ACS
Chemistry for Life™

Safety in the Elementary Science Classroom

THIRD EDITION

American Chemical Society

FOREWORD

Science education in the elementary school is crucial to the education of our children. Hands-on science activities encourage students to become active participants in learning about the world around them. This booklet is designed to assist elementary science teachers with one of the special aspects of teaching science—creating a safe experimental environment for students.

A special note of acknowledgement to members of the American Chemical Society (ACS) Committee on Chemical Safety who prepared the first edition of this manual in 1993: Jack Breazeale; who chaired the Subcommittee; Robert Alaimo; Patricia Redden; Jay Young; Maureen Matkovich, ACS staff liaison; and, especially, Beverly DiMaio of the Horry County School District in South Carolina.

This third edition contains several additions and updated references and graphics. This edition was revised and edited by Bettyann Howson, Task Force chair; David Crumrine; David Katz; Robert Hill; Patricia Galvan, ACS Office of K–8 Education; and Marta Gmurczyk, ACS staff liaison. Their contributions to this edition are gratefully acknowledged.

Laurence Doemeny, Chair
Committee on Chemical Safety

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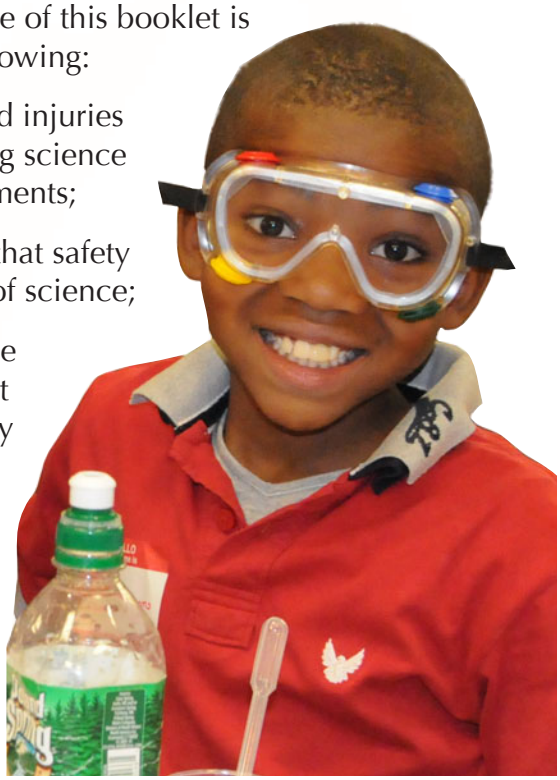
SAFETY IN THE ELEMENTARY SCIENCE CLASSROOM

INTRODUCTION

Science activities in the elementary classroom are safe provided that you and your students are aware of potential hazards and take all necessary and appropriate precautions. By modeling safe lab practices and instructing your students to do the same, they will not only avoid injury now but they will also be better prepared for lab experiences in their upper level science classes.

The safety measures described in this booklet have been compiled by scientists whose area of expertise is chemical safety. The purpose of this booklet is to help you achieve the following:

- Prevent accidents and injuries that may occur during science activities and experiments;
- Teach your students that safety is an important part of science;
- Gain awareness of the potential hazards that exist in an elementary science classroom; and
- Identify safe lab practices that students should know and follow.



These scientists recognize that they are not the only source of classroom safety information. You may consult your science textbooks or kit programs, state department of education, science supply companies that serve K–12 schools, or the National Science Teachers Association for additional safety information. Science faculties at nearby colleges and universities are often willing to assist in safety matters, as well.

TAKE TIME TO PLAN

Many potential hazards can be eliminated if you are organized and prepared. The key is to become familiar with the procedures and substances used in hands-on activities so that you will know what to expect. Always perform activities and experiments before assigning them to students and, while practicing the experiment, consider the following:

- Identify the materials you will need and how you will distribute them to students;
- Identify safety issues and plan how you will address these with students;
- Consider how you will instruct students as they conduct the activity;
- Consider possible emergencies and plan how you will handle them should they occur;
- Ensure that the necessary equipment and emergency supplies are readily available and that you know how to use them;
- Plan how you will collect materials and safely dispose of waste after the activity; and

- Plan to have students wash their hands after completing a lesson that includes an experiment or activity.

Follow only reputable published procedures when mixing or using chemicals. All activities published by the ACS, for use at the elementary school level, go through a safety-review process. If you would like to use or combine chemicals on your own, find out whether or not the activity you are planning is safe to perform in a classroom setting. Consult a high school science teacher, science supervisor, or a science professional to learn about any potential problems. Feel free to contact the ACS Education Division at education@acs.org with questions about the safety of a planned science activity in your classroom.

GRAB YOUR GOGGLES AND GEAR

You, your students, and any visitors to the classroom should wear goggles whenever you conduct or observe hands-on activities. You may find that you need to remind students that goggles work only if they cover a student's eyes, not their forehead or neck! However, wearing goggles is just one way to protect your eyes when conducting science activities or experiments. Consider the following to ensure that you and your students are properly protected during science activities:

- Wear properly fitting splash-proof safety goggles when working with chemicals or observing others who are working with chemicals. Both child and adult-sized goggles are available from the American Chemical Society at www.acs.org/store, as well as from a variety of K–12 science suppliers;
- Always wear splash-proof safety goggles when working with, or observing, students who are using chemicals, hot liquids, or flying objects;

- Wear a laboratory apron or art smock made of cotton, if there is a chance of soiling or damaging clothing;
- Use gloves, heat or cold-resistant mitts, or other hand protection when working with hot materials, dry ice, noxious plants, or live animals;
- Tie back long hair and secure loose clothing and dangling jewelry, especially when working with chemicals or heat sources; and
- Remind students to keep science materials away from their mouths, noses, or eyes when conducting or cleaning after an activity or experiment.

CHECK YOUR SCIENCE EQUIPMENT

CHEMICALS

- You will find that most K–6 science activity procedures call for household chemicals. Before using these, study the product label carefully to learn the hazards and warnings.
- When using a chemical purchased from a science supply company that serves K–12 schools, check the Material Safety Data Sheet (MSDS). This document describes the hazards of using the chemical, along with proper storage and disposal information.
- Always store chemicals and solutions in properly labeled containers meant for holding chemicals and solutions. Never store chemicals in containers that were originally used for food.

- Be sure to dispose of chemicals properly. If you have any questions about how to do this, consult the MSDS or your science supervisor. Regulations vary, so it is best to contact local experts.
- Keep the MSDS handy when using a chemical. If a student is injured as a result of coming into contact with the chemical, the MSDS will explain what to do. Be sure to send the injured student to the nurse's office along with the MSDS. Every MSDS should be on file in the school district office, as well as in the school or science department office. Copies should be available for the classroom.
- Always wear cotton or insulated gloves, such as gardening or work gloves, when handling dry ice. This solid carbon dioxide is extremely cold and can damage bare skin.
- Store dry ice in a container, such as an open cooler or cardboard box, so that carbon dioxide gas can escape. If placed in a sealed container the gas pressure will build and may cause the container to explode.

TOOLS

- Keep the use of glass to a minimum by using it only when necessary. Plastic nonbreakable containers are often a fine substitute.
- Cuts are among the most common of all laboratory injuries. Take proper precautions when using sharp objects, such as knives, scalpels, compasses with sharp points, wires, needles, or pins. Carefully consider whether cutting or sharp tools are really needed. If necessary, tools that have retractable

blades are recommended. Precutting materials will eliminate the need for students to handle cutting tools. If students must use sharp objects, demonstrate how students should safely handle these items to prevent injury.

- Store batteries with at least one terminal covered with tape. Batteries with any signs of corrosion should be discarded according to school policy or local disposal regulations. Because the contents of batteries are potentially hazardous, do not cut batteries open or take them apart.
- Old batteries should not be thrown away with the regular classroom trash. Instead, dispose of these, with one terminal covered with tape, in the community hazardous waste recycling collection.
- To minimize environmental impact consider using rechargeable batteries.

THERMOMETERS

- Use alcohol thermometers instead of traditional mercury thermometers. Mercury from broken thermometers is difficult to clean up and the vapor from spilled mercury is dangerous and toxic for the environment.
- Thermometers with plastic or metal backing are best. If using glass thermometers without this support, they should be equipped with a cap or triangular ring to prevent rolling.
- Students must not use the thermometers as stirring rods.

THINK BEFORE YOU BRING PLANTS & ANIMALS INTO YOUR CLASSROOM

PLANTS

- Never place seeds or plants used in science activities in your mouth.
- Always wash hands after working with seeds and plants.
- Many store-bought seeds have been coated with insecticides, fertilizers, or both.
- Approximately 700 species of plants are known to cause illness or death. Learn about plants in your area that are harmful and be sure to avoid contact with these. Contact your local agricultural extension office to learn more.
- When taking students on trips into areas where they may be exposed to hazardous plants, such as poison ivy, be prepared to instruct students to recognize and avoid these plants.
- Learn the signs of the plant poisoning so that you can act quickly if a student exhibits such signs after a lesson. Symptoms may include one or more of the following: headache, nausea, dizziness, vomiting, hives, itching, or other skin irritation.

LIVE ANIMALS

- Give students a safety lesson to show them how to properly care for and treat an animal before bringing it into a classroom.
- Students should handle animals voluntarily and only under your close supervision.
- Students must not mishandle or mistreat animals.
- Animals caught in the wild have no place in your classroom. Wild animals may have serious diseases, such as rabies or may carry infectious diseases, that are dangerous to people. For example, turtles may carry salmonella.

DISSECTION

- Only dissect animals that have been purchased from a science supplier to K–12 schools specifically for this purpose. Never dissect any other animal corpse.
- Do not use any animal body that has been preserved in formaldehyde.

PREVENT BURNS AND FIRES

HEATING MATERIALS

- The area surrounding a heat source should be clean and have no combustible materials nearby.
- Students should not work with hot materials, such as very hot water.
- Not all glass can handle the stress of being heated. Do not use household glass. Use only borosilicate laboratory glassware, such as Kimax™ or Pyrex™ when heating substances.
- Common household liquids, such as alcohol or oil, are flammable and should not be heated. Heat only water or water solutions.
- Never use alcohol burners.
- Handle all hot materials using the appropriate type of tongs.

HOT PLATES

- Use only laboratory type hot plates. These are sealed against minor spills.
- Place the hot plate in a location where a student cannot pull it off the worktop or trip over the power cord.
- Never leave the room while the hot plate is plugged in, whether or not it is in use.
- Keep students away from hot plates that are in use or still hot, unless you are right beside the students and have given them specific instructions.

- Before handling a hot plate, make sure that it is both unplugged and cool. You can check to see if a hot plate is still too hot by placing a few drops of water on the surface. If the water does not evaporate, it should be cool enough to touch.

FIRE

Use only safety matches. But even with these, handle and use matches yourself. If you decide that students themselves must use matches as part of a science activity or experiment, provide explicit instructions on how to safely use them and only permit students to use them under your direct supervision.

Students should use candles only under your strict supervision. Use tea candles that are short and wide, and cannot be knocked over in normal use. Place other candles in a "drip pan," such as an aluminum pie plate, that is large enough to contain the candle if it is knocked over.

- Never leave the room while a flame is lit or other heat source is in use.
- Know the location of the nearest fire extinguisher and make sure you are trained in how to use it.
- Check your school's policy about what to do in the event of a fire.
- Know the location of the nearest fire alarm. Have a map by the door of the classroom illustrating its location.

CLEAN UP BROKEN GLASS AND SPILLS

- Clean up broken glass by using a broom and dustpan. Do not touch, and do not allow students to touch, broken glass. Dispose of the glass in a separate container and label it to inform others that it contains broken glass.
- Clean up any spill immediately, especially a liquid spill. This will prevent further contamination of the work area and the possibility of slipping, falling, or tracking the chemical to another location.
- When using household or other chemicals, follow the clean-up instructions on the label or the MSDS.
- Throw all paper towels or other clean-up materials in a separate container for chemical wastes. Do not put chemical waste in the normal trash containers.

ESTABLISH EMERGENCY PROCEDURES

- Talk with other science teachers and your principal to develop and establish emergency procedures for first-aid, electric shock, poisoning, burns, allergic reactions, fire, evacuations, spills, or animal bites.
- Find contact information and keep it handy, so that you can contact the appropriate authorities and response agencies, in the event of an emergency.

STUDENT SAFETY RULES

Introduce safe practices and help your students understand why and how these practices are used. You may either set the rules or have students help you develop science safety rules. Either way, make sure students understand these rules and why they are necessary. You may choose to have students create posters for display in the room throughout the year to emphasize safety and remind students of the specific safety rules. Review the following safety rules with your students before beginning an activity.

- Always get your teacher's approval before conducting a science activity and be sure to have your teacher supervise whenever you conduct a science activity. Never experiment on your own.
- Always wear safety goggles when your teacher tells you to do so. Do not remove your goggles until your teacher says that it is OK.
- If instructed to do so, wear an apron or smock to protect your clothing.
- Read and follow all warning labels on substances being used.
- Be sure your teacher is aware of any allergies you may have.
- Carefully follow all instructions when conducting a science activity. Be sure to use substances exactly as described in the activity.

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Safety in the Elementary Science Classroom

- Keep all materials used in the science activity away from your mouth, nose, and eyes. Do not place your hands on your face when conducting or cleaning after an activity.
- Never taste anything during a science activity. If an investigation involves tasting, it will be done in the cafeteria.
- Tie back long hair, and secure loose clothing and dangling jewelry.
- Know the location of all safety equipment, such as the goggle cabinet, fire blanket, first-aid kit, and so forth, in or near your classroom.
- Safety equipment must remain in good working condition. Do not play with it.
- Tell your teacher immediately if an injury, spill, or other accident occurs.
- Clean up your work area after conducting a science activity.
- Wash your hands with soap and water after completing a science activity.

Even very young students must follow safety rules and have a sense of whether or not a behavior will be safe. Make it clear that students who do not follow these rules will lose the privilege of taking part in fun, hands-on activities. For the safety of all, misbehaving students must be removed from the area where hands-on activities are being conducted.

As students continue to learn about the importance of science safety throughout their elementary school years, they will transfer these skills beyond the science classroom to other classes, to the science lab in middle and high school, and to life in general.

RESOURCES

American Chemical Society
Education Division
1155 Sixteenth St., NW
Washington, DC 20036
800-227-5558
www.acs.org

American Chemical Society
Committee on Chemical Safety
1155 Sixteenth St., NW
Washington, DC 20036
www.acs.org/safety

National Association of Biology Teachers
12030 Sunrise Valley Drive
Suite 110
Reston, VA 20191
703-264-9696
www.NABT.org

National Science Teachers Association
1840 Wilson Blvd.
Arlington, VA 22201
703-243-7100
www.NSTA.org

Laboratory Safety Institute
192 Worcester Road
Natick, MA 01760
508-647-1900
www.labsafety.org

RECOMMENDATIONS FOR CLEANING SHARED GOGGLES

American Chemical Society
Joint Board-Council Committee on Chemical Safety
May 1, 2009

INTRODUCTION

Chemical safety goggles are often a shared commodity in secondary schools and in various programs such as the American Chemical Society's **Kids & Chemistry** and **National Chemistry Week** activities. Teachers and parents of children participating in school and other chemistry-related activities may be concerned with disease transmission associated with the reuse of protective chemical goggles.

The Safe Practices Subcommittee of the American Chemical Society's Committee on Chemical Safety (CCS) was tasked to investigate and make recommendations regarding cleaning goggles for reuse.

The successful transmission of disease requires a number of factors to occur simultaneously:

1. The presence of a pathogen that is virulent enough to cause disease;
2. The concentration of the pathogen must be high enough to cause an infectious dose;
3. There must be a transmission method from the environment to the host;
4. The pathogen must enter the correct portal to the host;
5. The host must be susceptible to the disease pathogen; and

6. The pathogen must be "strong" enough to overcome environmental stressors so as to remain active.

The first five points above are sometimes referred to as the "chain of infection." The absence of any of these factors will prevent an infection. The fifth edition of the Centers for Disease Control and Prevention (CDC)/ National Institutes of Health (NIH)'s Biosafety in Microbiological and Biomedical Laboratories states:

> "To accomplish successful transmission [of disease] from an environmental source, all of these requirements for the "chain of infection" must be present. The absence of any one element will prevent transmission... Reduction of environmental microbial contamination by conventional cleaning methods is often enough to prevent environmentally mediated transmission."

RECOMMENDATION:

After use, shared goggles, including the straps should be thoroughly washed in warm water containing a high-quality dishwashing detergent, thoroughly rinsed with fresh water and allowed to dry before the next use. This procedure should be sufficient to prevent environmentally transmitted disease.

According to the CDC, the washing protocol should provide adequate protection against common head lice (Pediculus). More information on preventing the transmission of head lice may be found at: http://www.cdc.gov/lice/head/prevent.html [accessed April 25, 2009].

REFERENCE:

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention/National Institutes of Health. *Biosafety in Microbiological and Biomedical Laboratories*, 5th ed. 2007, Appendix B. This reference is available online at: http://www.cdc.gov/OD/ohs/biosfty/bmbl5/bmbl5toc.htm [accessed April 25, 2009].

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