Safety Is Elementary

The New Standard for Safety in the Elementary Science Classroom

Second Edition

The Laboratory Safety Institute
Natick, Massachusetts

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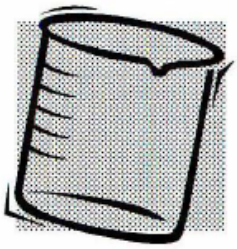


About This Guide...

This guide offers some suggestions and guidelines for safer and proper use of materials, which are most likely to be used in the K-6 science program. Thus, safety comments refer to only those materials and topics which are appropriate for the K-6 science classroom. This also means that you will not find information on, for example, the use of concentrated acids, flammable materials, harmful chemicals, dangerous equipment, or other inappropriate topics since these have no place in the K-6 science program.

This guide is *not* intended to be a complete resource manual for teaching science, although some ideas and teaching tips are included that relate to safer and effective use of science materials. While the information in this book has been gathered from sources generally recognized as accurate, the editors make no claim to its accuracy or completeness. Information regarding other resources for teaching elementary science can often be found in the Teacher's Manual for the science program you are using.

Finally, the intent is certainly not to frighten you or your students away from active participation in science activities. In fact, it is intended to inform you about safer practices to make your teaching of science a more enjoyable and meaningful experience for all of your students.

The *National Science Education Standards (1996)* states:

"Safety is a fundamental concern in all experimental science. Teachers of science must know and apply the necessary safety regulations in the storage, use, and care of the materials used by students. They adhere to safety rules and guidelines that are established by national organizations such as the American Chemical Society and the Occupational Safety and Health Administration, as well as by local and state regulatory agencies. They work with the school and district to ensure implementation and the use of safety guidelines for which they are responsible, such as the presence of safety equipment and an appropriate class size. Teachers also teach students how to engage safely in investigations inside and outside the classroom."

The main goal of this second edition has been to include only that information that is pertinent to grades K-6. Many A-Z topics have been edited, and new topics added. Useful internet references are now found throughout. New and appropriate material safety data sheets are included.

A Special Note Concerning the First Edition...

The Alabama Science Teachers Association (ASTA) published the first edition of this guide. Although there were several mistakes evident in the text such as incorrect spelling or inconsistent formatting, ASTA felt that it was still important to get this information out into the hands of teachers. Therefore, the first edition was printed errors and all. However, we greatly underestimated the demand for this document. Because of the special interest given to the manual, ASTA had the text scanned by computer and re-formatted into the more fashionable form for the second edition. They also used this opportunity to update the content to include the latest information on the use of hazardous chemicals in the classroom.

The Laboratory Safety Institute received permission from Lee Summerlin, editor of the original edition, to publish these new editions. LSI added more information and updated the entire book in January 2000. The following year we completed a more comprehensive revision. Special thanks to the co-editors, Peter Markow and Ken Roy, for their help in updating and revising this current edition.

The Institute and editors wish to thank and acknowledge the Cabot Corporation Foundation. The Foundation provided generous financial support for a comprehensive revision.

We would also like to thank Brian Shmaefsky, Mickey Sarquis, Roy LaFever, Sandra West, Terrie Wierenga, Victoria Sample, and Bobby Mize for their comments and suggestions.

We hope that *Safety is Elementary* is useful to you. In addition, we hope more than anything that the instructions provided here allow you to be more comfortable using hands-on science with your students. Please do not hesitate to contact LSI whenever you have a question concerning science safety.

Jim Kaufman, Director
The Laboratory Safety Institute

Introduction

It is a common observation that science receives less attention in the elementary classroom than any other subject does. This is due to many reasons, including the fact that many elementary teachers have limited academic backgrounds in science and do not have the experience in designing, conducting, and evaluating activities that are required for a legitimate "science" course. It is also clear that many elementary teachers have not had the opportunity to become adequately trained in the safety aspects of conducting science activities, and they approach this subject with a considerable amount of apprehension.

It is important that we address these issues for several reasons:

- **Science is a laboratory-centered Subject.** Everything that we know and teach about science *came from the laboratory.* Therefore, one can either teach "about science" from a nonactivity centered approach, or one can teach "science" by involving students in hands-on experiences from which they can build a strong background.

  The advent of science assessment fostered by No Child Left Behind Federal Legislation (2001 and amendments), has necessitated hands-on, inquiry-based science for all students at the elementary level. This has amplified the need for safer instructional practices in elementary classrooms.

- **Traditional science textbooks will soon be a thing of the past.** All major publishers are in the process of revising their K-6 science materials to be centered on activities that involve active student participation. This is in response to the many reports of professional scientific and educational organizations indicating that students learn science best from a laboratory centered approach.

- **Students need to become actively involved in science at an early age, when their enthusiasm and natural curiosity is at its peak.** It is important that they carry this positive attitude with them as they enter the higher grades where the laboratory aspect of science receives more emphasis.

- **Activities to support a K-6 science program need not require expensive materials, elaborate equipment, or exotic and harmful chemicals.** In fact, the emphasis on safety has forced most publishers to write science activities for K-6 that require only common materials and common sense in their use.

How to Use This Guide

Topics are listed in alphabetical order. Many topics are cross listed and refer you to related topics. For example, if you look under **ACIDS,** you will find that it refers you to **BASES,** since these two topics are usually discussed together.
Topics such as **CHEMICALS** or **CARE OF ANIMALS** require a more lengthy discussion. These topics are placed in the Appendix.

DISCLAIMER

Health and Safety regulations vary from state to state, and country to country. Users of this guide are encouraged to review local, state and national legal safety regulations and prudent safety practices as appropriate for their grade level.

No warrantee, guarantee or representation is made by the editors as to the accuracy or sufficiency of the information contained herein.

General Safety Practices for the Elementary Science Classroom

1. Obtain a copy of the school district's policies and regulations regarding school safety, reporting of accidents, safety goggle legislation, disposal techniques, and use of plants and animals in the classroom. Ask your building principal or district science supervisor about applicable local, state and federal regulations.

2. If copies of the above are not available or do not exist, work with your administration and science specialists to establish written policies for your school and enforce these policies.

3. Know the location of all safety devices, including chemical splash goggles, eyewash stations (when dealing with hazardous chemicals), fire extinguishers, and be familiar with your school's plan for evacuation in case of fire or other emergencies.

4. Before beginning any science activity, discuss possible safety hazards with your students.

5. In order to promote a safer instructional environment, limit your class size to a number that you can adequately supervise. When doing inquiry-based science, safety trained volunteer assistants can be helpful in providing adequate supervision.

6. Design an instructional format that allows students maximum time to conduct a science activity, with attention and involvement of each student. One suggestion is an "Activity Team" consisting of an Organizer, an Investigator, a Recorder, and a Reporter.

7. Students should always keep their work area clean and clear of unnecessary materials such as bags, lunches, or books, and other trip/fall hazards.

8. Students should never eat or drink in the classroom where science activities are conducted.

9. Students should never be allowed to conduct any unauthorized experiment or to work alone or unsupervised.

10. Convince students that the science activity area is a special place where special precautions are always taken, even when working with ordinary and harmless materials. These precautions include wearing appropriate eye protection, washing the hands frequently, and being especially alert and responsible.

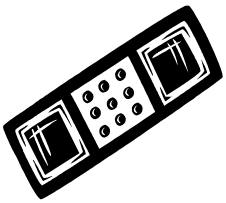
11. Regardless of the age or grade level of the student, horseplay or irresponsible behavior that threatens the safety of any individual cannot be allowed.

12. Although safety aspects should be stressed, do not create an atmosphere of fear and apprehension, which will prevent students from enjoying their science experiences.

13. Appendix 1 (page 52) contains a "Safety Checklist" for elementary science teachers. Use the checklist as a daily guide for science safety in your classroom.

A to Z Safety Topics

ACCIDENTS



Be sure that you are thoroughly familiar with your school's policy for first aid and reporting accidents. You should discuss this with your students and send a copy home to the parents. If your school has an established policy, follow it. Otherwise, the following is recommended:

For an accident that you can manage:

1. Give appropriate first aid, but give no oral medications, not even aspirin.

2. If the student is bleeding, take necessary precautions (see **BLOOD).**

3. If appropriate, correct the situation that caused the accident.

For an accident that* is *more than you can manage:

1. Notify the school nurse or other person designated to administer first aid. If neither is available, immediately obtain medical help by calling the police or fire department (911), or other local emergency numbers.

2. Make the student comfortable.

3. Notify the school principal.

NEVER take a student away from school (field trip, etc.) without first obtaining written permission from the parent to allow you to approve any necessary medical treatment resulting from an accident.

ACIDS

Acids are chemical substances that have certain properties in common:

1. They are corrosive and can cause skin burns.
2. They are the opposite of Bases, thus they tend to neutralize each other. (See **BASES.)**
3. They produce hydrogen gas (flammable) when they react with some metals.

4. They generally taste sour (like lemon juice that contains citric acid). ALTHOUGH THIS IS A CHEMICAL PROPERTY, YOU SHOULD NEVER ALLOW STUDENTS TO TASTE ANYTHING DURING A SCIENCE LABORATORY ACTIVITY.

5. They react with certain *indicators*, causing them to change colors. (See **INDICATORS**)

A list of common acidic substances and their degree of acidity is given in Appendix 2, page 54.

A common acid, suitable for use in elementary science, is *acetic acid (CH_3COOH).* This is found in a 5% solution as vinegar.
Practically all elementary experiments requiring an acid can be done with vinegar. Students should always wear chemical splash safety goggles and have ten second access to an eyewash station when using vinegar. And, they should wash their hands with soap and water after using it.

Occasionally, you may want to use other acids such as hydrochloric acid (HCl). These should never be used in concentrations greater than 1.0% (i.e., one milliliter of concentrated HCl diluted with water to 100 milliliters, which in chemical terms is about 0.1 to 0.2 Molar). Students should not have direct contact with any acid other than vinegar by mixing or pouring them. The teacher should dispense these acids preferably in small clearly labeled dropper bottles.

If you have acids and bases in a storeroom, always store them separately.

ALCOHOL BURNERS (See Heat Sources)

Under no circumstances should alcohol burners be used at the elementary level.

ANIMALS (See Appendix 3, pages 56-63)

Local school districts usually have a written policy concerning animals in the classroom. Contact your science coordinator or principal to obtain a copy of this policy.

Other organizations that have animal care policies and position papers include: the National Science Teacher's Association (www.nsta.org), the National Association of Biology Teachers (www.nabt.org), and the

National Society for the Prevention of Cruelty to Animals (www.nspca.org).

1. Do not bring wild animals into the classroom since they may carry diseases such as rabies and salmonella.

2. Know which children are allergic to animals. Alert parents of the instructional use of animals.

3. Minimize the handling of animals to avoid children being bitten. Check your school's policy concerning the use of protective equipment, such as gloves and eye protection, when handling animals. If a child is bitten, send him or her to the school nurse for proper medical treatment.

4. Be careful on field trips. Deer ticks can carry Lyme disease. Mosquitoes can carry the West Nile Virus. Some students can be allergic to bees.

5. Check with your building principal or science specialist about the proper disposal of animal feces, urine, and bedding.

6. Wash hands with soap and water after handling animals and cleaning cages or aquariums.

7. Chemicals used for aquariums and for cleaning animal cages must be stored in an area that is not accessible to students.

AQUEOUS

A solution where the solvent is water.

ASBESTOS (www.epa.gov/asbestos)

One of the best insulators is asbestos. However, asbestos causes severe health problems (lung cancer, asbestosis, and mesothelioma) and is now considered one of the most hazardous materials. It is being removed from buildings and structures where it was placed as an insulator years ago. You should never use asbestos as an insulator in the laboratory. Many wire-gauze pads, used in laboratories a few years ago, contain asbestos. You should not use these. If you have any of them, seal them in a zip lock baggy and give it to your science coordinator or principal for proper disposal.

The Environmental Protection Agency (EPA) regulates asbestos in school construction. The Asbestos Hazards Emergency Response Act (AHERA) requires schools to develop publicly available asbestos management plans and remove or contain asbestos in schools.

BACTERIA

There is little reason to use live bacteria in the elementary science classroom. Most bacteria are visible only with magnification greater than that available with simple and inexpensive student microscopes. If you want students to examine bacteria, use *only* commercially available prepared slides. With the presence of harmful bacteria such as MRSA and STREP, do not ever try to prepare your own bacterial cultures or slides. Do not use bacteria prepared by doctors' offices, clinics, or hospital laboratories.

One possible exception to this policy might be the cultivation of yogurt and Kefir.

BASES (see ACIDS)

Bases are a group of chemical substances that have the following similar properties:

1. They are corrosive and can cause skin burns.
2. They neutralize the action of acids.
3. They taste bitter, like soap. ALTHOUGH THIS IS A CHEMICAL PROPERTY, YOU SHOULD NEVER ALLOW STUDENTS TO TASTE ANYTHING DURING A SCIENCE LABORATORY ACTIVITY.
4. They feel slippery to the touch, like soap.
5. They cause certain indicators to change color.
   (See **INDICATORS**)

A list of bases, and the degree of basicity, also known as alkalinity, of each is given in the Appendix 2, page 54.

Sodium bicarbonate (baking soda, $NaHCO_3$) is a suitable and safe base for use in practically any elementary science experiment. Aqueous household ammonia is also suitable, but younger students will probably be bothered by its stinging odor. Never use strong bases such as Drano,

Lye, or oven cleaner. CAUTION: Never mix household ammonia with bleach. They react to produce a toxic, explosive gas.

Always have students wear chemical splash safety goggles when using any basic solution, and they should wash their hands after using these materials.

If you have acids and bases in a storeroom, always store them separately.

BATTERY

A battery produces a steady stream of electricity by chemical reactions that occur within a container. Most batteries are called "dry cells" because the contents are enclosed and cannot spill out.
Other "wet cell" batteries involve metal strips immersed in acids, like an automobile battery.

Commonly used "dry cells" provide 1.5 volts of direct current or DC. These include sizes AA, AAA, C, and D. They are not intended to be recharged. Specially designed rechargeable batteries are available in these sizes and help to reduce waste generation.

Students must use batteries with care. If they are mistakenly connected (the tops connected to the bottoms), they will get hot.
Students should never attempt to open a battery since the chemical contents could be harmful.

Never try to revive dead batteries by warming them in an oven or microwave. Collect used batteries in a recycle/waste container. Alkaline batteries can be put in the regular trash, but rechargeable nickel/cadmium (Ni-Cad) batteries, mercury batteries (small, round, watch and calculator batteries) must be properly disposed of as hazardous waste. Consult with the science specialist or principal for the proper method to dispose/recycle.

Never use an automobile battery in an elementary classroom. They contain concentrated sulfuric acid that can cause severe burns. If improperly connected, they can also form hydrogen, a flammable and explosive gas.

You can make a dry cell battery easily by stacking, in an alternating pattern a copper penny dated before 1982; two circles of blotter paper that are cut slightly smaller than the penny; a dime; two more circles of blotter paper; another copper penny; etc. Continue until you have a stack containing five pennies.

Wrap a piece of tape around the stack to hold it together. Tape the end of a foot-long piece of insulated copper wire to the top coin (a dime). Tape the end of a second foot-long piece of insulated copper wire to the other end (a penny).

Moisten each piece of blotter paper with a dropper containing 10% salt-water solution (one gram of salt dissolved in 10 milliliters of water). Connect the "battery" to a small socket with a small flashlight bulb. Does it light the bulb?

BLOOD

Do not, under any circumstance, use blood from any source in any activity in the elementary grades. Do not allow yourself to come in contact with blood from a student, and do not let any student come in contact with blood from another student. Simple cuts and scrapes, nosebleeds, or bleeding from a pre-existing wound must all be treated the same using universal precautions.

There is a possibility of infection with Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV) from any human blood or other body fluids. These and other disease-producing agents are referred to as bloodborne pathogens. You must protect your students and yourself from these.

Many school districts are covered under the federal regulation concerning bloodborne pathogens (29CFRI910.1030) (www.osha.gov). The Occupational Health and Safety Administration (OSHA) regulation requires that school districts have a written compliance plan.
Also, they must provide annual training to employees who they believe are likely to have routine exposure to blood and other potentially infectious materials (OPIMS).

The following recommendations apply only in the absence of a school district policy dealing with these issues.

Prepare a Bloodborne Pathogen Clean Up Package for future use.

This should be a large, zip-lock type bag containing the following items:

1. A pair of chemical splash safety goggles.
2. Paper towels.

3. A small bottle containing 10% by volume of bleach. At time of use add 90% water. This is ineffective against HBV after one day.

4. Two pairs of vinyl gloves.

In *the event of student bleeding, contact the school nurse. If the nurse* is *not available, do the following as long as it is in concert with the schools bloodborne pathogen plan:*

1. Hand the student gauze pads or tissue to press against the area where bleeding occurs.

2. Unwrap, peel, and hand the student a bandage. Instruct the student to bandage his or her own cut or wound. Do not do it yourself.

3. If any blood has dripped on desks or the floor, get your Bloodborne Pathogen Clean-Up Package and take the following steps:

   a. Put on the chemical splash safety goggles and vinyl gloves.

   b. Carefully wipe the blood away with paper towels.

   c. Place the paper towels in the baggie.

   d. Pour the Clorox solution over the area that was covered with blood.

   e. Wait 20 minutes.

   f. Carefully wipe the area clean with more paper towels.

   g. Add the paper towels and gloves to the baggie, zip it tightly, and give it to the school nurse or an administrator for proper disposal.

Of course, this procedure runs counter to your own ideas and customs of being a helpful, caring, teacher when a student has a cut that is bleeding. However, this procedure must be followed in order to insure everyone's protection against bloodborne pathogens. Because custodians often assist with incidents involving blood, they should be trained in these procedures.

BODY FLUIDS (See BLOOD)

NO EXPERIMENTS OR ACTIVITIES SHOULD BE CONDUCTED THAT REQUIRE THE USE OF ANY BODY FLUID. This includes

blood "typing," the use of saliva for test of enzyme activity on starches, etc. Also, no experiments should be done that require any contact with saliva by placing objects in the mouth. This includes taste bud studies, determining sweetness, etc.

Vomit resulting from student illness should be cleaned up using the same precautions as described under **BLOOD.** Clothing contaminated with vomit should be double, plastic-bagged and laundered with bleach.

BURNERS (www.porta-lab.com)

Bunsen burners are not recommended for use in the elementary science program. Acetylene burners or propane torches that produce intense heat should never be used in an elementary classroom. Also, "canned heat" products, known as Sterno, should never be used as a source of heat. The flames from Sterno are almost invisible, and it is very easy to get burned.

Portable micro-lab propane and butane burners, designed for elementary school use, provide a safer source of heat when needed. The following precautions should be followed before lighting the burner:

1. Wear safety goggles.
2. Be sure that students with long hair have it pulled back.
3. Any loose-fitting garments (especially sleeves) are tied back.
4. Move all combustible materials away from the burner.
5. If you smell gas, contact the principal immediately.

CANDLES

Candles are a suitable source of heat, but they must be used very carefully. It is best to use the large, short chafing-dish candle. Ordinary utility candles should never be used without a candleholder. Do not allow students to remove candles from their holders. Hot wax is not too dangerous, but it may startle young children if it drips on them, and that could result in an accident.
Do not use scented candles.

CAST PLASTER (See PLASTER OF PARIS)

CHEMICALS (See individual chemicals, i.e., IODINE, etc.)

One definition of a chemical is *"...anything used in, or produced by, a chemical process."* This means that almost everything is a chemical! We will narrow the definition to include those specific materials you use in your science program to conduct chemistry activities. Here are some general comments about chemicals for the elementary science program:

1. Most of the chemicals that you need are everyday chemicals that can be purchased from the grocery, drug and hardware store. See Appendix 4, p 64-65.

2. You should only have in storage those specific chemicals that you need for your science activities. Do not be a collector of exotic chemicals!

3. Store all chemicals in locked cabinets or locked storage room.

4. You should only have small quantities of each chemical available to students at any one time.

5. All material safety data sheets (MSDSs) received with chemical orders must be retained and made available. You should file copies of the MSDS so that they are readily accessible, e.g., in the classroom/lab, storage area, and main office. (See **MSDSs)**

6. DO NOT ACCEPT gifts of chemicals from well-meaning friends, high school science teachers, or professional scientists. This gets you into a great deal of trouble for the following reasons:

    a. When you accept any chemical from any source, you also accept the responsibility for disposing of that chemical.

    b. Disposing of chemicals can be an extremely difficult and expensive process!

    c. You may be exposing yourself and your students to chemicals that are toxic, cause cancer, or have other associated hazards (flammable, irritating, etc.).

    d. You take up valuable and limited storage space with materials you will seldom, if ever, use.

    e. Even if they are chemicals you can use, there is the possibility that they are contaminated or outdated.

A list of some common chemicals that you might use is given in the Appendix 4, pages 64-65. Although you may never need to use some of these, perhaps it will be of interest to note that many chemicals can be readily found in the grocery store, drug store, and hardware store.

Chemicals that come in kits:

You may have science activity kits that come with packaged programs such as FOSS, STC, GEMS, CEPUP, Integrated Science, etc. Do not use these with your students unless the kits include the following:

1. MSDS for each chemical in the kit.
2. Information on required personal protective equipment (PPE) and engineering controls (e.g. eyewash station).

Chemical labels:

Chemicals are sold with labels on the containers. The labels indicate any hazard associated with that particular substance.
The four types of chemical hazards are shown below along with examples of chemicals belonging to each type. We recommend that each school district review the appropriateness of using these chemicals in their science programs.

Corrosive

This includes acids and bases in higher concentrations.
Commercial names include Lye, Drano, Muriatic acid and battery acid.
They cause destruction of tissue and equipment on contact.

Poisons

This includes compounds containing lead, mercury and barium.
These substances are hazardous to health when inhaled, swallowed, injected, and in contact to skin. In sufficient quantity they can cause death.

Flammables

Generally includes liquids like methyl alcohol, rubbing alcohol, acetone (in nail polish remover and paint removers), gasoline, paint thinners, etc. These substances, usually liquids, give off vapors that can readily ignite at room temperature.

Reactives

These substances are either inherently unstable, react violently with water or with other substances to release energy. This includes metallic

sodium, potassium, ammonium nitrate (sometimes sold as garden fertilizer), and any metal in a powder form.

CLAYS

Clays are often bought in the dry form and mixed when needed for student use. Do not allow students to use clay in the dry form. Not only are some students allergic to the dust from dry clay, but many clays contain silica and asbestos that cause more serious problems when inhaled.

When clays are hardened, do not sand them to get a smooth surface. Do not sweep the areas where there may be clay dust, but rather clean the area thoroughly with a sponge or damp mop. Use only pre-mixed and talc-free clays with elementary students.

COMBUSTIBLES

This is any material that readily burns, such as paper, clothing, wood, and hair. The more volatile liquids that burn are referred to as "flammable liquids," such as alcohol, gasoline, paint thinners. These should be used with extreme caution. The less volatile liquids that burn are known as "combustible liquids," such as kerosene, jet fuel, and fuel oil.

CRYSTALS

Growing crystals is a popular and generally safe activity for elementary students. Some crystal growing experiments, such as sugar crystals require the use of boiling or very hot water. These experiments should be avoided, unless the teacher prepares the solution in advance for the entire class.

Students should never be allowed to taste crystals of sugar, rock candy, made during laboratory experiments.

NEVER make crystals of oxalic acid. Oxalic acid is very toxic, and it is the poison found in most toxic houseplants. (See **PLANTS** and Appendix 5, pages 66-69.)

Several safe crystal growing experiments include the following:

1. **Salt Garden: Wearing chemical splash goggles and vinyl gloves** dissolve 2 tablespoons each of salt, household ammonia, and

laundry bluing in 4 tablespoons of warm water. Place a charcoal briquette in a plastic plate and pour the solution over it. Beautiful crystals will grow in an hour or so. Mrs. Stewart's laundry bluing can be found in some grocery stores, but if not, ask your grocer to order it for you.

2. **Christmas Tree:** Prepare the same mixture as for salt gardens. Cut three pieces of poster board in the shape of a Christmas tree, fit them together and stand the tree in a plastic bowl. Put a drop of food color on the tips of the tree.
   Add the solution to the bowl at the bottom of the tree.

The crystals grown in the above two activities can be discarded by placing them in the solid waste trashcans.

CURRENT (See BATTERIES and ELECTRICITY)

Electrical current is the flow of electrons through wires.
Alternating Current (AC) typically comes from an electricity generating facility and is supplied to conventional electrical outlets. Direct Current (DC) is a steady stream of electrons that flows in one direction and is produced from batteries and electric cells ("Potato Clock," lemon batteries, etc.).

DEMONSTRATIONS

Science demonstrations enrich and enhance the science learning experience. Science teachers need to take appropriate precautions to ensure that demonstrations are sufficiently safe for their students and themselves. Please review the appropriate topics in this book, the "Elementary Safety Library" (see Appendix 7, page 72) and the "Minimum Safety Guidelines for Chemical Demonstrations" (see Appendix 6, pages 70-71).

DENATURED ALCOHOL (See METHYL ALCOHOL and ETHYL ALCOHOL)

DISPOSAL

Since many substances cause environmental hazards when they accumulate or decompose, great care must be taken to properly dispose of any material used in science activities.

None of the materials, which you are likely to use, present any unusual disposal problems. If they are non-hazardous solids, they can be discarded with the solid wastes. If they are non-hazardous liquids, they can be poured down the sink. If you find yourself with any unusual or unfamiliar chemical, you should find out if it requires any special disposal before you use it.

Never use any chemical from a commercial set of materials unless the set includes information on toxicity and disposal.

Don't dispose of any hazardous chemical solution down the drain unless you know exactly what the solution is, this is the proper disposal method and you have written permission from the water treatment facility that will be receiving the material.

Weak acids (pH 3-6) and weak bases (pH 8-11) can be poured down the drain. Strong acids (pH 1-2) or bases (pH 12-14) should be neutralized first.

Don't pour any organic solvent, such as methyl alcohol or paint thinners, down the drain. Collect these solvents in sealed, labeled containers for proper disposal by a hazardous waste disposal company.

Dispose of solid waste by wrapping it securely in a paper or plastic bag. If the substance is an EPA and/or other governmental agencies regulated hazardous waste, it must be stored in properly labeled containers for removal by a hazardous waste disposal company. Place any broken glass in a special box or other suitable container for solid waste disposal.

If you have any questions regarding the disposal of science materials, consult your school district's hazardous waste coordinator, science coordinator, principal, or call The Laboratory Safety Institute (1-508-647-1900). Your state's Department of Environmental Protection, hazardous waste division is another source you can use. Also check the MSDS, section 13.

DISSECTION

Animal dissection activities help students develop process skills and greater understanding of animal organ structure and function. For further information, see the NSTA position statement, 'Responsible Use of Live Animals and Dissection in the Science Classroom.' (www.nsta.org/about/positions/animals.aspx.)

DRY ICE

Dry ice is solid carbon dioxide. It provides a simple and effective way to illustrate sublimation by going directly from a solid to a gas without appearing as a liquid. Wearing indirectly vented chemical splass goggles and gloves carefully put a small amount in a latex glove or balloon, and tie the opening. Or put some dry ice in an open vessel, add a squirt of liquid detergent and some water. It will bubble and smoke like an erupting volcano!

However, dry ice is not something elementary students should play with. It is *very cold*, about -78°C, and can cause frostbite. It should never be handled with the bare hands. In addition, it should never be added to a rigid container, such as a bottle or jar that can be capped. Placing dry ice in a container and sealing or capping it has caused explosions. Lastly, in a small room or unventilated area, such as a closet, dry ice can displace the air, resulting in suffocation.

ELECTRICITY

Allow students to plug, or unplug, electrical plugs into electrical wall outlets only with teacher supervision. Electrical tools, instruments, and equipment should be used only by the teacher or with strict teacher supervision.

There are four things teachers should never* do *when using electrical wall outlets:

1. Notice that some electrical plugs are "polarized." In other words, one of the two prongs on the plug is wider than the other prong. The wider prong should be inserted into the wider slot of the wall outlet. NEVER try to force a plug into an outlet, such as trying to plug the wider prong into the smaller slot. NEVER file the wider prong to make it fit into the outlet.

2. Only use equipment that has polarized plugs.

3. NEVER try to force a plug with a round ground pin into an outlet that has no opening for the ground pin. DO NOT cut off the ground pin to make it fit.

4. When removing a plug from a wall socket, always grasp the plug by the plastic base. NEVER remove the plug by pulling the cord. This breaks the connection in the wires and can produce dangerous short-circuits.

Plug all of the unused electrical outlets with plastic plug guards.

Do not use extension cords unless absolutely necessary and only temporarily. Heavy-duty extension cords or multiple outlet boxes should be used rather than inexpensive extension cords. In addition to an electrical hazard, they can be a trip/fall hazard. If you use electrical outlets that are anywhere near a source of water, such as faucets, coolers or aquariums, use a Ground Fault Interrupter (GFI). These are inexpensive, can be purchased at any hardware store or electrical supply dealer. GFIs should be installed by electricians at either the circuit breaker panel or the wall outlets.

Never place animal cages near electrical cords. Animals will chew through cords!

Static electricity

This type electricity results from a buildup of electrons, or electrical "charge." Comb your hair on a dry, cool day, and the comb will pick up small pieces of paper; rub an inflated balloon on a wool sweater and it will pickup pieces of paper, and also stick to the wall! Walk across the carpet of the room and notice the spark and small shock when you touch something metal. Although lightening is also static electricity, there is no danger from the static electricity which students typically experience.

ENGINEERING CONTROLS

Engineering controls are devices that ensure the safety of teachers and students in case of an emergency in the science lab or classroom. Examples are fire extinguishers, fume hoods, room ventilation, and eye wash stations.

ETHYL ALCOHOL

"Ethanol" is drinking alcohol. It is sometimes used in school alcohol burners. Ethanol and its aqueous solutions (70% and higher) are flammable. Skin contact can cause dryness and should be avoided. The use of gloves is recommended.

Heating flammable liquids on a hotplate is not recommended. The hotplate's temperature controlling thermostat and hot surface can be ignition sources. Demonstrations involving flammable liquids should

only be performed with a shield between the demonstration and the students and with appropriate personal protective equipment.

EYE PROTECTION

You should strictly adhere to the eye protection policy of your school or school district. Contact your science coordinator or principal to obtain this policy.

Basically, there are three types of eye and face protection:

1. **Safety glasses** with side shields-These provide the minimum acceptable protection for the eyes. They are intended to offer minimal protection against impact with objects.

2. **Safety goggles-**These offer better protection against impact or splash. There are three types of safety goggles. Impact goggles are directly ventilated. These goggles often have many holes on the sides and would allow liquid to go directly into the eyes. Chemical splash goggles are indirectly ventilated. They have vents with baffles which prevent liquids from going directly into the eyes. Chemical splash goggles are also available with no venting.

3. **Face shields-**These cover the entire face and throat. They protect a larger area from splashes and impact. Face shields are intended to be used in addition to either safety glasses or safety goggles. For example, teachers might use a face shield when diluting concentrated acids in a fume hood.

***Recommendation*: Indirectly vented chemical splash goggles** offer the most protection and can be worn without discomfort. Teachers should carefully consider each activity for its inherent safety hazards and prescribe the use of appropriate safety goggles accordingly.

Safety goggles must meet certain standards established by the American National Standards Institute (ANSI). This standard is called ANSI Z-87.1. *You and your students should only use eye protection that are stamped on the frame with ANSI Z-87.1.*

Eye protection can be adequately disinfected by cleaning with a gauze pad soaked in rubbing alcohol. Students should be encouraged to wash their eye protection with soap and water when washing their hands at the end of class.

Contact Lenses: In the past, there is some controversy over the wearing of contact lenses in laboratories. The current view is that there is no problem with wearing contact lenses in the elementary science classroom provided the same approved eye protection is worn as required of others in the area. Contact lenses are not intended to serve as eye protection.

FELT-TIP MARKERS (See MARKERS)

FIELD TRIPS

Obtain and review a copy of your school district's Field Trip Policy.

NEVER take a student on a field trip without first obtaining written permission from the parent to allow you to approve any necessary medical treatment resulting from an accident.

Always check out the area where you are taking a field trip before you take students. Determine what special conditions or hazards exist. Will they need safety goggles? Is the field trip area near water? Will they need life jackets? Is the area slippery, rocky, or uneven?

If the field trip is through woods or fields, students should always wear long sleeves and pants to prevent contact with harmful plants (poison ivy and oak), fleas, ticks, etc.

Always take a first-aid kit, a *Bloodborne Pathogen Clean-Up Package* (See **BLOOD),** a bee-sting kit (may be included in the first-aid kit), and any necessary allergy medication. Remind parents to provide and apply appropriate sun screen lotion.

Be sure to include means of communication (cell phone, walkie-talkie) to use in case of a medical emergency.

Always have a second responsible adult along, and keep a ratio no less than 1 adult per 10 students.

Prepare a permission slip for parents to sign before any field trip. This may not exempt you from a lawsuit, should a mishap occur, but it is a responsible act on your part and leaves a good impression with the parents. The permission slip must give you permission to approve medical treatment in the event of an accident. Have your administration approve your slip before it is sent to the parents for their signature.

Carefully monitor what materials your students collect on a field trip. Be especially cautious of plants and small animals, such as snakes or insects. If you expect to collect specimens, take necessary materials, such as jars or nets.

Use the buddy system. Make each student responsible for the presence and actions of another.

Leave a complete list of the students and adults going on the field trip in the school office.

FIRE EXTINGUISHERS

There are basically four types of fires. The proper extinguisher depending upon the type of fire for which they are used:

"A" For fires from burning paper, wood, trash, etc. They form an Ash. A water extinguisher is normally used for these fires.

"B" For fires from burning flammable liquids. They have a liquid that Boils. Carbon dioxide or dry chemical extinguishers can be used.

"C" For electrical fires. They carry a Charge. Dry chemical (powdered phosphates) extinguishers are appropriate.

"D" For active metal (e.g. sodium, potassium) fires. Elementary schools are not likely to have or need an extinguisher for this type of fire. Sand can be use to extinguish active metal fires.

You should have an ABC type fire extinguisher available in your science laboratory or school science classroom when using flammable chemicals. It should be handy, but not in the open where students might tamper with it.

Fire extinguishers should be visually inspected monthly and more formally checked annually. Some schools use a professional service for this latter inspection. A tag should be attached to the extinguisher indicating the date of the last annual inspection.

If the school expects staff members to use fire extinguishers in the event of a fire, the school needs to provide training. If specific staff members are designated as fire fighters, the school should provide annual hands-on fire fighting training.

Fire extinguishers should not be used by teachers unless instruction is provided by your employer.

FLAMMABLE LIQUIDS

Liquids that are more volatile and burn are referred to as "flammable liquids," such as gasoline, paint thinners, acetone, methanol, ethanol, and rubbing alcohol. These should be used with extreme caution.

FUME HOODS

Fume hoods lower or eliminate exposure to hazardous chemical fumes. Commonly, fume hoods are not necessary in elementary schools. If the MSDS recommends use of a fume hood, then a safer chemical should be used.

GASES

The gas that you are most likely to produce and study is carbon dioxide. Exposure to large concentrations of this gas will cause suffocation, but there is no hazard associated with the small amounts that your activities will generate.

Carbon dioxide (CO_2) is most easily produced by adding vinegar (acetic acid) to a solution of baking soda (sodium bicarbonate) or by allowing dry ice to sublime. (See **DRY ICE.)**

Hydrogen (H_2) should never be produced in the elementary science classroom. It burns and explodes when mixed with oxygen.

Oxygen (O_2) can be easily produced by adding hydrogen peroxide to a juice made by grinding a potato in water. The potato contains an enzyme (catalase) which decomposes hydrogen peroxide into water and oxygen. You can easily collect the oxygen by allowing it to displace water in a test tube. You should NEVER try to generate oxygen by heating potassium chlorate. This is a highly reactive substance and very dangerous. Misuse can result in explosions.
Any activity that results in the production of a visible or toxic gas should be done in a chemical fume hood or in a well-ventilated area away from students. If neither is available, the activity should not be conducted. It should be noted that most toxic gases are not visible and some are not detectable with the human nose, such as carbon monoxide.

GLASSWARE

Because glass containers are so easily broken, you should use plastic materials whenever appropriate. Plastic cups and baggies make good beakers and are reusable.

Be careful when heating any glass container. Hot glass looks just like cool glass, and students should be warned about handling glass.

Only glass labeled "Pyrex" or "Kimax" can be safely heated. Check the glassware for cracks, nicks, and scratches before using.
Discard damaged glassware in appropriately designated containers.

Never use glass containers that are cracked or chipped. Only use glass containers that are appropriate for the activity being conducted. If you need a 100-mL container, don't use a quart jar.

Food containers, such as baby food jars, soft drink bottles, are less suitable containers. Glassware designed for lab work is more appropriate. Food containers are made of soft glass and should not be heated. If they are warm they should never be placed in cold water.

Never clean up broken glass by picking it up with the fingers. Sweep large pieces into a dustpan, and pick up smaller fragments with moist paper towels. Have a separate broken glass container in every science classroom.

Keep only the type glassware you need for your activities. This should consist of a collection of beakers, flasks, and test tubes. Keep only the number you need. Do not over stock with a needless assortment of glassware. Be cautious about accepting gifts of glassware and other materials from well-meaning parents, druggists, or scientists. Quite often this consists of exotic types of glassware that will be of little use to you or your students.

GLOVES

The use of gloves is recommended whenever materials are being used which could cause harm if they came in contact with the skin. Care should be taken to ensure that the glove is appropriate to the material being used. Vendors are happy to provide compatibility charts for determining appropriate gloves.

Some individuals are allergic to latex. The allergic reaction can vary from mild skin irritation to life threatening. Vinyl or nitrile gloves are often substituted when latex poses a problem.

GLUES

Do not use any of the instant glues, including epoxy, Superglue, and airplane glue. These contain harmful organic solvents that can cause toxic effects when inhaled. You should also use rubber cement, and preferably low volatility rubber cement thinner only in open and well-ventilated areas. Keep the containers of rubber cement tightly closed when not in use. White glue, school glue, Elmer's glue, carpenter's glue, and wheat paste are safer to use.

GROUND FAULT INTERRUPTERS (GFls)

Ground fault interrupters (GFIs) are also known as GFCIs. These devices provide protection from electric shock. Electricians should install GFIs in either circuit breaker panels or wall outlets wherever water and electricity are used together, such as aquariums and sinks. If your classroom is not ground fault protected, temporary GFI cords can be purchased. (See **ELECTRICITY.)**

HAZARDOUS CHEMICALS (See CHEMICALS)

It might seem obvious that some chemicals are considered safer (water) and others extremely dangerous (sulfuric acid). But, the actual line between these two extremes is not well distinguished. Because of legal complications, few people are willing to characterize particular chemicals as hazardous or safe. However, this doesn't help the teacher who is trying to determine whether or not her chemicals are safe.

Truly hazardous chemicals should never be used in the elementary science program. Because of the level of maturity of the students, you can never fully depend on them to follow written or verbal directions that might prevent their injury. But, how do you determine which chemicals are too hazardous and which are not? How do you determine whether the pedagogical benefits of the activity will outweigh the risks?

The most important aid is the Material Safety Data Sheet (MSDS). It is important to obtain and read the MSDS for each chemical used in the science classroom (see **MSDSs).** Taking time to understand the hazards, the possible emergency situations, and the prudent practices,

protective equipment and protective facilities is the best way to ensure that an informed decision can be made about the appropriateness of using any chemical. And it's the best way to ensure that those chemicals used are handled safely. In addition, MSDS information can be very helpful to medical and emergency staff in providing proper care.
(See **NFPA Hazardous Chemical Rating System**).

HEAT SOURCES (See BURNERS and CANDLES)

Open flames are not recommended as sources of heat for elementary programs. Hot plates, when they can be used, are safer. When using hot plates, be sure to set them up so that they are not in heavy student traffic areas. Wrap the cord around a table leg to prevent the hotplate them from being pulled off.

When using any source of heat, always provide students with eye protection and gloves, mitts, beaker tongs, etc. for removing hot objects. Always have an insulated ceramic pad, or some surface, on which to place the hot object.

Heating flammable liquids on a hotplate is not recommended. The hotplate's temperature controlling thermostat and hot surface can be ignition sources.

Immersion coils like those used to heat a cup of coffee water should never be used.

INDICATORS

Indicators are organic dyes that change colors at varying degrees of acidity and alkalinity. These degrees are referred to as "pH levels." A pH of 7 is neutral. A pH of 1 to 7 indicates an acidic substance, with 1 being the most acidic. For basic substances, pH increases from 7 to 14. The most basic substance has a pH of 14.

(See **ACIDS** and **BASES** in the Appendix 2, pages 54-55.)

Indicators change colors in various pH ranges, depending upon the indicator. Most indicators are very complex organic molecules. Some, however, are conveniently found in common substances and can be used in the elementary laboratory. Some of these are listed below.

Litmus Paper: *blue to red in acid; red to blue in base.*

pH Paper: *red in acid, green in* neutral *and violet in basic solutions.*

Phenolphthalein: *colorless in acid, pink in slightly basic solutions.* This is a common acid-base indicator. It is often available as a solution. Phenolphthalein used to be the active ingredient in ExLaX laxatives. It was replaced because of concerns about its oral toxicity. Students should wash their hands after using this indicator. Lower elementary students should not use it.

Red Cabbage Juice (Anthocyanin): *red in acidic; violet in slightly acidic, blue in slightly basic, green in weakly basic and yellow in strongly basic solutions.*
Place a few leaves of red cabbage in warm tap water. Use the light blue solution as the indicator. This is the pigment found in blue and red flowers.

Blueberry juice and flower pigments are also common indicators. Soak flower petals in small amounts of warm water and determine the pigment's color changes at various pH levels!

Turmeric: *yellow in acid, red in base.*
Dissolve about a spoonful of turmeric in about a cup of rubbing alcohol. The yellowish liquid is the turmeric indicator. Use this carefully-it stains skin and clothing.

Iodine: *reddish-brown solution turns bluish-black in the presence of starch.* (See **IODINE** and **STARCH.)**

INSULATORS

An insulator does not allow the complete passage of electricity or heat. A "conductor" does. Good insulators against heat loss include trapped air (as in thermos bottles), ceramics (as in hot pads), and fiberglass. Good insulators against loss of electricity include rubber, glass, ceramics, wool, and plastics. Metals are poor insulators but good conductors.

When testing materials for their usefulness as an insulator, students must be careful to guard against burns and electrical shock.

IODINE

Iodine is a silver looking solid commonly found in the laboratory. It is often used to show sublimation, the passage of a material from the

solid to the gaseous phase without going through the liquid phase. (See **DRY ICE.)**

You should not use solid iodine in the elementary programs. It is toxic and the purple fumes can be irritating to the respiratory system. Iodine should never be heated in a closed room.

Solutions of iodine are commonly used to test for the presence of starch in foods. Students should wear chemical splash goggles, gloves and aprons and wash their hands with soap and water after using iodine solutions.

When iodine is dissolved in alcohol it is called Tincture of Iodine. "Tincture" refers to any alcohol solution. Although this iodine solution is an effective antiseptic, it should be used with great care. Use only weak iodine solutions, and dispense it in small dropper bottles.

CAUTION: Iodine solutions are corrosive to skin, eyes and lungs. Avoid direct contact.

JACK-IN-THE-PULPIT

www.babygiftspersonalized.com/poisonousplants/jackinthepulpit.html

A poisonous plant of eastern North America.

JELLYFISH http://firstaid.about.com/od/bitesstings/ht/06_jellyfish.htm

Of the more than 2,000 species of jellyfish worldwide, less than 100 are considered dangerous to humans. Symptoms of a jellyfish sting include redness, skin swelling and pain. First aid: pour vinegar over the tentacles, and lift off the tentacles with a stick. Apply aloe jell, and get medical attention. Commercial treatment kits are available.

KITS

The Full Option Science System (FOSS) and Science and Technology for Children (STC) are two of the best science kit systems available for grades K-6. The teacher's guides for each kit provide you with hazard warnings and instructions for students. Teachers still must be aware of the need for personal protective equipment (PPE) and should consult the Material Safety Data Sheet (MSDS) for every chemical used in any kit activity. Local and school guidelines for the proper disposal of waste material should always be followed.

KNIVES

Only the teacher should ever use a knife, box cutter or paper cutter in an elementary classroom. Use extreme caution. Always carry the knife tips down and away from the body.

LABELING

All of the materials that you use for your elementary science program should be clearly labeled and properly stored. Add the date purchased to the label of all new chemicals. Take care not to obscure any of the information on the label.
All the chemicals that you use, even simple chemicals like table salt and sugar, should be placed in safe glass or plastic containers that are clearly labeled.

When transferring chemicals from supply bottles to smaller containers, label the smaller container with the following information:

1. Chemical name

2. Chemical formula

3. Concentration (for solutions)

4. Hazard(s)

5. Precautions

6. Date prepared or transferred

7. Initials of the person making the label.

LIABILITY AND NEGLIGENCE

Elementary schools need to conduct all of their programs in a manner that would be considered reasonable, prudent, and meeting responsibilities relative to duty of care. When this is not done and injuries or damages occur, the employee and the school system may be considered negligent and therefore liable. "Duty of care" means the teacher has responsibility to oversee students relative to a safer instructional environment.

Teachers are expected to do seven things:

1. Follow all school district policies and procedures, as well as state and federal regulations.

2. Supervise their students.

3. Inspect all science-related equipment and report any malfunctions. Do not operate until repaired (e.g. sinks, electrical cords and outlets).

4. Provide instructions about the hazards that are present.

5. Directly supervise their students.

6. Exercise good judgment.

7. Document safety related matters.

MAGNETS

In 2008 the Consumer Product Safety Commission recalled painted magnets because of high lead content. Also, be aware that ceramic magnets are breakable and could have sharp edges.

MARKERS

The use of water-based markers is preferred over permanent felt tip markers. The latter contain volatile organic compounds (VOCs) that can cause headaches, sore throats, and dizziness. These solvents evaporate as the marker is used. Use only low or no VOC markers. Water-based markers pose fewer safety hazards.

Markers and other arts and crafts materials must be certified by the Arts and Crafts Materials Institute (ACMI, www.acminet.org/index) as being safe and non-toxic in order to meet federal guidelines. Those that are approved will bear one of three approval seals:

1. The Health Label seal, indicating that the product is nontoxic, or that no health label is required.

2. The AP Non-Toxic seal. This insures that the product is nontoxic and meets specifications established by Federal Law P.L. 100-695.

3. The CP Certified Product Seal. This means that, in addition to being non-toxic, the product has met stringent requirements of material workmanship and color quality.

YOU SHOULD NOT USE ARTS AND CRAFT MATERIALS THAT DO NOT BEAR ONE OF THE ABOVE SEALS.

Such materials might include: adhesives, airbrush colors, inks, ceramic materials, chalks, clays, crayons, glitter, markers, mediums and varnishes, paints, pastels and solvents.

MERCURY

Under no circumstances should mercury or mercury containing equipment (e.g. thermometers, barometers) be used in an elementary school. If any mercury is discovered, contact your science coordinator or principal immediately.

Non-mercury filled thermometers, such as alcohol, are preferable to thermometers that contain *mercury.* Some vendors and community health departments are assisting with the disposal of *mercury* thermometers when non-mercury ones are purchased. If you do use mercury-filled thermometers and any should break, you must take specific action to completely clean up the spill:

1. Wearing latex or nitrile gloves, carefully collect the pieces of glass and place them in a jar that can be sealed. (See **GLASSWARE.)**

2. Carefully scoop up the *mercury,* using two index cards, being sure to get even the smallest bit. It will tend to form small balls and roll around. Check with a magnifying glass. Place the *mercury* in the same container.

3. Small drops can be picked up with a copper wire that has been dipped into a 10% hydrochloric acid (HCl) solution, one milliliter of concentrated HCl diluted with water to ten milliliters.

4. Place your gloves in the container with the glass and *mercury.* Seal and label the container. Then give it to your science coordinator or principal for proper disposal.

METALS

Aluminum, copper, iron, and zinc are some metals commonly used in elementary science programs. The hazards posed by metals can

include the sharpness of solid pieces, such as galvanized nails; the flammability of fine powders; and toxicity.

When we speak of metals as being toxic and posing environmental hazards, we are generally referring to metal compounds, and not the metals themselves. However, some metals themselves are hazardous to health and should not be used.

Students should also have limited contact with metallic lead, although this is certainly not as toxic as the lead found in lead compounds. Prior to 1978, house paint contained lead. This continues to be a major cause of childhood lead poisoning and affects adults as well.

If lead metal is used, students should wash their hands after handling lead. Certainly it should never be put in the mouth. Melting lead to produce the liquid form should not be done. The lead fumes produced are highly toxic.

METHYL ALCOHOL

There are basically three kinds of alcohol sold on the retail market: rubbing alcohol (isopropyl alcohol), grain alcohol (ethyl alcohol or ethanol), and wood alcohol (methyl alcohol or methanol). All are flammable liquids and therefore should be used with extreme caution.

Flammable liquids should not be heated on a hotplate. The hotplate's temperature controlling thermostat and hot surface can be ignition sources. Demonstrations involving flammable liquids should not be performed at the elementary level.

Although toxic effects are common for all three forms of alcohol when they are ingested, the rubbing alcohol and methyl alcohol are the more dangerous. The ingestion of rubbing alcohol will make a person very sick, but the ingestion of methyl alcohol very often causes blindness or death.

When the liver metabolizes methyl alcohol, the alcohol turns into formaldehyde. The retina of the eye is the most sensitive tissue to this poison, so irreversible eye damage is usually the first indication of methyl alcohol poisoning.

As an elementary teacher, you should remember this information because some products that you use contain methyl alcohol. Students may recognize the word "alcohol" and try to drink the substance to imitate adult behavior. Denatured alcohol that is often purchased in hardware stores is actually ethyl alcohol that has been "denatured" or

made poisonous by the addition of methyl alcohol. Anyone consuming any quantity of methyl alcohol should receive immediate medical attention.

MINERALS / ROCKS

Most of the minerals and rocks which would be available to the elementary teacher pose little health or safety hazard. Properties of rocks and minerals, including their colors, colors of their streak tests, consistency, etc. can be studied without taking extra safety precautions.

Many students may be taking dietary mineral supplements at home such as cupric sulfate, manganese sulfate, sodium molybdate and zinc oxide, which provide them with the specific metal atoms necessary for optimal health.

Limestone (calcium carbonate) is perhaps the most commonly used mineral in the science program. It reacts with vinegar to produce bubbles of carbon dioxide.

Safety glasses with side shields or safety goggles must be worn by students and teachers during two potential hazardous situations using rocks and minerals:

1. If students are to crush rocks or minerals for closer observation of fragments or grains, they should wrap the rock or mineral in cloth and crush it under the supervision of a teacher.

2. Students often strike certain minerals (like calcite) with a sharp edge to fracture it along cleavage planes. Care must be taken when using the sharp edges. The specimen should be mounted or held in place when the student attempts this. Never use a razor blade or knife blade-use a wedge.

Incidentally, any college geology department, or state geological society will assist the teacher in collecting rock and mineral specimens. They will also provide advice about possible toxic or harmful minerals.

MIXTURES

A mixture has several components, each with its own distinguishable property. The components of mixtures can be separated by physical methods. A common "mixture" used in the elementary science

program consists of sand, sugar, and baking powder. Cat litter is a mixture of clay, quartz or diatomaceous earth and odor neutralizers.

MODEL ROCKETS

Model rockets, from approved kits, should be assembled and ignited only with direct teacher supervision, and outdoors in a cleared, non-grassy, non-wooded area. Safety glasses with side shields or safety goggles should always be worn. Never attempt to prepare or ignite any kind of fuel other than that specified with the kits.

It is recommended that students are not allowed to show their model rockets from home to the class, even if their parents will also be present. Because of the hazards associated with rockets, only school purchased materials should be used in elementary science programs. Solid chemical engines must be stored in a flame-proof container or cabinet. Check your local codes.

Rockets powered by water or air pressure are projectiles. Care should be taken with these devices. Because they pose a risk of eye injury, appropriate eye protection should be worn.

MOLD / MILDEW www.epa.gov/mold

Mold is a parasite found on plants and animals. The mold that commonly forms on bread and fruit is a fungus called Rhizopus.

Close relatives to Rhizopus include black, blue, and green molds that grow on jellies, cheeses, and mildew that grows on damp clothing. They can be easily grown when bits of fruit or bread are sealed in a plastic bag. Mildew lives on shower walls, window sills and other areas where moisture levels are high (leaking sinks). (Fungi cannot make their own food - cannot photosynthesize because they do not have chlorophyll. The fungi kingdom includes molds, mushrooms and yeasts). Some of these fungi can be toxic, poisonous, or harmful to students with allergies or suppressed immune systems. Check with your school nurse. Because some students may be allergic to mold or mildew, parents should be notified about activities involving these materials. The parents should be asked to identify children who have these allergies. For this reason, activities using these fungi should be conducted in sealed plastic containers whenever practical. Alternative activities may be appropriate for student with allergies.

Students should wash their hands thoroughly with soap and water after using any of these materials.

MSDSs (Material Safety Data Sheets)

Materials Safety Data Sheets (MSDSs) list all of the properties and hazards of a chemical. Sample MSDSs for 5% acetic acid (vinegar) and isopropyl (rubbing) alcohol can be found in the Appendix 8, pages 75-87.

Since 1985, importers, manufacturers and distributors are required to provide MSDSs for every chemical they sell. The sheet details all of the properties of that chemical, including its hazardous aspects, such as toxicity, corrosivity, flammability, and reactivity.

You should keep copies of the MSDSs on file for all chemicals that you purchase. These files should be located both in an area convenient to where the chemicals are used and in the school's administrative offices or safety library.

The state and federal regulations require that employers inform "workers" exposed to chemicals about the chemicals' hazardous properties. The employer needs to provide the MSDSs and training in how to read them.

Your students are entitled to protection at levels even greater than that accorded to workers. You must make sure that your students know if they are using anything that might pose any danger. *This* is *the law!*

MSDSs are available online. Here are several of our favorite sites: www.siri.org/msds, www.jtbaker.com/msds, www.sciencelab.com.

MUSHROOMS www.mycology.cornell.edu/fmush.html

A mushroom is really a large edible fungus. However, its close relative is *not edible,* and these are called Toadstools. *There* is *no single characteristic that will allow one to distinguish between a mushroom and a toadstool.* Therefore, you should never collect these on field trips into the woods. If you need mushroom specimens for your science activities, obtain them only from a science vendor or grocery store.

NFPA Hazardous Chemical

The National Fire Protection Association (NFPA) has a system (Code 704) that was designed primarily to help firemen understand chemical hazards under fire conditions. On chemicals that are purchased from

laboratory suppliers, there will always be a NFPA 704 diamond symbol somewhere on the label. The diamond is divided into four colored regions (red, yellow, blue, and white). Within these regions is placed a number from 0 to 4 or a symbol. These numbers and symbols are meant to show at a glance the information necessary to assess that particular chemical's hazardous properties. Please note that chemicals purchased in grocery stores or retail stores will not bear this symbol! The colors indicate four possible categories of hazardous characteristics: red (flammability), yellow (reactivity), blue (health), and white (special). The number range indicates the degree of hazard associated with each category: 0 is the least dangerous, and 4 is considered the most dangerous. Typically, chemicals used in the elementary science program should not have any numbers higher than 1, and chemicals above 2 in any category should NEVER be used. A description of the numeric rating system used by NFPA is listed below (www.nfpa.org):

Hazard Rating	***Color Key***
0: Minimal danger	**RED:** Flammability
1: Slight danger	
2: Moderate danger	**YELLOW:** Reactivity
3: Serious danger	
4: Extreme danger	**BLUE:** Health

(See **HAZARDOUS CHEMICALS.)**

NIOSH (www.cdc.gov/niosh)

The National Institute for Occupational Safety and Health has a toll free hotline for questions. Call 1-800-35-NIOSH for additional information on workplace health and safety topics.

OSHA (www.osha.gov)

The Occupational Health and Safety Administration has regulations that apply to many school districts and their employees. These include the Hazard Communication Standard (29CFR1910.1200), the Laboratory Standard (29CFR1910.1450), and the Bloodborne Pathogen Standard (29CFR1910.1030). Contact your science supervisor or principal for more information.

PAINTS www.acminet.org/index

You should only use paints with the Arts and Crafts Materials Insititue (ACMI) Seal of Approval. Prior to using any paint, obtain and consult the MSDS. The following recommendations are made regarding the use of paints in the elementary program:

1. Water-based paints are recommended, because oil-based paints cause indoor air quality issues.
2. Powdered tempera colors create a dust problem during mixing. If powders are to be used, the teacher should pre-mix the paints for student use.
3. Aerosol spray paints may contain harmful gaseous propellants that may be irritating or flammable. Also, there is the possibility that students may accidentally spray paint in another student's face, resulting in eye injury.
4. Outdated paints and glazes may contain the toxic chemicals lead and chromium. They should not be used. Contact your science coordinator or principal for disposal procedures.

(See **MARKERS.)**

PAPER MACHE

Instant paper mache creates dust when it is mixed. Some students may be allergic to the dust. The use of black and white paper and white paste for a safe and non-toxic paper mache is recommended.

PASTE (See GLUES)

PETS (See ANIMALS and Appendix 3, pages 56-63)

Prior to introducing pets into the classroom, contact the school nurse and send a letter home to parents relative to pet allergies and suppressed immune systems. Students should be encouraged to leave their pets at home. A veterinarian should certify that animals in the classroom are healthy.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment refers to protective clothing (lab coats, aprons), eye protection (goggles, safety glasses), and hand protection (gloves) used to protect the wearers from injury by hazards found in an instructional setting.

pH

The relative acid or base strength of a solution is described by its pH. The pH scale ranges from 0-14. (See **ACIDS, BASES, INDICATORS** and Appendix 2, pages 54-55).

0-2	Strongly acidic
3-6	Weakly acidic
7	Neutral
8-11	Weakly basic
12-14	Strongly basic

PHOTOGRAPHIC CHEMICALS

Photographic chemicals are not recommended for use with elementary students. If photography is part of the science activity, instant photos should be used instead.

Light sensitive paper (blueprint paper and sunprints) can be used instead of photographic paper to show the effect of light on chemical reactions.

Contact your science coordinator or principal for proper disposal of photographic chemicals.

PLANTS

Plants contribute to the "living laboratory" in the elementary science program. However, there are some general guidelines regarding the use of plants:

1. Select only those plants for which there is a specific instructional need. Unless you have a greenhouse, do not overstock with plants primarily for decorative purposes.

2. Select plants that are fast growing and easily reproduced. These include Coleus, Fast Plants, and Tradescantia.

3. If you want to grow plants quickly from seeds, select zinnia, marigold, pea, bean, squash, radish, grass, tomato, or polebean. To germinate seeds, wrap them loosely in a moist paper towel and seal them in a baggy. Use caution as this may lead to mold growth.

4. Be aware that some children are allergic to pollens from certain flowers and other plants. Contact the school nurse and send a note to parents when appropriate.

5. The use of plants that are poisonous or toxic is not recommended. See Appendix 5, pages 66-69 for a list of poisonous plants. Keep in mind that many common house plants are toxic!

6. When on field trips, never allow students to collect unknown plants, flowers, berries, or seeds. Do not use plants that have been exposed to herbicides or other hazardous chemicals.

7. When using plants in elementary activities, do not allow students to put parts of plants in their mouths; do not allow sap or juices to come in contact with skin; and do not inhale any smoke from burning plants.

8. Do not keep sick plants. The school science area is NOT an animal or plant hospital!

The teacher must be especially careful when handling plants and animals in the elementary program, because you will likely want students to help you with the chores of caring for these plants and animals. Therefore, you should establish and enforce clear policies regarding plant and animal care.

PLASTIC BAGS

Plastic bags are convenient for storage, collecting, and distributing materials for laboratory use. However, you should never let young elementary students use plastic bags large enough to cover the head. If you use large bags, use only those with holes in them or, cut holes in them before using them.

If you are using zip-lock baggies to contain chemicals that react, be sure to leave the bag open enough for any gases that are produced (usually carbon dioxide) to escape.

PLASTER OF PARIS

Also known as Cast Plaster, Plaster of Paris is often used to make molds of leaves and footprints. Students should NOT be allowed to mix this powder with water. Some students may be allergic to the dust in the dry powder, and a considerable amount of heat is produced when the powder is mixed with water-enough to burn the hands.

Teachers should mix this in an open area with appropriate ventilation, add the water before giving it to students, and wear eye and hand protection.

Some variations of plaster may contain powdered silica or asbestos. This is a serious inhalation hazard. Always consult the MSDS prior to purchase and use. Do not dispose of down the drain because it can cause plumbing issues.

POISONOUS PLANTS (See Appendix 5, pages 66-69)

POLLUTION

You are not likely to contribute significantly to air, water, or solid waste pollution when disposing of materials used in the elementary science program. The guidelines presented under **DISPOSAL,** however, are recommended since you want to impress upon your students your concern for the environment. (See **DISPOSAL**).

PROTISTS

Protists are one-celled organisms often grown in class and used for study. Grow your specimens from pond water or by soaking a bit of hay in water. The growth medium should be allowed to stand for several days for protist growth to occur. Protists can also be purchased from scientific supply vendors. (See **SAFETY EQUIPMENT VENDORS** and Appendix 9, page 88.)

You are not likely to grow any harmful plant or animal life by this method. However, students should handle this material carefully and wash their hands with soap and water after each activity.

QUAKES www.mdusd.k12.ca.us/adminservices/risk/loss09.htm

Earth quake codes call for all shelves that have chemicals on them to have lips to prevent chemicals from falling.

QUIZ (See Appendix 11, Safety Quiz for Grades 3-6, page 90)

Students should take a safety quiz at the beginning of the year, before engaging in any science activity.

ROCKS (See MINERALS / ROCKS)

RULES AGREEMENTS

LSI encourages science teachers to prepare a written list of science safety rules for their classroom. Students and their parents should be asked to sign and date the rules agreement. The agreement serves to underscore the importance of the rules. The signatures provide a record that the rules were presented and understood. (See Appendix 10, page 89 for Sample Rules Acknowledgement)

SAFETY EQUIPMENT VENDORS (See Appendix 9)

The list (Appendix 9, page 88) of safety equipment vendors was compiled based on our experience and that of our workshop participants and newsletter readers. Please suggest names of others from whom you've received good products and good service.

SAFETY GUIDELINES www.csss-science.org/downloads/scisafe_cal.pdf

A listing of Safety Guidelines for the elementary science program is presented on pages 6-7. You should thoroughly familiarize yourself with these guidelines, and discuss them with your students frequently.

SALIVA (See BODY FLUIDS)

SALTS

A "salt" is a general term for the product formed when an acid reacts with a base. Sodium chloride (NaCl) is the most common "salt," and is produced when hydrochloric acid (HCl) reacts with sodium hydroxide (NaOH).

Most salts that you will use are water soluble and can be flushed down the drain. If the salt is not soluble, you should pour off the water, allow the wet precipitate to dry, and dispose of it with your solid waste. You should not use or produce salts of metals such as mercury, barium, lead, cadmium, chromium, or nickel. Due to their toxicity, these require special disposal by a licensed hazardous waste disposal company.

SCIENCE FAIRS http://home.comcast.net/~familysciencefair/safety_rules.htm

All the safety rules and policies that apply to the science classroom should apply to science fair projects. In addition, consideration should be given to the safe transportation of materials to and from the school and the student's home. And, when students work at home on science fair projects, it should be only with adult supervision. The website given above contains the Parkmead Family Science Fair Safety Rules.

SEEDS (See PLANTS)

SIGNAGE

Important items to have posted in your classroom include:

1. Regulations concerning eye protection devices;
2. List of Safety Rules and General Safety Practices (see pages 6-7);
3. Eyewash sign (if appropriate);
4. Exit signs.

SNAKES (See ANIMALS and Appendix 3, pages 56-64)

SOLUTIONS

For any activity that requires a solution, you should use the lowest concentration of that solution that will work, and you should prepare only enough for that specific activity.

Some solutions have a short shelf life (e.g.hydrogen peroxide, starch) and should not be stored for long periods of time.

Prepare solutions by first dissolving the solid (solute) in a small amount of water (solvent). Then, add the remainder of the water to make the total solution.

Regardless of the solution you are using, require students to wear chemical splash safety goggles when using the solution, and wash their hands with soap and water after each activity. Clean up any spills of solutions quickly and thoroughly. **(See SPILLS)**

SOLUTION PREPARATION (See Appendix 12, pages 91-94)

SOLVENTS

The solvent is the liquid portion of a solution. Water is the most common solvent and is known at the "universal solvent."

Solvents that pose the greatest risk to student safety are the following organic solvents: alcohols; some craft dyes; paint strippers; fingernail polish remover (acetone or dimethylketone); white-out solution (toluene); as well as the solvent in many glues. (See **GLUES**) These should not be used in the elementary program.

They require special disposal procedures and are extremely toxic.

They can be inhaled, absorbed through the skin, or ingested.

Even small amounts can have serious effects, including blindness and death. (See **METHYL ALCOHOL**)

SPILLS

Common spills involve weak solutions of acids or bases. Follow the following procedures for these simple spills:

1. Move students away from the spill.
2. Wear PPE (indirectly vented chemical splash goggles and gloves).
3. Pour sand/kitty litter around the spill.
4. Add a 5% solution of baking soda for an acid spill, or 5% acetic acid for a base spill.
5. Using a plastic dustpan and broom, sweep up the neutralized mixture and place in a heavy duty plastic garbage bag.
6. Contact your custodian for appropriate disposal.

SPRAY CONTAINERS

Do not allow students to use materials in spray containers. This includes paints and lacquers. There is always the problem of students spraying each other in the face and eyes. Also, the propellant may be

flammable. Spray containers should not be incinerated because they can explode.

STARCH

Some elementary activities require the use of starch and starch solution. It is recommended that you NOT try to make a starch solution by dissolving starch in boiling water. Instead, the following procedures are suggested:

1. Use bottled starch solution from the grocery store. Not the starch in spray containers. (See **SPRAY CONTAINERS**). Dilute this to the desired concentration.
2. Dissolve small pieces of Ecofoam, the soluble packing peanuts that many companies use as packing materials, in cold water. Some are made of polystyrene and are not water soluble.

It is safe to use starch, although students should never put it in their mouths. (See **INDICATORS** and **IODINE**)

STERNO

NEVER use Sterno or canned heat in the science laboratory. This compound produces a very intense flame that is very difficult to see. Students often burn themselves when handling this material.

STORAGE

Materials and chemicals used for elementary science activities should be stored neatly and orderly in a convenient, locked place away from high student traffic areas. Store chemicals separately in clearly labeled containers. Do not allow students to enter your storage area to use, remove or replace items.

Store only the materials that you need, and in amounts appropriate for your program. Do not purchase and store large quantities of chemicals, or chemicals in very large containers. If you use cabinets in the classroom for storage, always keep them locked and maintain a complete inventory of every item in storage.

Store chemicals grouped by compatibility classes: Flammables, Toxics, Reactives, Corrosives (separate acids and bases), and nonhazardous. All flammables should be stored in a NFPA certified flammable liquids cabinet.

Alphabetical arrangement within the groups is recommended.

Inspect the storage area annually. Resecure any labels that may be starting to fall off of containers. Wide, clear packing tape is excellent for this purpose.

SWEETENERS

Sweeteners are not toxic in the amounts you will use in your activities, however, they should never be used for taste tests that require students to taste or ingest them.

Sugar and other sweeteners can be reacted with yeast to study fermentation. Store sugar and all other sweeteners in tightly closed containers to prevent the accumulation of ants and other insects.

NEVER allow students to use a sweetener from your storage area to sweeten anything they might eat or drink.

THERMOMETERS (See MERCURY)

Use electronic or small, inexpensive alcohol-filled thermometers.

Do not use mercury filled thermometers. Caution: alcohol thermometers are glass, so handle carefully. They are expensive, awkward for small children to handle, and they expose students to toxic mercury when they are broken, which happens frequently. If you find a mercury thermometer, give it to your science coordinator or principal for proper disposal.

UV LIGHT

Exposure to ultraviolet light (sunlight) can cause sun burn, skin cancer, skin aging, allergic reactions, and eye damage. Appropriate precautions (long sleeves, long pants, hat and sunscreen) should be taken when exposure is likely. Be sure to get parents' permission before applying sunscreens.

VERMICULITE www.epa.gov/asbestos/pubs/verm.html

Vermiculite is commonly used in plant growth studies. There can be trace amounts of asbestos found in vermiculite and which can be released and pose an inhalation hazard.

VINEGAR

Vinegar is a 5% solution of acetic acid (CH_3COOH) in water. Although it is commonly used in the kitchen, students should handle it with respect, like they would with any other chemical, when using it in the laboratory. Always wear chemical splash safety goggles when using vinegar. And, wash hands with soap and water after each activity. Vinegar may be disposed of by flushing down the sink.

VOC (volatile organic compound)

Volatile organic compounds are chemical compounds that under normal conditions (room temperature) vaporize and enter the atmosphere. Many of these have inhalation hazards associated with them. Practical examples include new carpets, new cars, and new upholstery. Classroom examples may include bleach vapors, methanol, older toxic markers, rubber cement, and whiteout.

VOLCANO (See DRY ICE)

You can make an effective simulated volcano by adding vinegar to a solution of sodium bicarbonate ($NaHCO_3$), by adding a little piece of dry ice to a bubble solution, or a small amount of detergent in water.

The classic "volcano" was made by igniting solid ammonium dichromate $(NH_4)_2Cr_2O_7$ in a cone-shaped vessel. This should NEVER be done with elementary students. There is the danger of fire from the hot reaction, and the chromium in the compound is a known carcinogen.

WATER

Tap and well water contains chlorine and minerals. It is better to use distilled or deionized water for some science experiments.

X-RAY

No radioactive materials or devices that produce ionizing radiation (x-rays) should be used in the elementary science classroom.

YEAST

Yeast is a fungus that can be safely used in the elementary program. It can be examined under the microscope and used to ferment sugars. Caution-when yeast is used in fermentation activities, it produces a large amount of carbon dioxide gas.
Therefore, never allow fermentation to occur in a closed container.

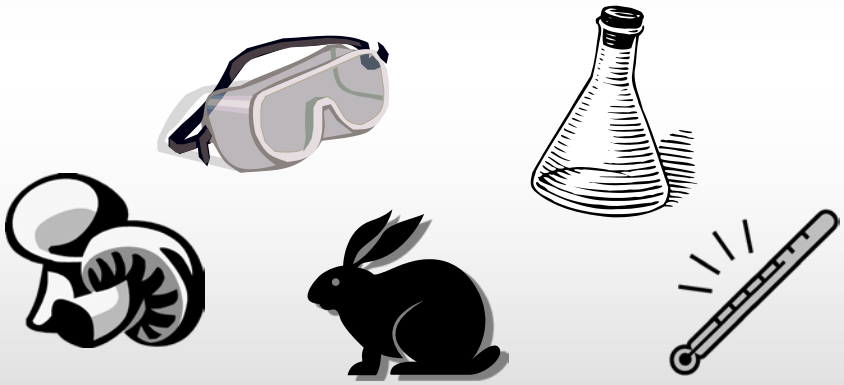
ZINC

Zinc metal (Zn) is a commonly used metal in elementary classrooms.

ZOO

The science classroom is not a zoo. Animals from the wild should not be kept in a classroom. Many allergens are associated with domesticated or household animals, and caution should be taken when considering bringing an animal into the classroom.

Appendices



Appendix 1

Safety Checklist

1. Have you read your school's Science Safety Policies?
2. Do you instruct your students concerning safety procedures and potential hazards prior to each science activity?
3. Have you read the Material Safety Data Sheets (MSDS) for every chemical you will use during each science activity and shared appropriate hazard information with students?
4. Are you present at all times during a science activity?
5. Do you emphasize the importance of observations and alertness skills?
6. Are your students aware that it is unsafe to touch their faces, mouths, eyes, and other parts of their bodies while doing science?
7. Do your students wash their hands with soap and water after science activities?
8. Is everything stored in easily handled and labeled containers?
9. Are chemicals stored in a locked cabinet or separate secured room?
10. Have you inspected all glassware for cracks or defects?
11. Do students know how to properly dispose of broken glass and removed it from use?
12. Do your students know how to properly dispose of all science activity wastes?
13. Do you have chemical splash safety goggles and eyewash stations available for activities which require them?
14. Do students eat drink or chew gum while doing science?
15. Are all electrical cords free of broken or exposed wires?
16. Are adequate first aid supplies in your room or access to medical responder (e.g. nurse)?

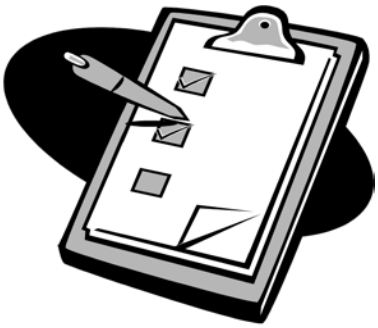
17. Do you know which of your students have allergies to materials which might be encountered during science activities or field trips? Are you aware that some students may have suppressed immune systems?

18. Are you comfortable with all the equipment you use during science activities?

19. Are classroom animals taken care of properly?

20. Do you know the name and phone number of a colleague, or internet resource whom you can call on, or access, with questions concerning science safety?

21. Are you aware of your school's policies for field trips, including communications, permission forms, medications and supervision?



Appendix 2

Acidity/Alkalinity and pH Values for Some Common Substances

Acids

SUBSTANCE	*Approximate pH*		
Pure Water	7		**Neutral**
Mouthwash			
Hair tonics			
Rainwater	6		
Potatoes			
Cabbage			
Black coffee	5		**Weakly Acidic**
Bananas			
Tomatoes			
Sauerkraut	4		
Beer			
Cherries			
Carbonated drinks	3		
Aspirin			
Lemon juice			
Vinegar	2		**Strongly Acidic**
Stomach acid			
Battery acid	1		

INCREASING ACIDITY

Bases

SUBSTANCE	*Approximate pH*	
Oven cleaner	14	
Drano		
Lye		
Hair remover	13	
Concentrated cleaners		**Strongly Basic**
Tub and tile cleaners		
Limewater	12	
Household ammonia		
Glass cleaners	11	**Weakly Basic**
Detergent		
Milk of Magnesia		
Tums	10	
Chlorox		
Borax		
Hand soap	9	
Baking soda solution		**Neutral**
Sea water		
Eggs	8	
Pure Water	7	

INCREASING ALKALINITY

Appendix 3

Animals In The Elementary Science Classroom

General Comments

1. Remember, as noted in the A-Z section, review and follow you School District's policy on animals in the classroom.

2. The care and well-being of any animal should be one of your primary concerns.

3. The science classroom is not a Zoo! Maintain only those animals that are necessary to support your science program.

4. Do not allow students to bring wild animals into the science room. Do not collect these on field trips. This includes animals, such as snakes and turtles. Be especially cautious about insects, since they often transmit serious diseases, such as Lyme disease from deer ticks and West Nile Virus from mosquitoes.

5. Provide simple, but comfortable, living areas for your animals. They should not be crowded. The cages should be clean, and the area should be well ventilated.

6. Remember that animals require care and feeding during weekends, holidays and vacations. Be sure that you make provisions for this.

7. Never allow students to tease the animals or frighten them in any way. Most animals are especially sensitive to sudden loud noises or rapid movements.

8. Purchase animals only from reputable pet shops or science supply vendors.

9. Animal experts at your local zoo or local veterinarians will gladly assist you with questions regarding animals. Arrange for a veterinarian to visit your school and give a general briefing to your students regarding the care and safe handling of animals.

10. Do not encourage students to bring their pet animals from home, unless a veterinarian has certified in writing that the animal is healthy.

11. Always discard of animal waste, including bedding material, frequently and completely. Place in plastic bags and have it disposed in the dumpster. Wash the area with a germicide solution.

12. New animals require a period of adjustment to new surroundings. Only the teacher should handle animals during this period. Wear heavy gloves to avoid bites and scratches.

13. Always provide water bottles for mammals.

14. Some students may be allergic to animals. Ask both students and their parents about allergies.

15. If an animal dies in your classroom, contact your science specialist or principal for the proper disposal method.

Guidelines For Using Specific Animals

Rabbits:

1. NEVER pick a rabbit up by the ears! Grasp the loose skin of the neck (scruff), lift the rabbit, and support the rabbit with the other hand and forearm placed beneath it. Small rabbits can be picked up by cupping them in the hands, like a kitten or puppy.

2. You can tell when rabbits are threatened or frightened; they thump their hind feet and claw and bite. Rabbits and most other animals do not like to be cornered.

3. Rabbits should only be kept in mesh-wire cages. They will eat through cardboard or wooden boxes. Opinion is divided as to the best flooring for cages. Some say that the floor should be mesh wire with an aluminum pan beneath to catch waste droppings. Others believe that solid or slatted floors are better. We recommend speaking with your veterinarian.

4. If they have the opportunity to run in the classroom occasionally, they do not require a large living space.

5. Rabbits generally do not soil their entire cage. They tend to leave their waste droplets in one corner of the cage, which makes clean up easier.

6. Students love to feed laboratory animals. Determine the nutritional requirements of each animal and try not to exceed this.

Guinea Pigs:

1. Guinea pigs make the best animals for elementary programs. They love to be petted, and they are small and strong enough to be handled easily. They are usually clean and odorless.
2. Pick up guinea pig as you would a rabbit, or since most are small, by scooping them with cupped hands.

3. Guinea pigs should not be placed in areas where there is a draft, or where the temperature changes suddenly, such as near a heat vent.

4. Their cages should be tall enough to allow them to stand on their hind feet.

5. Unlike rabbits, guinea pigs will soil their entire cage. Thus, the floor of their cage should be covered with wood shavings, shredded paper, or other absorbent material. The cage and floor material should be changed weekly.

6. Follow same feeding scheme as you would for a rabbit. However, be sure to use only guinea pig food because it contains the necessary nutrient, vitamin C, while rabbit food does not.

Gerbils, Rats, Mice, and Hamsters:

1. These animals are placed together because they are nocturnal. They like to sleep during the day, and are active at night. Students often become inpatient with their lack of activity and desire to be handled during the day. Most of these animals adapt to daytime cycles over a period of time.

2. Hamsters should be picked up as you would a rabbit or a guinea pig. Gerbils, rats, and mice can be picked up by their tail, and then supported by the other hand.

3. Although all of these animals like to be petted, rats require the most time to adjust to a new surrounding and are the most likely to bite.

4. These animals love to gnaw and will escape easily from any cage unless it is heavy-duty mesh wire. Aquariums make excellent living quarters for these animals.

5. Cover the bottom of the cage with absorbent material, like kitty litter, and add shavings, sawdust, or other material for their bedding. Hamsters usually make their beds in one corner of the cage.
6. Unlike rabbits and guinea pigs, these animals exercise frequently, and provision must be made for this. Ladders; exercise wheels; and several levels in the cage with connecting tubes or sticks will do fine.

Fish:

1. Large, rectangular aquariums are best for keeping fish. Small bowls and decorative containers do not provide enough surface area. The aquarium should have a cover.

2. Make certain that any chemicals used to maintain the aquarium are not stored in an area that is accessible to students.

3. Make sure that the stand you place an aquarium on is sturdy and that the weight of the aquarium is well balanced across its surface. Aquariums that are full of water are much heavier than most people think, and you wouldn't want a collapse to injure anyone.

4. Check with pet stores about specific requirements of specific types of fish.
   a. Goldfish are hearty and require little attention. They only require natural light whereas tropical fish require more attention and must have a tank light.

   b. All salt water fish require separate and special containers. Check with a pet shop for details.

   c. Keep guppies in a separate container. If new guppies are born, separate them as soon as possible from any adults in the tank. Place leafy plants in the container to provide shelter from adult fish. A female guppy usually gives birth to about 50 babies at a time.

5. Each aquarium should be equipped with a pump and filter. Cover the bottom with a 1 inch layer of sand and gravel or pebbles.

6. Never use tap water directly for a fish tank. Let the tap water stand for 24 hours before use to allow chlorine to dissipate. The temperature of the added water should be the same as that in the tank. Do not place the aquarium near windows, furnace vents, or drafty areas.

7. Fish will eat as long as you feed them. Give them only as much fish food as they can consume in 3 or 4 minutes. Overfeeding is the most common cause of death in aquarium fish!

8. If the fish should die, remove them as soon as possible from the tank and flush the fish down the toilet. The fungus that grows on the dead fish can spread disease to the remaining fish. Check fish for white fungus spots, and consult a vet or pet shop if the fish do become diseased.

9. All the electric outlets for fish tank installations should be ground fault interrupter (GFI) protected.

10. When cleaning algae from the inside of the fish tank glass, wear rubber gloves with long gauntlets or use devices which do not require having your hand and arm in the tank.
Tropical fish can have diseases that are harmful to people.

Frogs and Toads:

1. Frogs and toads can be kept in any container with a covered top to prevent them from jumping out. Be sure that the top has air holes.

2. Put water in the bottom of the container, and build a small island of rock for the toads. Put a few sticks and limbs in the container for them to crawl on.

3. Feed frogs and turtles small live worms and bugs. They especially like flies.

4. Frogs and toads are safe to handle. They do not bite, and THEY DO NOT CAUSE WARTS! Students should avoid holding them high in the air, since the animal may be injured if they jump to the ground.

5. Keep frogs and toads of the same size in the same container.

Turtles:

1. Turtles require little attention or special care. However, discourage students from capturing turtles in the wild. Some States have species of turtles that are considered endangered. Also, turtles in the wild often carry parasites or leeches. It is better to obtain your turtles from a pet store.

2. Put turtles of the same size together in the same container. A rectangular container works well. Make an island in the shallow water of the container. Turtles like to bask in the light at least 8 hours per day.

3. Allow tap water to set for 24 hours before using it in the turtle aquarium.

4. Turtles should be fed daily, but never from the fingers! You can easily feed turtles by offering them food from a stick or plastic spoon.

5. White fungus spots often appear on turtles when the salt concentration gets too low. If this happens, place the turtle in a separate container and add a pinch of salt to the water in the container.

Snakes:

1. Follow the advice of your veterinarian or pet shop owner regarding the types of snakes suitable for your science area. Green snakes, garter snakes, and ribbon snakes are popular and easy to keep.

2. The container for snakes must be completely tight, except the top that can be of wire mesh.

3. Provide twigs and sticks for snakes to climb on and curl around.

4. Provide water for snakes in a small bowl on the bottom of the container. The snakes recommended above will eat worms, grubs, and small insects.

5. NEVER allow students to bring snakes to class, and never bring them from field trips or other wild surroundings. You should not *try* to determine which snake is poisonous and which is not. Ask your pet shop owners for advice.

6. Children fear snakes perhaps above all other animals. You can help dispel this fear by involving them in the care and handling of harmless snakes.

Insects and Spiders:

1. Consideration should be given to ant farms and observation beehives.

2. There are over 100,000 species of insects, and only a few of them are poisonous to humans. Common poisonous insects that you might encounter and that should not be used in the classroom include:

    a. Most types of ants. When disturbed, ants can bite or sting. Those with more serious stings include velvet ants and fire ants.

    b. Most wasps, hornets, yellow jackets, or bees. Make yourself aware of students who may have particular allergies to their stings.

    c. Scorpions. These are easily distinguished by their upturned tail. The sting of most scorpions in the U.S. is painful and will produce local swelling, but is not lethal.

3. Keep insects in a glass container with a covered top. They like fresh leaves and perhaps small worms for food.

4. Be *very* careful with any hornet's or wasp's nest that students might bring to school. Often, adult wasps and hornets are deep inside the nest.

5. Tarantulas, although big and scary, seldom bite, and when they do it is no worse than an ant bite.

6. Spiders are not insects, but they are often grouped together because of similarities. The black widow spider and the brown recluse spider are extremely poisonous.

7. Collect spiders in large jars and place them in a big glass container, with a cloth covering. Provide them with water; food, such as fresh live flies and small bugs, and a few twigs and leaves.

8. Most insects, including scorpions and the poisonous spiders, do not usually attack humans unless they are disturbed or threatened.

Handling Newborn Mammals

1. Mother animals and their newborn require special care and privacy.

2. NEVER handle newborn animals unless it is absolutely necessary. Then, do so ONLY WHEN WEARING VINYL GLOVES. Do not use latex gloves as some people have latex allergies. Nitrile gloves can be substituted.

3. The mother is quite capable of tending to her newborn; it is not necessary to move them or rearrange them in the cage.

4. Provide clean bedding materials. Soft material, like cotton or shredded newspaper, is better than wood shavings for nesting materials.

5. Quite often the mother will reject her young, and in some cases eat them, if they detect a foreign scent. If the mother rejects a newborn, as they sometimes do if the baby is *very* weak or if there are more than the mother can feed and attend, you can remove it and care for it. Feed a *very* dilute corn syrup solution, using a dropper, and keep the baby warm and *dry*. Heat lamps work well. But, don't get it too hot!

Gestation Periods Of Some Animals

If you do not separate laboratory animals, you will have more animals-and sooner than you think! Ask your veterinarian how to distinguish between male and female, and separate them as soon as they no longer depend upon the mother for nourishment.

The following chart gives the times it requires the animals to produce offspring, the average number in a litter, and characteristics of the newborn.

Animal	***Gestation Period***	***Number born***	***Characteristics***
Guinea Pig	65-68 days	1 to 8	With hair, eyes open
Rabbit	28-30 days	4 to 8	No hair, blind
Gerbil	23-24 days	4 to 6	No hair, blind
Mouse	20-22 days	1 to 12	No hair; blind
Rat	21 days	6 to 9	No hair, blind

The guinea pig and rabbit reach sexual maturity in about two months. The others on the chart take about one month.

Appendix 4
Common Chemicals from the Grocery, Drug, and Hardware Store

NOTE: This list is provided for information purposes only. You should consult the directions for obtaining chemicals and preparing solutions that come with the directions for conducting an experiment before using chemicals from the above sources. If at all possible, consult a Chemistry teacher before using any chemical in an experiment for the first time. Also, read Appendix 8 of this guide for further information on Material Safety Data Sheets.

Chemical	***Name of Commercial Product***
Note: (D) Drug Store; (G) Grocery Store; (H) Hardware Store	
Acetic acid (CH_3COOH)	Vinegar, 5% solution (G)
Acetone (CH_3COCH_3)	Nail polish remover (D, G, H)
Aluminum metal (Al)	Aluminum foil or wrap (G)
Aluminum sulfate [$Al_2(SO_4)_3$]	Alum (G, D)
Ammonium hydroxide (NH_4OH)	Ammonia water, clear (G)
Ammonium nitrate (NH_4NO_3)	Garden fertilizer (H)
Ammonium sulfate [$(NH_4)_2SO_4$]	Garden fertilizer (H)
Ascorbic acid ($C_6H_6O_6$)	Vitamin C tablets (D)
Boric acid (H_3BO_3)	Boric acid roach pills (D, G)
Butane (C_4H_{10})	Cigarette lighter fluid (G)
Calcium carbonate ($CaCO_3$)	Chalk (G, D)
Calcium chloride ($CaCl_2$)	Calcium chloride (D)
Calcium oxide (CaO)	Lime (H)
Calcium sulfate ($CaSO_4$)	Plaster of Paris (H)
Carbon, graphite (C)	Graphite (H)
Carbon, electrodes (C)	Pencil lead (G, D)
Carbon, absorbing (C)	Activated charcoal (G, D)
Copper (Cu)	Pre-1982 pennies, copper wire (H)
Copper (II) chloride ($CuCl_2$)	Soot-remover (H)
Copper (II) sulfate ($CuSO_4$)	Root treatment (H)
Ethyl acetate ($CH_3COOC_2H_5$)	Finger nail polish remover (G, D)
Ethyl alcohol, ethanol (C_2H_5OH)	Denatured alcohol (H)
Fructose ($C_6H_{12}O_6$)	Fruit sugar (G)
Glycerol ($CH_2OHCHOHCH_2OH$)	Glycerin (G, D)
Hydrochloric acid (HCl)	Muriatic acid (H)

Chemical	*Name of Commercial Product*
Note: (D) Drug Store; (G) Grocery Store; (H) Hardware Store	
Hydrogen peroxide, 3% (H_2O_2)	Hydrogen peroxide (G, D)
Hydrogen peroxide, 6% (H_2O_2)	Clairoxide (D)
Iodine, alcohol solution (I_2)	Tincture of iodine (D)
Isopropyl alcohol ($CH_3CHOHCH_3$)	Rubbing alcohol, dry gas (G, D, H)
Lead (Pb)	Gunshot, fishing sinkers (H)
Magnesium sulfate ($MgSO_4$)	Talc (D)
Methyl alcohol, methanol (CH_3OH)	Burner fuel, dry gas (H)
Phenolphthalein indicator ($C_{20}H_{14}O_4$)	Formerly in Ex-lax tablets (G, D)
Phosphoric acid (H_3PO_4)	Naval Jelly (H)
Potassium chloride (KCl)	Salt substitute (G, D)
Potassium nitrate (KNO_3)	Saltpeter (H)
Potassium sulfate (K_2SO_4)	Garden fertilizer (H)
Sodium bicarbonate ($NaHCO_3$)	Baking soda (G)
Sodium bisulfate ($NaHSO_4$)	Sani-Flush (G)
Sodium carbonate (Na_2CO_3)	Washing soda (G), soda ash (Culligan)
Sodium chloride (NaCl)	Table salt (G)
Sodium hydroxide (NaOH)	Lye, Drano, oven cleaner (G, H)
Sodium hypochlorite (NaClO)	Bleach, 5.25% solution (G)
Sodium nitrate ($NaNO_3$)	Garden fertilizer (H)
Sodium borate ($Na_2B_4O_7$)	Borax (G)
Sucrose ($C_6H_{12}O_6$)	Table sugar (G)
Sulfur (S)	Flowers of Sulfur (D)
Zinc chloride ($ZnCl_2$)	Plumbing flux (H)

Appendix 5

Poisonous Plants

General Comments About Plants

1. Some plants are poisonous to the touch. These often secrete oils that are poisonous to humans. They cause rashes, itching and blisters. These include poison oak, poison ivy, and poison sumac, which will be discussed later.

2. Most plants that are poisonous release toxins when the plants are eaten. Various parts of poisonous plants can be toxic-this includes the leaves, stems, roots, bulbs, fruits, seeds, and flowers.

3. Some of the most potent toxins are found in certain seeds. Sometimes, commercial garden seeds have been treated with chemical fungicides. Therefore, as a general rule, DO NOT EAT THE SEEDS OF ANY PLANTS.

4. In some familiar plants, the part that we eat is the ONLY non-poisonous part of the plant. For example, All of the potato plant, except for the potato itself, is poisonous! All of the tomato plant, except for the tomato itself, is poisonous. All of the elderberry shrub, except for the elderberry itself, is poisonous. And, all of the rhubarb plant, except for the stalk, is poisonous.

5. Many houseplants and garden plants are poisonous if eaten. Be sure to warn students about this, and never allow them to put any part of any plant from the school science room or the garden in their mouth.

6. Have students wash their hands thoroughly after handling any plants in the science laboratory or garden.

7. If you collect wild plants on field trips, be sure that you do not include poisonous plants. Place all plants that you collect in plastic bags and do not let students handle them.

8. If any student becomes ill because they have eaten a part of a poisonous plant, they should receive emergency medical treatment. Contact your school nurse or emergency designee immediately.

9. If possible, keep the plants in your science laboratory together in a green house, or in a separate area near a window.

10. Do not feed poisonous plants to pets or livestock.

Plants That Are Poisonous To The Touch

These are the poisonous plants that students are most likely to come in contact with in the garden and in the wild. These plants secrete an oil, called Urushiol, which coats the plant. This poisonous oil can be picked up by direct contact with the plant; by animals who brush against the plant and then come in contact with humans; from the smoke when these plants are burned; and from volatile oils on hot days. Poison ivy, poison oak, and poison sumac cause a delayed response with a rash and blistering occurring one to three days after contact with the plant. Poison ivy and poison oak can be easily identified because of their characteristic cluster of three leaves, hence the saying, *"Leaves of Three-Let it Be!"*

- **Poison Ivy** *(Toxicodendron radicans).* This is the most commonly encountered poisonous plant.

- **Poison Oak** *(Toxicodendron diversilobum).* Similar to poison oak.

- **Poison Sumac** *(Rhus vernix).* This is a close relative to poison oak and poison ivy. It is most often found growing in damp places, like swamps. It is more like a shrub or small tree and has 6-12 leaflets arranged in pairs with a single leaflet at the tip.

- **Stinging Nettle** *(Urtics)* and **Wood Nettle** *(Laportea)* also cause immediate skin irritations.

Students who develop symptoms of poisoning from these plants, such as rash, itching and blisters, should receive emergency medical treatment.

Some common commercial products that can reduce itching include: Calamine lotion, Technu, Ivarest, Caladryl, Caldyphen, Ivy-Dry, and Aveeno.

Poisonous Plants Commonly Found in the House, Garden, and the Wild

This list does not include all of the poisonous (or allergy causing) plants, just some of the most common.

Poisonous House Plants:

Caladium	Lantana
Castor Bean	Mistletoe
Croton	Poinsettia
Caladium	*Dieffenbachia sequine*
Ricinus communis	*Lantana camara*
Croton variegatum pictum	*Phoradendron serotinum*
Dumbcane, Elephant Ear	*Euphorbia pulcherrima*

Poisonous Garden Plants:

Azalea	*Rhododendron*
Caladium	*Caladium*
Daffodil, bulb	*Narcissus pseudo-narcissus*
Foxglove	*Digitalis purpurea*
Hyacinth	*Hyacinthus orientalis*
Iris	*Iris versicolor*
Jonquil, bulb	*Narcissus jonquilla*
Larkspur	*Delphinium spp.*
Lupine	*Lupinus spp.*
Lily-of-the-Valley	*Convallaria montana*
Monkshood	*Aconitum napellus*
Morning Glory	*Ipomoea*
Mountain Laurel	*Kalmia latifolia*
Narcissus	*Narcissus*
Oleander	*Nerium oleander*
Potato, leaves	*Solanum tuberosum*
Red Sage	*Lantana camara*
Rhododendron	*Rhododendron*
Rhubarb, leaves	*Rheum*
Sweet Pea	*Lathyrus odoratus*
Tomato, leaves	*Lycopersion esculentium*
Wisteria	*Wisteria*
Yellow Jessamine	*Gelsemium sempervirens*

Poisonous Wild Plants, Shrubs (S), and Trees (T):

Bloodroot	*Sanguinaria canadensis*
Buttercup	*Ranunculus*
Chinaberry (T)	*Melia azedarach*
Chokecherry	*Prunus*
Elderberry (S), leaves	*Sambucus*
False Hellebore	*Veratrum viride*
Golden Chain (T)	*Laburnum Watereri*
Holly, berries (S)	*Ilex*
Hydrangea (S)	*Hydrangea*
Indian Tobacco	*Lobelia injlata*
Jack-in-the-Pulpit	*Ariseema triphyllum*
Jimson Weed	*Datura stramonium*
Mayapple	*Podophyllum peltatum*
Nightshade	*Solanum*
Poison Hemlock	*Conium maculatum*
Poison Ivy	*Toxicodendron radicans*
Poison Oak	*Toxicodendron diversilobum*
Poison Sumac (T)	*Rhus vernix*
Pokeweed	*Phytocacca americana*
Scotch Broom	*Sarothamnus scoparius*
Skunk Cabbage	*Smylocarpus foetidus*
Wild Tobacco	*Nicotiana spp.*
Wild Tomato	*Solanum carolinense*
Yew	*Taxus spp.*

Websites for Poisonous Plants (Pictures and Descriptions):

www.plantsciences.ucdavis.edu/ce/king/poisplant
www.cbif.gc.ca/pls/pp/poison
www.cdc.gov/niosh/topics/plants
www.vth.colostate.edu/poisonous_plants/

Appendix 6

Minimum Safety Guidelines for Chemical Demonstrations

When performing a demonstration in an elementary science classroom or laboratory, the teacher should know the potential hazards involved in the demonstration, and take the appropriate precautions while preparing, transporting and presenting the demonstration. The Laboratory Safety Institute has prepared a report "Science Demonstration: Safety and Liability." Copies of the report can be purchased by contacting LSI.

The American Chemical Society Division of Chemical Education recommends the following safety guidelines:

Chemical Demonstrators Must:

1. Know the properties of the chemicals and the chemical reactions involved in all demonstrations presented.

2. Comply with all local rules and regulations.

3. Wear appropriate eye protection for all chemical demonstrations.

4. Warn the members of the audience to cover their ears whenever a loud noise is anticipated.

5. Plan the demonstration so that harmful quantities of noxious gases (e.g. $N0_2$, $S0_2$, H_2S) do not enter the local air supply.

6. Provide safety shield protection wherever there is the slightest possibility that a container, its fragments, or its contents could be propelled with sufficient force to cause personal injury.

7. Arrange to have a fire extinguisher at hand whenever the slightest possibility for fire exists.

8. Not taste or encourage spectators to taste any non-food substance.

9. Not use demonstrations in which parts of the human body are placed in danger, such as placing dry ice in the mouth or dipping hands into liquid nitrogen.

10. Not use open containers of volatile, toxic substances (e.g. benzene, formaldehyde) without adequate ventilation as provided by fume hoods.

11. Provide written procedure, hazard, and disposal information for each demonstration whenever the audience is encouraged to repeat the demonstration.

12. Arrange for appropriate waste containers for and subsequent disposal of materials harmful to the environment.

Appendix 7

Elementary Safety Library

1. MSDS for all chemicals in the school.

2. Jim Kaufman, Peter Markow, Ken Roy, Eds.,
   Safety is Elementary: The New Standard for Safety in the Elementary Science Classroom, 2nd edition, The Laboratory Safety Institute, Natick, MA, 2010, 102 pages.

3. Terry Kwan and Juliana Texley,
   Exploring Safely, A Guide for Elementary Teachers,
   NSTA Press, Arlington, VA, 2002, 125 pages.

4. Kenneth Russell Roy,
   The NSTA Ready-Reference Guide to Safer Science,
   NSTA Press, Arlington, VA, 2007, 156 pages.

5. Council of State Science Supervisors,
   Science and Safety: It's Elementary, (calendar format)
   www.csss-science.org/downloads/scisaf_cal.pdf

Appendix 8

MSDS
Material Safety Data Sheet Samples

Notes on MSDSs

Whenever you buy a chemical or kit that includes various chemical solutions from a science supply company, that company is required by law to provide a Material Safety Data Sheet for every hazardous chemical included in the shipment. This sheet lists critical information in a predetermined format that is useful for both teachers and students. In addition, this information would be useful to an emergency services worker such as a school nurse, paramedic or fireman who might be responding to an accident involving a particular chemical. Because of this, *schools must keep these sheets when they unpack shipments.*

The standard sixteen sections of a MSDS are as follows:

1. Chemical product and Company Identification

2. Composition/Information on Ingredients

3. Hazards Identification

4. First Aid Measures

5. Fire Fighting Measures

6. Accidental Release Measures

7. Handling and Storage

8. Exposure Controls/Personal Protection

9. Physical and Chemical Properties

10. Stability and Reactivity

11. Toxicological Information

12. Ecological Information

13. Disposal Considerations

14. Transport Information

15. Regulatory Information

16. Other Information

The MSDSs should be placed in a central, easily accessible location and organized in a manner that would allow a teacher to readily locate a sheet dealing with a particular chemical. The MSDSs should be obtained prior to use for the purpose of helping a teacher judge the relative hazards (section 3), necessary precautions (section 8) and possible emergency procedures (sections 4, 5, and 6) involved in using various chemicals as a part of their classroom activities. One disadvantage to buying chemicals from *grocery,* drug, or hardware stores is that these businesses are *not* required to include MSDSs with their chemical purchases. However, as noted earlier in this document, some of the most hazardous chemicals are readily available in these stores. If an accident were to occur, critical information that could save lives may not be available. If you purchase chemicals from these sources, consult Appendix 4 of this guide to determine the chemical name associated with the product you are using. Most science supply companies will provide you with extra copies of MSDSs for those chemicals if you supply them with the chemical name.

On the following page, a sample of the MSDSs that accompany 5% Acetic Acid and Isopropyl Alcohol are provided for your examination. Additional MSDSs are readily available on the Internet. Three of our favorite sites are listed on page 38.

The following MSDSs are printed with permission from Science Lab.com

ScienceLab.com
Chemicals & Laboratory Equipment

Health	2
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Acetic Acid, 5%(v/v) MSDS

Section 1: Chemical Product and Company Identification

Product Name: Acetic Acid, 5%(v/v)

Catalog Codes: SLA2227

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Acetic acid; Water

CI#: Not applicable.

Synonym: Acetic Acid, 5% (v/v) Solution

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Acetic acid	64-19-7	5
Water	7732-18-5	95

Toxicological Data on Ingredients: Acetic acid: ORAL (LD50): Acute: 3310 mg/kg [Rat]. 4960 mg/kg [Mouse]. 3530 mg/kg [Rat]. DERMAL (LD50): Acute: 1060 mg/kg [Rabbit]. VAPOR (LC50): Acute: 5620 ppm 1 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), inhalation (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Acetic acid].
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.

Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Acetic acid vapors may form explosive mixtures with air.
Reactions between acetic acid and the following materials are potentially explosive: 5-azidotetrazole, bromine pentafluoride, chromium trioxide, hydrogen peroxide, potassium permanganate, sodium peroxide, and phorphorus trichloride.
Dilute acetic acid and dilute hydrogen can undergo an exothermic reaction if heated, forming peracetic acid which

is explosive at 110 degrees C.
Reaction between chlorine trifluoride and acetic acid is very violent, sometimes explosive. (Acetic acid)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Neutralize the residue with a dilute solution of sodium carbonate. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Acetic acid
TWA: 10 STEL: 15 (ppm) [Australia]
TWA: 25 STEL: 27 (mg/m3) [Australia]
TWA: 10 STEL: 15 (ppm) from NIOSH
TWA: 25 STEL: 37 (mg/m3) from NIOSH
TWA: 10 STEL: 15 (ppm) [Canada]
TWA: 26 STEL: 39 (mg/m3) [Canada]
TWA: 25 STEL: 37 (mg/m3)
TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [United States] [1999]
TWA: 10 (ppm) from OSHA (PEL) [United States]
TWA: 25 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acetic acid. (Strong.)

Taste: Acid. (Strong.)

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 100°C (212°F) (Water). Weighted average: 100.91°C (213.6°F)

Melting Point: May start to solidify at 16.6°C (61.9°F) based on data for: Acetic acid.

Critical Temperature: The lowest known value is 321.67°C (611°F) (Acetic acid).

Specific Gravity: Weighted average: 1 (Water = 1)

Vapor Pressure: The highest known value is 2.3 kPa (@ 20°C) (Water). Weighted average: 2.26 kPa (@ 20°C)

Vapor Density: The highest known value is 2.07 (Air = 1) (Acetic acid). Weighted average: 0.69 (Air = 1)

Volatility: Not available.

Odor Threshold: The highest known value is 0.48 ppm (Acetic acid)

Water/Oil Dist. Coeff.: The product is more soluble in water.

Ionicity (in Water): Not available.

Dispersion Properties:
Partially dispersed in methanol, diethyl ether, n-octanol.
See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in cold water, hot water.
Partially soluble in methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Slightly reactive to reactive with oxidizing agents, reducing agents, metals, acids, alkalis.

Corrosivity:
Corrosive in presence of zinc.
Slightly corrosive in presence of steel, of aluminum, of copper.
Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316).

Special Remarks on Reactivity:
Reacts violently with strong oxidizing agents, acetaldehyde, and acetic anhydride. Material can react with metals, strong bases, amines, carbonates, hydroxides, phosphates, many oxides,cyanides, sulfides, chromic acid, nitric acid, hydrogen peroxide, carbonates. ammonium nitrate, ammonium thiosulfate, chlorine trifluoride, chlorosulfonic acid, perchloric acid, permanganates, xylene, oleum, potassium hydroxide, sodium hydroxide, phosphorus isocyanate, ethylenediamine, ethylene imine. (Acetic acid)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 66200 mg/kg (Rat) (Calculated value for the mixture).
Acute dermal toxicity (LD50): 21200 mg/kg (Rabbit) (Calculated value for the mixture).

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Acetic acid].

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of eye contact), of inhalation (lung irritant).
Slightly hazardous in case of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May affect genetic material and may cause reproductive effects based on animal data. No human data found. (Acetic acid)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: causes skin irritation with redness and pain.
Eyes: causes eye irritation with redness, pain and tearing.
Inhalation: Causes respiratory tract and mucous membrane irritation with coughing, dyspnea, thoracic pain. May cause bronchopneumonia, chemical pneumonitis, pulmonary edema. May affect behavior/central nervous system and cause central nervous system depression with headache, nausea, vomiting.
Ingestion: Ingestion of large amounts may cause gastrointestinal (digestive) tract irritation with nausea, diarrhea, abdominal pain. May affect urinary system (albuminuria, hemoglobinuria, anuria, uremia kidney damage)
Chronic Potential Health Effects:
Ingestion and Inhalation: Prolonged or repeated ingestion of large doses may affect behavior, liver, and metabolism (weight loss). Prolonged or repeated inhalation may cause pharyngitis, chronic bronchitis, and may affect blood (changes in leukocyte count), and urinary system (kidney damage)
Skin: Prolonged or repeated skin contact may cause irritation or dermatitis, hyperkeratosis.
Eyes: Prolonged or repeated eye contact may cause conjunctivitis.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental

control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Acetic acid
Rhode Island RTK hazardous substances: Acetic acid
Pennsylvania RTK: Acetic acid
Florida: Acetic acid
Minnesota: Acetic acid
Massachusetts RTK: Acetic acid
New Jersey: Acetic acid
California Director's List of Hazardous Substances: Acetic Acid
TSCA 8(b) inventory: Acetic acid; Water
CERCLA: Hazardous substances.: Acetic acid: 5000 lbs. (2268 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36/37/38- Irritating to eyes,
respiratory system and skin.
S26- In case of contact with eyes, rinse
immediately with plenty of water and seek
medical advice.
S36/37/39- Wear suitable protective clothing,
gloves and eye/face protection.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent.
Splash goggles.

Section 16: Other Information

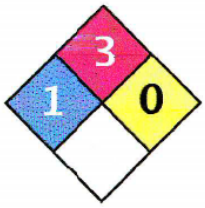
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:42 AM

Last Updated: 11/06/2008 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Isopropyl alcohol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Isopropyl alcohol

Catalog Codes: SLI1153, SLI1579, SLI1906, SLI1246, SLI1432

CAS#: 67-63-0

RTECS: NT8050000

TSCA: TSCA 8(b) inventory: Isopropyl alcohol

CI#: Not available.

Synonym: 2-Propanol

Chemical Name: isopropanol

Chemical Formula: C3-H8-O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Isopropyl alcohol	67-63-0	100

Toxicological Data on Ingredients: Isopropyl alcohol: ORAL (LD50): Acute: 5045 mg/kg [Rat]. 3600 mg/kg [Mouse]. 6410 mg/kg [Rabbit]. DERMAL (LD50): Acute: 12800 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, sensitizer, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE].
The substance may be toxic to kidneys, liver, skin, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops. Cold water may be used.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 399°C (750.2°F)

Flash Points: CLOSED CUP: 11.667°C (53°F) - 12.778 deg. C (55 deg. F) (TAG)

Flammable Limits: LOWER: 2% UPPER: 12.7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat.
Flammable in presence of oxidizing materials.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME.
Hydrogen peroxide sharply reduces the autoignition temperature of Isopropyl alcohol.
After a delay, Isopropyl alcohol ignites on contact with dioxgenyl tetrafluorborate, chromium trioxide, and potassium tert-butoxide. When heated to decomposition it emits acrid smoke and fumes.

Special Remarks on Explosion Hazards:
Secondary alcohols are readily autooxidized in contact with oxygen or air, forming ketones and hydrogen peroxide. It can become potentially explosive.
It reacts with oxygen to form dangerously unstable peroxides which can concentrate and explode during distillation or evaporation. The presence of 2-butanone increases the reaction rate for peroxide formation.
Explosive in the form of vapor when exposed to heat or flame. May form explosive mixtures with air.
Isopropyl alcohol + phosgene forms isopropyl chloroformate and hydrogen chloride.
In the presence of iron salts, thermal decompositon can occur, whicn in some cases can become explosive.
A homogeneous mixture of concentrated peroxides + isopropyl alcohol are capable of detonation by shock or heat.
Barium perchlorate + isopropyl alcohol gives the highly explosive alkyl perchlorates.
It forms explosive mixtures with trinitormethane and hydrogen peroxide.
It produces a violent explosive reaction when heated with aluminum isopropoxide + crotonaldehyde.
Mixtures of isopropyl alcohol + nitroform are explosive.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 983 STEL: 1230 (mg/m3) [Australia]
TWA: 200 STEL: 400 (ppm) from ACGIH (TLV) [United States] [1999]

TWA: 980 STEL: 1225 (mg/m3) from NIOSH
TWA: 400 STEL: 500 (ppm) from NIOSH
TWA: 400 STEL: 500 (ppm) [United Kingdom (UK)]
TWA: 999 STEL: 1259 (mg/m3) [United Kingdom (UK)]
TWA: 400 STEL: 500 (ppm) from OSHA (PEL) [United States]
TWA: 980 STEL: 1225 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Pleasant. Odor resembling that of a mixture of ethanol and acetone.

Taste: Bitter. (Slight.)

Molecular Weight: 60.1 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 82.5°C (180.5°F)

Melting Point: -88.5°C (-127.3°F)

Critical Temperature: 235°C (455°F)

Specific Gravity: 0.78505 (Water = 1)

Vapor Pressure: 4.4 kPa (@ 20°C)

Vapor Density: 2.07 (Air = 1)

Volatility: Not available.

Odor Threshold:
22 ppm (Sittig, 1991)
700 ppm for unadapted panelists (Verschuren, 1983).

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.
Insoluble in salt solution.
Soluble in benzene.
Miscible with most organic solvents including alcohol, ethyl alcohol, chloroform.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, Ignition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts violently with hydrogen + palladium combination, nitroform, oleum, COCl2, aluminum triisopropoxide, oxidants
Incompatible with acetaldehyde, chlorine, ethylene oxide, isocyanates, acids, alkaline earth, alkali metals, caustics, amines, crotonaldehyde, phosgene, ammonia.
Isopropyl alcohol reacts with metallic aluminum at high temperatures.
Isopropyl alcohol attacks some plastics, rubber, and coatings.
Vigorous reaction with sodium dichromate + sulfuric acid.

Special Remarks on Corrosivity: May attack some forms of plastic, rubber and coating

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 3600 mg/kg [Mouse].
Acute dermal toxicity (LD50): 12800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 16000 8 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.
DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE].
May cause damage to the following organs: kidneys, liver, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (irritant, sensitizer, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive/teratogenic effects (fertility, fetoxicity, developmental abnormalities(developmental toxin)) based on animal studies.
Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause mild skin irritation, and sensitization.
Eyes: Can cause eye irritation.
Inhalation: Breathing in small amounts of this material during normal handling is not likely to cause harmful effects. However, breathing large amounts may be harmful and may affect the respiratory system and mucous membranes (irritation), behavior and brain (Central nervous system depression - headache, dizziness, drowsiness, stupor, incoordination, unconciousness, coma and possible death), peripheral nerve and senstation, blood, urinary system, and liver.
Ingestion: Swallowing small amouts during normal handling is not likely to cause harmful effects. Swallowing large amounts may be harmful. Swallowing large amounts may cause gastrointestinal tract irritation with nausea, vomiting and diarrhea, abdominal pain. It also may affect the urinary system, cardiovascular system, sense organs, behavior or central nervous system (somnolence, generally depressed activity, irritability, headache, dizziness, drowsiness), liver, and respiratory system (breathing difficulty).
Chronic Potential Health Effects:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable.
R36- Irritating to eyes.
S7- Keep container tightly closed.
S16- Keep away from sources of ignition - No smoking.
S24/25- Avoid contact with skin and eyes.
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Appendix 9

Safety Equipment Vendors

The following list of safety equipment suppliers was compiled based on our experience and that of our workshop participants and newsletter readers. Please suggest names of others from whom you've received good products and good service.

CAROLINA BIOLOGICAL SUPPLY COMPANY, 2700 York Road, Burlington, NC 27215; 1-800-334-5551; www.carolina.com; science and safety equipment and science kits.

CT VALLEY BIOLOGICAL SUPPLY COMPANY, 82 Valley Rd., Southhampton, MA 01073. 800-628-7748, www.ctvalleybio.com.

DELTA EDUCATION, P.O. Box 3000, Nashua, NH 03061; 1-800-258-1302; www.delta-education.com; science and math kits.

DIRECT SAFETY COMPANY, P.O. Box 27648, Tempe AZ 85044; 1-800-528-7405; www.directsafety.com; general safety equipment supplier.

FISHER SCIENTIFIC, Fisher Science Education, 485 S.Frontage, Burr Ridge, IL 60521; 1-800-766-7000; www.fishersci.com; chemicals, furniture, instruments and safety equipment.

FLINN SCIENTIFIC, INC., PO Box 219, Batavia, IL 60510; 1-800- 452-1261; www.flinnsci.com; chemicals and safety equipment.

FREY SCIENTIFIC, 100 Paragon {kwy, Mansfield, OH 44903, 800-225-3739, www.freyscientific.com.

THE LABORATORY SAFETY INSTITUTE, 192 Worcester Road, Natick, MA 01760; 1-508-647-0900; www.LabSafetyInstitute.org; AC Sensors, First Aid Kits, Audio and Video Programs, Circuit Analyzers, Vaneometers, and safety related books.

LAB SAFETY SUPPLY, PO Box 1368, Janesville, WI 53547; 1-800-356-0783; www.labsafety.com; lab safety supplies and books.

SARGENT-WELCH (VWR) P.O. Box 5229, Buffalo Grove, IL 60089; 1-800-727-4368; www.sargentwelch.com; science and laboratory supplies.

SCIENCE KIT & BOREAL LABS, P.O. Box 5003, Tonawanda, NY 14151. 800-828-7777, www.scikit.com.

Appendix 10

Sample Rules Acknowledgement

Elementary Student
Science Safety Acknowledgement

I, _____, recognize that the science classroom or laboratory is a safer place to work and learn if I conduct myself in a responsible manner by following the guidelines given below.

1. I will follow the teacher's instructions at all times.

2. I will handle all equipment properly as instructed by my teacher.

3. I will familiarize myself with the techniques involved in each investigation before I attempt to perform the investigation.

4. I will use the appropriate safety equipment, such as eye protection, aprons, and gloves, when necessary.

5. I will not eat or drink during science activities.

6. I will report any accident to the teacher immediately.

7. I will not touch chemicals with my hands.

8. I will not touch my face or other exposed body parts while working with chemicals.

9. After each experiment has been completed, I will clean up my work area, and return all materials and equipment to their proper place.

10. I will wash my hands with soap and water after field trips, working with animals or experiments involving chemicals.

Student: _____ Date: _____

Parent:_____ Date: _____

Appendix 11

Safety Quiz (grades 3-6)

Name _____ Date _____

Teacher's name _____

Directions: Carefully read the following items. Circle **T** for those statements that are true.

Circle **F** for those statements that are false.

1.	Students **cannot** eat or drink during a science activity.	**T**	**F**
2	It is OK to touch chemicals with my hands.	**T**	**F**
3.	My partner and I should never do experiments in the classroom without teacher approval,	**T**	**F**
4	When working with chemicals, I do not need to wear eye protection	**T**	**F**
5.	It is OK to use broken or chipped glassware as long as I am careful with it.	**T**	**F**
6.	I should always wash my hands with soap and water after doing science.	**T**	**F**
7.	I will always listen to my teacher and follow their directions.	**T**	**F**

Appendix 12

Preparing Chemical Solutions

General Comments

1. Always wear indirectly vented chemical splash goggles when preparing any solution.

2. Select a container that is larger than the total volume of solution you want to prepare. For example, if you are preparing 100 mL of a solution, use a 250-mL container.

3. Prepare solutions in beakers or large-mouth flasks, where there is a large area at the top for stirring the solution.

4. Use containers (beakers, flasks, etc.) that are graduated, allowing you to read the volume of the solution. These marking are generally accurate to plus or minus 10%. Graduated cylinders provide greater accuracy if needed.

5. Use only glass or plastic stirring rods, or a wooden stirring stick. NEVER use thermometers, pencils, kitchen utensils, or your fingers as stirrers.

6. Be careful not to slosh or splash the solution outside the container. Wet glassware is slippery and can lead to the container being dropped and broken. Furthermore, it can lead to chemical exposures.

7. Prepare only the amount of solution than you need for a particular activity. Some solutions have a very short shelf life, for example, bleach and starch solutions.

8. Some solutions must be made in warm water. Be very careful when heating water. Use a hot plate rather than a ring stand and burner. Do not use tongs, or clamps to remove a container of hot water from the heat source. Use insulated gloves or pot holders and grasp the beaker securely with both hands.

9. The use of some chemicals produces vapors which are hazardous, e.g. bleach. Always make solutions in a well-ventilated area.

Dissolving A Solid In A Liquid

A. Preparing a "Percent" Solution:

Suppose that you want to prepare 100 mL of a 10% solution of sodium chloride (NaCl).

Most solutions for K-6 science activities are "percent" solutions, such as 10% sodium bicarbonate solution ($NaHCO_3$), or 5% bleach solution. Prepare these according to the following instructions.

1. Select a clean 250-mL beaker or large-mouth flask.

2. Add 50 mL of water to the container.

3. Weigh out 10 grams of NaCl and add it to the container.

4. Add water to the container until the 100 mL mark on the container is reached.

6. Stir the solution until all of the NaCl dissolves.

7. Place the solution in a small screw-capped bottle and label the bottle "10% sodium chloride (NaCl) Solution." Include the date of preparation and your initials.

B. Preparing a Solution of Specific "Molarity":

Chemists most often express the concentration of solutions as "molarity." A 1.0 molar solution (1.0 M) contains the molecular or formula weight of a chemical, in grams, dissolved and diluted up to 1000 mL (or 1 liter) of solution.
Suppose you want to make 1,000 mL of a 1.0 M solution of sodium chloride (NaCl):

1. Determine the molecular weight of NaCl by adding the atomic weights of Na and Cl. Atomic weights are found on the periodic table of elements.

Na atomic weight	= 23.0 grams/mole
Cl atomic weight	= 35.5 grams/mole
NaCl molecular weight	=58.5 grams/mole

2. Place 500 mL of water in a large, clean container.

3. Weigh out 58.5 grams of NaCl and add it to the container.

4. Add more water to the container until the 1000 mL mark is reached.

5. Stir the solution until all of the NaCl is completely dissolved and the solution is well mixed.

6. Place the solution in a screw-capped bottle and label properly.

Actually, you will seldom need 1000 mL of a solution. Suppose you only wanted to make 100 mL of a 1.0 M NaCl solution. Since 100 mL is 1/10 of 1000 mL, you would need only 1/10 of 58.5 grams of NaCl in a volume of 1/10 of 1000 mL. Therefore, you should:

1. Place 50 mL of water in a clean, 250-ml graduated container.

2. Weigh out 5.85 grams (0.1 mole) of NaCl and add it to the container.

3. Add more water until the volume is 100 mL.

4. Stir until the NaCl has dissolved and the solution is well mixed.

5. Place solution in a screw capped bottle and label properly (include hazard warning).

Dissolving A Liquid In Water:

Suppose you want to prepare 100 mL of a 10% solution of bleach.

1. Place about 50 mL of water in a clean, 250-mL container.

2. In a well-ventilated area measure out 10 mL of bleach, using a graduated cylinder.

3. Add the 10 mL of bleach to the water. Add it slowly and with constant stirring.

4. Add more water to the container until the total volume is 100 mL.

5. Place solution in a screw-capped bottle and label properly. Include a hazard warning.

As a general rule, when you are diluting a liquid (acid, base, bleach, alcohol, etc.) ALWAYS ADD THE LIQUID BEING DILUTED TO THE WATER. This prevents possible splashing and the buildup of heat when the two are mixed. Just remember the chemist's rule... *"AAA: Always Add Acid To Water"*

Always dispense your solutions in small bottles for student use, preferably dropper bottles, and clearly label each bottle.

Pour used and unused solutions into properly labeled waste containers. Wash your glassware thoroughly before using it again.

Drain disposal should only be used if you are certain that Federal hazardous waste disposal regulations would not be violated. If, for some reason, you have a solution on hand that you are not familiar with, ask advice of your science coordinator, principal, or a local high school chemistry teacher for proper disposal procedures. Always consult the MSDS for disposal guidelines.

Appendix 13

Useful Websites

Arts and Craft Materials Institute (ACMI)	www.acminet.org/index
Asbestos	www.epa.gov/asbestos/
Bloodborne pathogens	www.osha.gov
Button batteries	www.nwma.org/gov/env_conscious_design/drybat/upload/batteryingest.pdf
Laboratory Safety Institute (LSI)	www.LabSafetyInstitute.org
Micro-burners	www.porta-lab.com
MSDSs	www.siri.org/MSDS
	www.jtbaker.com/cgi-bin/MSDS
	www.sciencelab.com
Mushrooms	www.mycology.cornell.edu/fmush/html
National Association of Biology Teachers	www.nabt.org
National Fire Protection Association	www.nfpa.org
National Institute for Occupational Safety and Health	www.cdc.gov/niosh/
National Science Teachers Association	www.nsta.org
National Society for Cruelty to Animals	www.nspca.org
Occupational Health and Safety Administration (OSHA)	www.osha.gov
Poisonous plants	www.cdc.gov/niosh/topics/plants
Safety Guidelines	www.cssc-science.org/download/scisafe_cal.pdf
Science Fairs	http://home.comcast.net/~familysciencefair/safety_rules.htm

Appendix 14
The Laboratory Safety Institute

About the Laboratory Safety Institute

The Laboratory Safety Institute is a non-profit organization whose mission is to make health, safety and the environment an integral and important part of science education, work, and life. LSI provides training, consultations, publications, audio-visual materials, and responds to requests for information.

LSI was founded in 1978 as The Laboratory Safety Workshop by James A. Kaufman, Ph.D. His experience working for the Dow Chemical Company convinced him that schools and colleges were not doing enough to encourage health and safety. Studies by LSI and others have shown the accident rate at schools and colleges to be 100 to 1000 times that of Dow and DuPont.

Since 1978, Dr. Kaufman has trained over 65,000 science educators and scientists. His brand of safety training is a unique blend of technical information; practical and inexpensive solutions; humor; and accounts of accidents drawn from a collection of over 5,000 examples.

LSI has produced two lab safety training audio-visuals: "The One Day Lab Safety Audio Course" (5.5 hours) and "The Two-day Lab Safety Video Short Course" (8, 90-minute VHS Cassettes)

LSI publishes a newsletter: "Speaking of Safety."

LSI offers lectures, seminars, short courses, audit and inspections, and regulatory compliance and safety program development consultations throughout the world for academic, industrial, medical, and government laboratories.

LSI operates an Internet discussion list, LABSAFETY-L and maintains an informative website, http://www.LabSafetyInstitute.org.

LSI is supported by corporate sponsors, agencies, associations, generous individuals, its members. Members receive a newsletter subscription; use of the audio-visual lending library; a 10% discount on most LSI publications; a 5% discount on training and consultation services; and use of the toll free, 24-hour Lab Safety Information Hotline.

The Journal of Chemical Education called The Laboratory Safety Institute "a national resource for safety conscious science teachers." If you would like to help support the efforts of The Laboratory Safety Institute:

(1) Subscribe to "Speaking of Safety," (2) Become a member of LSI (partially tax deductible), and (3) Make a contribution (tax deductible).

Free copies of our "Laboratory Safety Guidelines," Publications List, Audio-Visual Lending Library List, and Introduction to The Laboratory Safety Institute (containing seminar schedule and membership Information) are available on request. For more information about LSI, contact: The Laboratory Safety Institute, 192 Worcester Road, Natick, MA 01760 508-647-1900; Fax: 508647- 0062, Email: Info@LabSafetyInstitute.org.

About the Editors

Dr. Ken Roy is Director of Environmental Health & Safety for the Glastonbury Public Schools (GPS), Glastonbury, Connecticut. He also is manager of National Safety Consultants, LLC, a company that provides services to the educational and business communities in the areas of employer/employee safety. He is also an authorized OSHA instructor for General Industry.

Dr. Roy earned his BS & MS from Central Connecticut State University. He completed his Sixth Year & Ph.D. from the University of Connecticut.

During his career, Dr. Roy served as president of the National Science Supervisors Association (NSSA), Executive Director of the National Science Education Leadership Association (NSELA), member of the National Science Teachers Association (NSTA) Board of Directors, and Institute Director of the NSSA National Science Leadership Institute. He also served as North American Representative for the International Council of Associations for Science Education (ICASE). Dr. Roy was a reviewer and contributor to the AAAS's Project 2061 and NSTA's Program on Scope, Sequence, and Coordination for Secondary School Science.

He has had numerous publications on education and safety in professional journals, in addition to seminars, workshops and other presentations in state, regional, national and international forums. He is co-author of a book series dealing with learning/thinking skills and interdisciplinary education in elementary and middle schools. He also worked as an ICASE consultant at the United Nations UNESCO Headquarters in Paris, France.

He currently serves on The Laboratory Safety Institute's Board of Directors and is the International Safety Project Officer for ICASE. He is a safety compliance columnist for several national and international professional education publications. Dr. Roy is a safety consultant for several national publishers and science laboratory equipment suppliers. He serves as science safety compliance consultant/editor/author/columnist for NSTA and NSELA.

Dr. Peter Markow is Professor of Chemistry at Saint Joseph College in West Hartford, Connecticut. He served for many years as a member of the Board of Directors of the Laboratory Safety Institute. He received a Bachelor of Arts degree in chemistry from Hartwick College, a Master of Arts for Teachers in chemistry from Colorado State University, and a doctorate in education from the University of Connecticut.

Dr. Markow teaches an elementary school science methods course. Dr. Markow's research interests include: developing and publishing interesting experiments for students enrolled in first and second year college chemistry courses; using concept maps to help students learn the conceptual material associated with the experiments they perform; and using photovoltaic solar panels to generate electricity in Connecticut.

Dr. James Kaufman is President of The Laboratory Safety Institute and former Professor of Chemistry at Curry College. He received his bachelors degree in chemistry from Tufts University and his doctorate in organic chemistry from WPI.

After two years as a post-doctoral fellow in the WPI Chemical Engineering Department converting garbage into fuel oil, Dr. Kaufman joined the Dow Chemical Company's New England Research Laboratory as a Process Research Chemist. During his four years with Dow, he became increasingly involved in laboratory safety related activities. He authored "Laboratory Safety Guidelines." Originally distributed by Dow, now over two million copies of the widely requested and reprinted brochure are in circulation. Dr. Kaufman is the founder and president of The Laboratory Safety Institute-an international, non-profit center for safety in science and science education. LSI's lectures, training programs, AV lending library, and publications help academic institutions throughout the world. LSI is supported by grants from individuals, foundations, companies and professional societies. LSI also conducts audits and inspections for schools, colleges, and industry. LSI provides advice on regulatory compliance, safety program development, facilities design and editorial commentary on laboratory texts.

Dr. Kaufman is a former, 10-year member of the American Chemical Society's (ACS) Council Committee on Chemical Safety and is past-chairman of the 2,500 member ACS Division of Chemical Health and Safety. He is the author-narrator of the ACS Audio Course on Laboratory Safety and editor of "Waste Disposal at Academic Institutions" from Lewis Publishers.
Most recently he recorded and edited the "One-Day Laboratory Safety Audio Seminar" and “Two-day Lab Safety Video Course."

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