFINITIONS

1. Acids/Bases – chemicals that release hydrogen or hydroxide ions when mixed with water, becoming corrosive. May be strong (e.g., hydrochloric acid, sodium hydroxide, lye) or weak (e.g., acetic acid, vinegar, baking soda).
3. Body fluids – any liquid produced by the body of humans or other animals; includes saliva, blood and urine.
4. Chemicals – materials that may produce reactions leading to corrosion, noxious fumes, or other negative effects when used inappropriately in the classroom.
5. Combustibles – any material that burns easily.
6. Hand tools – non-motorized implements used to do work in the laboratory.
7. Hazardous waste – materials that become toxic or could possibly endanger species and the quality of the environment when released.
8. Metals – shiny, dense, malleable elements that can be toxic if ingested, inhaled in powder or vapor form, or taken in through the skin (e.g., mercury).
9. MSDS (Materials Safety and Data Sheet) Sheet – contains information about chemicals purchased from a science supply vendor; lists all of the properties and possible hazards of the chemical. If an MSDS is not available, request one from the manufacturer or obtain one online at <http://www.msdsonline.com>
10. Organic compounds – chemical compounds containing carbon, hydrogen and often times oxygen bonded together (e.g., turpentine, fats and oils, sugars, starches, some fertilizers).
11. Safe environment – teaching and learning conditions that promote and allow attitudes and procedures that avoid accidents and injury within the school community.
12. Solvents – materials that dissolve other chemicals (e.g., water, fat, organic)
13. Toxins - materials that are or may become harmful if taken into the body or released into the environment.