

Chapter 14

Elementary Science Safety Standards

Introduction

The information presented here is correct to the best of our knowledge. Suggestions provided should be considered as the minimum applicable safeguards and should be used in conjunction with appropriate standards, regulations, state requirements, and federal codes that may prevail. The intent is to provide a guide to preventive measures which will avoid unsafe practices and also prepare teachers for any possible accidents. Of course, good common sense on the part of the teacher will avoid most situations where harm might come to students. To prevent injuries, teachers must attempt to foresee problems and address them immediately. Teachers must provide adequate supervision applicable for the environment and the degree of hazards anticipated, in addition to ensuring that the environment and equipment items are properly maintained. Teachers can assess the safety situation within their teaching environments (classrooms or field trips) regularly and accurately by developing and using safety checklists regularly. Refer to various safety checklists in this manual (Chemistry Safety, etc.). The assessments should be performed on a regular basis to ensure that safety problems are identified and corrected expeditiously.

14.1 General Safety and Use of Equipment Guidelines (refer to 14.2)

- 14.1.1 Check your classroom on a regular basis to ensure that all possible safety precautions are being taken. Equipment and materials should be properly stored; hazardous materials should not be left exposed in the classroom.
- 14.1.2 Be a positive role model for students by always practicing safe behaviors and using necessary protective equipment such as safety goggles.
- 14.1.3 Before handling equipment and materials, thoroughly familiarize yourself with their possible hazards. Alert students to potential dangers. Safety instructions should be given each time an experiment is begun.
- 14.1.4 Be extra cautious when dealing with fire and instruct your students to take appropriate precautions.
- 14.1.5 Be familiar with your school's fire regulations, evacuation procedures, and the location and use of fire fighting equipment.
- 14.1.6 Know your school's policy and procedure in case of accidents.
- 14.1.7 Good housekeeping is essential in maintaining safe laboratory conditions.
- 14.1.8 Sufficient time should be planned for students to perform the experiments, then to clean-up and properly store the equipment and materials after use.
- 14.1.9 Proper eye protection devices should be worn by all persons engaged in, supervising or observing science activities involving potential hazards to the eye.
- 14.1.10 At the start of each science activity, instruct students regarding potential hazards and the precautions to be taken.
- 14.1.11 Be sure that aisles remain clear and uncluttered, and lab or worktables are free of unnecessary and/or potentially hazardous items so that students have adequate room to move about and/or work during any demonstration or activity.
- 14.1.12 Supervise students at all times during a hands-on activity.
- 14.1.13 The group size of students working on an experiment should be limited to a number that can safely perform the experiment without causing confusion and accidents. Groups of two are recommended for primary students and groups of three are

recommended for grades three through five.

14.1.14 Students should be instructed never to taste or touch substances in the science classroom without first obtaining specific instructions from the teacher.

14.1.15 All accidents or injuries, no matter how small, should be reported to you immediately.

14.1.16 Students should be instructed that it is unsafe to touch the face, mouth, eyes, and other parts of the body while they are working with plants, animals, microorganisms, or chemical substances and afterwards, until they have washed their hands and cleaned their nails.

14.1.17 Critical safety equipment such as fire blankets, fire extinguishers, eyewashes, and drench showers should be located within thirty steps or fifteen seconds of any location in the science room. These vital equipment items should be checked for proper operation every three to six months.

14.1.18 Be sure that spills are cleaned up immediately. Water on tile floors can make the floors quite slippery.

14.1.19 Keep a whisk broom and dustpan available for sweeping up pieces of broken glass.

14.1.20 Hair and loose clothing (especially sweaters) should be restricted when students are working with open flames. Be careful to pull long hair back so that it does not hang down over the flame.

14.1.21 Never eat or drink during science activities or from laboratory equipment.

14.1.22 Provide for adequate and proper storage of materials and equipment either in the classroom or school storage room. Be certain to store any chemicals or potentially hazardous materials out of the reach of students, preferably in a locked cabinet or storage room.

14.1.23 Be aware of any allergies that students might have to certain foods, plants, chemicals, or other substances used in class.

14.1.24 Be sure you have secured permission from parents before students leave the school grounds, even if the destination is within walking distance.

14.1.25 Especially in the primary grades, be sure students use only nonpointed scissors. If students must walk around carrying scissors, remind them to point the tips of the scissors toward the floor.

14.1.26 Use only water-based, nontoxic glue, paste, and markers in class.

14.1.27 Many hand tools are designed for specific purposes and should be used on a suitable work surface and stored in proper storage facilities.

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14.2 Suggested List of Safety Equipment for the Elementary Science Classroom

In accordance with Illinois laws and regulations, all laboratories and science teaching areas should have and use safety equipment appropriate for the type of science activity being conducted. Protective equipment is designed to prevent or minimize injury. It does not prevent accidents from occurring. The following is a list of needed safety items in the science classroom and/or laboratory:

fire extinguishers (see section 14.3.5)

first aid kits

fire blankets
sand buckets
eyewash facilities
safety goggles
laboratory aprons
gloves
tongs

14.3 Specific Safety Equipment Information

Certain safety equipment items are essential when teaching science activities. Teachers should be confident that such items are immediately accessible when needed, that teachers and students can operate them, and that they are appropriate for the student audience being served. Students should also be taught the location and proper operation of all safety equipment items they might need to use. These should include fire extinguishers, fire blankets, eyewashes, safety goggles, and a telephone or intercom, if available. This might necessitate having duplicate safety items in more than one location in the room.

14.3.1 Electrical Equipment

It is recommended that whenever possible hot plates with on/off indicator lights replace open flames. This simple change could eliminate many fire situations from science rooms. You should not have to use extension cords for hot plates, since the room should have sufficient electrical outlets. Extension cords on the floor create tripping hazards unless they are in cord protectors. To prevent students from inadvertently upsetting apparatus, do not allow cords to be draped across desks or other work areas. Electrical outlet caps should be in place when the outlets are not in use. In primary grades, they should be covered at all times to prevent students from putting metal items in the plug holes, which could cause electrocution or burns.

14.3.2 Heating Equipment

If open flames are periodically necessary, be certain that emergency fire equipment is functioning properly and is immediately available. If alcohol lamps, sterno cans, or candles are to be used, place them in pie pans filled with damp sand. Should a spill accidentally occur, the pie pan would prevent the liquid from spreading onto clothing, tables, and so on. Since alcohol looks like water, it is essential to keep it off items where it might be treated like water. If you put alcohol in lamps, add a small amount of table salt so that the flame burns a bright orange color. Large quantities (one-half liter or more) of alcohol or other flammable liquids should never be brought into the room, and students should never have access to quantities of these liquids. From *Science for Life and Living: Integrating Science, Technology, and Health - Systems and Analysis* by BSCS. Copyright (c) 1994 by BSCS. Used by permission of Kendall/Hunt Publishing Company.

14.3.3 Flammable Liquid Storage

If teachers are storing flammable liquids such as alcohol, they should do so only in small quantities in the manufacturer's original container or in an approved safety can. A safety can is made of heavy-gauge steel or polyethylene. It has a spring-loaded lid to prevent spilling and to vent during vapor expansion caused by a heat source. It also has a flame arrestor or heat sump in the throat of the spout to help prevent explosions.

14.3.4 Fire Blanket

Fire blankets should be of the proper type and size and in the proper location. They should not be so large that students could not easily use them in an emergency. Check to be certain that they are placed in conspicuous locations and easily retrievable by both disabled and nondisabled students and staff. Unless otherwise recommended by your fire marshal, these blankets should be made of wool. Fire blanket display and storage containers should be carefully checked for proper function. Be sure to eliminate containers with rusted hinges and latches, blankets still stored in plastic wrappers, and blankets made with asbestos fiber. Six-foot vertical standing fire blanket tubes should be avoided since they can result in facial burns. Do not attempt to extinguish torso fires by having a student stand and be wrapped in the fire blanket. This results in a chimney effect, which pushes heat across the student's face and causes unnecessary facial burns. The stop-drop-and-roll procedure endorsed by fire departments appears to be most effective at extinguishing body fires and presents the fewest drawbacks.

14.3.5 Fire Extinguishers

ABC triclass fire extinguishers are usually preferred by fire departments due to their ability to extinguish most foreseeable fires from products likely to be found in elementary science settings (such as paper products, electrical items, grease). See section 14.5.1. on fire fighting. In settings where microcomputers are used regularly, it might be wise to investigate halon extinguishers. These have been used in aviation for years because their fire-extinguishing chemicals do not foul the contacts in delicate electronic navigation and communications equipment and microcomputers as dry chemical types will. Halon has also been preferred over carbon dioxide for extinguishing fires within electronic equipment, such as computers, because it does not cause a cold thermal shock to sensitive electronic microcircuits. Teachers should confirm such suggestions with their local or state fire marshal. The major disadvantage to halon is its harmful effect on the earth's ozone layer. Since halon contains such small quantities of this ingredient and such emergency tools are used so infrequently, the benefits may outweigh the drawbacks. It is a good idea to have fire department personnel come into your room and demonstrate for students appropriate fire procedures and equipment. Teachers should be confident and comfortable in using their fire equipment items. Teachers should also be in the habit of checking the pressure valves on fire extinguishers in or near their rooms to ensure that they are still adequately pressurized. It would also be wise for students to heft extinguishers, unfold and use a fire blanket, and rehearse foreseeable emergencies involving fire.

14.3.6 Eyewash

It is recommended that fifteen minutes (2.5 gallons per minute) of aerated, tempered (60-90 degrees Fahrenheit) running water be deliverable from an eyewash to flush the eyes of a person who has suffered a chemical splash. At the elementary level, eye irritants could include salt, vinegar, sand, alcohol, and other chemicals. Teachers should explore the installation of the fountain fixture type of eyewash station. It is inexpensive (\$60-\$70) and easy to install. Screw it into an existing gooseneck faucet. The fixture allows the plumbing to be used as both an eyewash and a faucet simply by pushing a diverter valve. Should traffic patterns or room designs change, such fountain fixtures can easily be moved to other faucets. Check the equipment and chemicals reference section of this book for sources. On a temporary basis, educators can stretch a piece of surgical tubing over a gooseneck faucet in order to deliver aerated running water to the eyes of a

chemical splash victim. Again, it is critical that such equipment be easily accessible to all staff and students. Be certain that the hot water faucet handle has been removed from any sink eyewash to prevent accidental burns caused by hot water. Bottled water stations are not recommended for use during science activities because they can be contaminated, and they cannot deliver fifteen minutes of aerated running water. They should only be used when there is no alternative, such as in field settings, and where the teacher maintains very strict control of them.

14.4 Eye Protection (refer to the Life Science Safety Manual section 14.2.2 for other protective equipment)

14.4.1 Eye Goggles

According to NSTA's "Safety in the Elementary Science Classroom," eye goggles protect against impact and splashes and reduce the amount of dust and fumes near or in the eyes. In order to establish an effective eye safety program, teachers should practice the following:

1. Demonstrate the proper way to wear safety goggles.
2. Require students to wear safety goggles whenever they use sharp objects, chemicals, or materials that could fly into someone's face. Such simple chemicals as vinegar and salt and objects such as rubber bands and toothpicks could pose potential risks of eye injury if students are not wearing safety goggles.
3. Assure that all persons performing science laboratory activities involving hazards to the eye wear approved eye protection devices. All persons in dangerous proximity to such activities must likewise be equipped.
4. Recommended safety goggles are those marked with the number "Z87" on the goggle's face. Such goggles meet the safety standards set by the American National Standards Institute.

14.4.2 Guidelines for Sanitizing Safety Goggles

The best way to ensure cleanliness of safety goggles is to assign one pair of goggles to each student in the class. Label the goggles with students' names, and insist that each student wear only his or her assigned pair. If students share goggles, you must clean and disinfect them after each use. Less expensive procedures for sanitizing goggles are described below:

1. Place a little dishwashing detergent in a dishpan or other large container. Fill it halfway with warm water. Make a bleach solution in a second dishpan, using 1/4 cup of bleach for each gallon of water. Swish the goggles in the soapy water, and then soak them in the bleach solution for 10 minutes. Rinse the goggles thoroughly in clean water, and let the goggles air dry. This process cleanses and disinfects the lenses and straps, although it might eventually cause the lenses to turn yellow and cloudy.
2. Purchase individually wrapped alcohol pads from a local pharmacy. The pads cost approximately 3 cents each and are available in boxes of 100. Wipe the lenses and straps of one pair of goggles with a fresh alcohol pad. Then dispose of the used pad in its original package. Allow the goggles to air dry.

14.4.3 Blindfolding

1. Maintain strict standards for cleanliness. If some blindfolding material is used for testing the senses, it should never be used on more than one child. Eye diseases are highly contagious.

14.5 Fire Prevention and Control

It is the responsibility of each science teacher to be prepared to act deliberately and intelligently in the event of a classroom fire. Your first concern should be to evacuate the area. It is important that you know not only the location of the fire fighting aids available - the blanket, the extinguishers, and the fire alarm box - but also how to use them. The principal concern in any materials fire is to immediately move students from the fire area. The teacher must quickly determine the immediate and potential danger from the fire. If there is any chance that the fire might spread or represent a danger to the classroom or students, the fire alarm must be sounded. It is the teacher's responsibility to know the location of the fire alarm box nearest the classroom. The first responsibility of teachers is to get students out of the area. Other common types of accidental fires in the science laboratory are those of clothes and hair when students lean too close to an open flame. In both cases, water is the most effective remedy. A fire blanket to smother the fire could also be used (see information on Fire Blankets, section 14.3.4). Do not use a CO₂ fire extinguisher on an individual. A CO₂ blast could spread the fire and possibly cause frostbite, thereby compounding the burn.

14.5.1 Fire Fighting

The use of the proper type of extinguisher for each of the four general classes of fires will provide the best control. The classification of fires here is based on the type of material being consumed.

Class A - Fires in wood, textiles, paper, and other ordinary combustibles. This type of fire is extinguished by cooling with water or a solution containing water (loaded steam) which wets down the material and prevents glowing embers from rekindling. A general purpose dry chemical extinguisher is also effective by fusing and insulating.

Class B - Fires in gasoline, oil, paint, or other flammable liquids that gasify when heated. This type of fire is extinguished by smothering, thus shutting off the air supply. Carbon dioxide, dry chemical, and foam are effective on this type of fire. To use a dry chemical or carbon dioxide extinguisher, pull the pin, point the nozzle at the flame, and squeeze the handle. Do not hold the horn of the carbon dioxide extinguisher with your hands; use the handle since the carbon dioxide causes supercooling of the horn.

To use a foam extinguisher, invert the extinguisher and point the nozzle in such a way as to cause the foam to float over the fire; do not point the stream at the flame. The extinguisher does not have a cut-off valve and must be completely expelled.

Class C - Fires in live electrical equipment. Whenever possible, the source of power to the burning equipment should be cut off. A Class "C" fire is extinguished by using a nonconductive agent. A carbon dioxide extinguisher smothers the flame without damaging the equipment. A dry chemical extinguisher is also effective.

Class D - Fires in combustible materials such as magnesium, titanium, zirconium, sodium, potassium, and others. This new and somewhat specialized classification is extinguished by a special extinguisher powder which is applied by a scoop, unlike general purpose dry chemicals. Dry sand may also be applied with a scoop to extinguish small Class D fires.

14.6 First Aid

First aid is the immediate care given to a person who has been injured or has suddenly taken ill. Its purpose is to protect rather than treat and it is used in emergency situations where medical assistance is not immediately available. It is the responsibility of each teacher to know how to proceed in the event that a student becomes ill or is injured in the

classroom. All teachers should receive first aid training from the American National Red Cross. Listed below are safety, emergency, and first-aid tips in the case of an accident. Keep in mind that the recommendations below may vary with individual schools. The specific procedures for your school should be followed.

14.6.1 Safety and Prevention

1. Have first aid procedures established in the event of an accident.
2. All students and teachers should know the location of fire extinguishers, eyewash fountains, fire blankets, and first aid kits.
3. Safety signs should identify the location of safety equipment.
4. Emergency instructions concerning fire, explosions, chemical reactions, spillage, and first aid procedures should be conspicuously posted near all storage areas.
5. Safety posters are encouraged in science laboratories.

14.6.2 Emergency

In the event of an accident or injury, take the following steps immediately:

1. Notify the school principal.
2. Have a properly trained person administer first aid, if necessary.
3. Notify the school nurse.

14.6.3 Serious injury

1. Immediately obtain medical help by calling a predetermined emergency number, or the police or fire department.
2. Establish contact with the parents or guardian as soon as possible and urge that they contact their family physician immediately.
3. If not able to reach parents or guardian, contact the alternate person designated and/or the family physician directly.
4. Give first aid. Do not treat or provide medication.

14.6.4 First Aid

1. KEEP CALM and keep crowds away from the injured student(s). Obtain staff assistance - send for the school nurse and principal. Handle the person as little as possible until the injury evaluation is complete and moving may be indicated. Do nothing else unless you are certain of the correct procedure.
2. RESTORE BREATHING. Restoration of breathing may be accomplished by using one of the methods listed below in which you have had sufficient training:
 - a. Mouth-to-mouth (mouth to nose) method
 - b. Cardiopulmonary resuscitation (CPR)
 - c. Heimlich Maneuver Technique (in the event of choking) for clearing obstruction of the airway
3. STOP ANY BLEEDING. The following steps should be taken for either massive or slight to moderate bleeding:
 - a. If bleeding is severe or profuse, it must be stopped before other aid can be given. Apply a large compress to the wound with direct pressure using the heel of the hand.
 - b. If the cut is slight and bleeding is not profuse, remove all foreign material (glass, dirt, etc.) projecting from the wound (but do not gouge for imbedded material). Wash with large amounts of water and apply sterile dressing.
4. PREVENT SHOCK. Symptoms are paleness, cold and moist skin with perspiration on the forehead and palms of the hands, nausea, shallow breathing, and trembling.

- a. Place the victim in a reclining position with the head lower than the body, unless victim is having difficulty breathing.
 - b. Control any bleeding by applying direct pressure.
 - c. Wrap with blankets, coats, paper, etc.
 - d. Keep the victim's airway open.
- It is essential to obtain medical aid in every case of serious injury or illness, in all cases of injury to the eye, and whenever in doubt. School employees should not diagnose, prescribe, treat, or offer medication, but may render first aid.

References

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14.7 Animals in the Classroom

The use of live animals in the classroom is essential if students are to fully understand and appreciate life processes. Students need ample opportunities to observe and experiment with living organisms at all levels in the curriculum. Good safety procedures should be established for the protection of students from the hazards of classroom animals as well as to ensure the humane treatment of animals.

The humane treatment of animals in research and teaching is becoming a more and more sensitive issue. The Council of State Science Supervisors, the National Association of Biology Teachers, the National Science Teachers Association, the Humane Society of the United States, the Animal Welfare Institute, and the National Society for Medical Research, all have established guidelines and position papers supporting the safe and humane treatment of animals used for the cause of science.

While many types of invertebrates and vertebrates can be kept successfully in the classroom, several factors should be considered before acquiring any animal and embarking on such a venture. Because of their diversity, it is difficult to generalize about their characteristics and habits, but their diversity is what makes them exceptionally interesting to study. Many of them can be kept or raised in captivity; organisms used in

the classroom are selected because of their popularity with children, their availability, their easy care, their unique habits, or their usefulness as a source of food for other classroom animals. Although general safety measures apply for the handling and care of most animals, knowing your organism's specific needs will encourage its proper care. It is important that students and teachers exercise proper collection, handling, and maintenance of all animals. Specific manuals for maintaining organisms in the classroom are available for purchase and use in the classroom. Planning is essential, not only for providing meaningful learning experiences for students, but for the welfare of the animal involved.

14.7.1 General Classroom Animal Safety Guidelines

Before introducing animals into the classroom, the policy of your local school district should be checked. When animals are in the classroom, care should be taken to ensure that neither the students nor the animals are harmed. Mammals protect themselves and their young by biting, scratching, and kicking. Pets such as cats, dogs, rabbits, and guinea pigs should be handled properly and should not be disturbed when eating. The following are some points to consider and classroom rules you may wish to adopt for invertebrates and vertebrates.

1. Do not allow students to bring live or deceased wild animals, snapping turtles, snakes, insects, or arachnids (ticks, mites) capable of carrying disease into the classroom.
2. Before a small animal is brought into the classroom for observation, plans should be made for proper habitat and food. These habitats must be kept clean and free from contamination, and animals must remain in a securely closed cage. Provisions for their care during weekends and holidays must be made.
3. When purchasing animals, purchase only from a reputable supply house. Fish should be purchased from tanks in which all fish appear healthy.
4. Discourage students from bringing personal pets into school. If they are brought into the room, they should be handled only by their owners and provisions should be made for their care during the day by providing fresh water and a place to rest.
5. When observing unfamiliar animals, students should avoid picking them up or touching them.
6. Caution students never to tease animals, nor to insert their fingers or objects through wire mesh cages. Report animal bites and scratches immediately to the school's medical authority. Provide basic first aid.
7. Animals should be handled only if it is necessary. This handling should be done properly according to the particular animal. Rats, rabbits, hamsters, and mice are best picked up by the scruff of the neck, with a hand placed under the body for support. If young are to be handled, the mother should be removed to another cage. By nature she will be fiercely protective. Special handling is required if the animal is excited, feeding, pregnant, or with its young.
8. Use heavy gloves for handling animals and have students wash their hands before and after they handle animals.
9. Any student who is bitten or scratched by an animal should report immediately to the school nurse.
10. Each study involving animals should have as a clearly defined objective the teaching/learning of some scientific principle(s).
11. All mammals used in a classroom should have been inoculated for rabies, unless

purchased from a reliable scientific company (this applies to domestic animals as well).

12. After a period of observing an animal brought in from the natural environment (i.e. toad, insect, etc.), it should be returned to its natural environment.

13. Individual animals require different environments to survive, and being knowledgeable about your animal's needs will encourage proper care behaviors by you and your students.

Selections below were obtained from the U.S. Humane Society Guidelines:

14. In vertebrate studies, palatable food shall be provided in sufficient quantity to maintain normal growth. Diets deficient in essential foods are prohibited. Food shall not be withdrawn for periods longer than 12 hours. Clean drinking water shall be available at all times (and shall not be replaced by alcohol or drugs).

15. Birds' eggs subjected to experimental manipulations shall not be allowed to hatch; such embryos shall be killed humanely no later than the nineteenth day of incubation. If normal egg embryos are to be hatched, satisfactory arrangements must be made for the humane disposal of chicks.

16. The comfort of the animal observed shall receive first consideration. The animal shall be housed in appropriate spacious, comfortable, sanitary quarters. Adequate provision shall be made for its care at all times, including weekends and vacation periods. The animal shall be handled gently and humanely at all times.

17. Respect for life shall be accorded to all animals, creatures, and organisms that are kept for educational purposes.

14.7.2 Animal Environments and General Maintenance

Each kind of animal has its own unique combination of environmental requirements that include habitat, food, water and climate. An animal's comfort in captivity and perhaps its survival depend to a great extent on the degree to which these needs are provided for or simulated. Listed below are suggestions for general environments necessary for maintaining animals in the classroom.

14.7.2.1 Animal Environments: Cages, Terrariums, Aquariums, and Jars - Below is a list of general tips for housing animals outside of their natural environment.

1. Enclosure should have easy access for the keeper to provide food, water, and general care and cleaning.

2. The environment should provide good visibility for the observer since it is intended to be used as a learning experience.

3. The environment should provide for the animal's basic needs (food and water) and comfortability. No single kind of environment meets the needs of all animals and habitat compromise might be necessary. Compromises should always be in favor of the well-being of the animal.

4. Avoid too much heat in an animal environment. High temperatures lower the oxygen concentration in water and increase the metabolic activity of organisms and thus increase their rate of oxygen consumption.

5. Unless culture methods specify otherwise, maintain a loose cover over all cultures to prevent contamination with dust and unwanted microorganisms.

6. Care should be taken to ensure that homemade cages are free from potentially harmful substances such as wood preservatives, paints, and adhesives and that there are no sharp edges or protruding nails that might cause injury to an animal.

7. Normal classroom lighting will meet the needs of most animals. Provide light for the

animal either on a 12-hour timer or by moving the cage to a room with a window for the weekend.

8. Normal classroom temperatures are within the satisfactory range for most animals, even though ideal conditions may be slightly warmer or cooler. If the building temperature is reduced overnight or on weekends (temperature falls below 60 to 65 degrees F), special arrangements must be made.

9. Depending on the organism, humidity may need to be regulated.

10. It is important to clean the animal's environment regularly to promote good sanitation practices.

11. All cultured organisms living in a very limited space use up their food supply, overpopulate, and accumulate toxic wastes or offensive products fairly rapidly. These cultures must be routinely fed, cleaned, and transferred.

14.7.2.2 Specific Information on Man-made Environments - Use the following tips to help care for plants and animals in the classroom.

1. A glass cover over a terrarium or aquarium will reduce evaporation and maintain a higher humidity level.

2. Especially in terrariums, plants may be kept in pots to allow easy removal and replacement and decrease the amount of uprooting.

3. When housing snakes, a screen-covered terrarium containing only the captive is suggested.

4. Do not use metal lids with nail-punched holes. Nail holes punched in metal jar lids are sharp and potentially dangerous. Punched inward, they can cause serious injury to an animal. Punched outward, they can cut fingers. Use screen covers instead.

14.7.3 Collecting Specimens

14.7.3.1 Limiting Your Collection - There are several reasons to limit your collection of organisms:

1. To model respect for all living things.

2. To model that all organisms are best studied in their natural environment without interference from observers.

3. To keep from impacting the organisms in the area, especially if many classes visit the same site.

4. To avoid making the main focus of the activity collecting animals instead of understanding ecological concepts.

14.7.3.2 General Recommendations - If you determine that you want your students to collect some organisms for closer observation, several recommendations are listed below:

1. Never collect material from an area unless you have permission from the person or organization who owns the land. You should not collect any material from national or state parks.

2. Never collect rare or endangered species. Someone at your State Department of Natural Resources or local cooperative extension service should be able to tell you if there are any such species in your area. See your phone book for the telephone numbers of these agencies.

3. Instruct students to minimize the number of organisms they collect.

4. Place all containers away from direct sunlight.

5. If aquatic animals are collected, use water for the containers from the area where the organisms were found. If the water in the containers with aquatic animals becomes

warm, replenish with cool fresh water.

Refer to general classroom animal safety guidelines (14.7.1) for other information regarding the collection of animals.

14.7.4 Animal Disposal

When animals are no longer wanted or needed in the classroom, they must still be dealt with in a responsible way. Animals that have been collected locally can be released back into their natural habitats, provided that the weather has not changed significantly. However, animals that are not native to a given area or animals that have been purchased (even if they are thought to be native to the area) should not be released. Non-native animals released into the local area may suffer and die if the environment is inappropriate. If they survive and become established, they can create serious ecological and environmental damage. Sometimes animals are given to other teachers who can use them for educational purposes. Many times, students will want to take a classroom animal home as a personal pet; but, of course, this should only be permitted with parental approval and if it is certain that both the child and the parent are knowledgeable about the animal's needs. A pet store might also accept (and will sometimes purchase) a healthy animal for resale. The store might also be interested in insects such as crickets or mealworms that can be used as food for other animals. Refer to the Biology Laboratory Safety manual for guidelines regarding humans as experimental organisms and on information concerning the obtaining, use, dissection, storage, and disposal of living and preserved animals.

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14.8 Plants in the Classroom

Teachers are encouraged to create a classroom environment where there are plants for students to observe, compare, and possibly classify as a part of their understanding of the

plant world. Plants that are used for such purposes should be well known to the teacher. Below are general safety guidelines for the use of plants in the classroom.

14.8.1 General Plant Safety Guidelines

1. Become familiar with dangerous plants in your environment.
2. Remember there are no "safe tests" or "rules of thumb" for distinguishing nonpoisonous from poisonous plants.
3. Breathing spores or pollen can cause reactions in many individuals which may later lead to allergies or diseases.
4. Adhere to the rules regarding poisonous plants in Section 14.8.4.

14.8.2 General Plant Care

The following is a list of ways to maintain plants in the classroom:

1. Never collect a plant if it's the only one growing in a particular area. Instead, collect plants that are growing in groups or stands.
2. Plants should be placed under fluorescent lights or near a window exposed to full sunlight at least part of the day.
3. The use of botanical or synthetic pesticides is strongly discouraged in the classroom.
4. Always take infected plants outdoors for treatment so students aren't exposed to chemicals.
5. Store pesticides in their original containers in a locked cabinet or room out of reach of children.

Refer to section 14.7.2 on Animal Environments and General Maintenance.

14.8.3 General Disease Prevention Methods

The most important means of avoiding disease and pest problems is to prevent them from becoming established. This means being vigilant, providing conditions for healthy plants, and practicing strict classroom garden hygiene as described below (recommendations adopted from the National Gardening Association's "Grow Lab").

1. Pay attention to the plants; investigate the soil, the underside of leaves, etc., for potential problems.
2. When you plant seeds, make sure your potting mix isn't so wet that you can wring water out of it, because algae and fungi will develop in the wet environment. When you water, avoid splashing or wetting the leaves for the same reason.
3. Don't bring in house plants that could have diseases or insect problems. If you must bring in house plants, reduce the risk by inspecting them carefully and by quarantining the newcomers in another part of the room for a few weeks.
4. Remove damaged, diseased, or weakened plant materials regularly from the indoor garden, because they attract insects and provide ripe conditions for diseases to develop.
5. Maintain good air circulation within the garden.
6. Disinfect your equipment.
7. Always use clean potting mix. Reusing potting mix, unless you have pasteurized it, will invite trouble. Commercial soil mixes are already sterile.
8. Fertilize properly. Too much fertilizer can cause lush growth which will be weak and extremely susceptible to attack.
9. Don't touch plants when they're wet. When the leaves of your plants are wet, touching them can spread waterborne diseases.
10. Use good watering practices. Watering too often deprives the roots of air and promotes rotting. Not watering enough stresses the plants and makes them more

susceptible to disease and insects.

11. Don't wait if you notice a problem developing. Take action immediately before the problem has a chance to become well-established and spread to other plants.

12. Dispose of empty pesticide containers properly. Don't reuse them for any purpose. Rinse thoroughly several times and use the rinse water as a last spray on your plants. Wrap empty containers in several layers of newspaper before putting them in the trash.

14.8.4 Poisonous Plants

Since many plants have not been thoroughly researched for their toxicity, the following are some common precautionary rules to impart to your students:

1. Never place any part of a plant in your mouth. (Note: Teachers may want to emphasize the distinction between edible plants, fruits and vegetables, and non-edible plants).
2. Never allow any sap or plant juice to set into your skin.
3. Never inhale or expose your skin or eyes to the smoke of any burning plant.
4. Never pick any unknown wildflowers, seeds, berries, or cultivated plants. If necessary, use gloves to touch unknown plants.
5. Never eat food after handling plants without first scrubbing your hands.

The reasons for these precautions are that any part of a plant can be relatively toxic, even to the point of fatality. The following are some specific examples of toxic plants. This list was obtained from NSTA's "Safety in the Elementary Science Classroom" and is only partial; teachers should include additional poisonous (toxic) plants for their specific geographical area. Also, be aware that many common house, vegetable garden, wooded area, swamp or moist area, ornamental, and field plants, trees and shrubs are toxic.

14.8.4.1 Plants which are poisonous to the touch due to exuded oils:

- a. Poison ivy (often found on school grounds)
- b. Poison oak
- c. Poison sumac
- d. Stinging nettles
- e. (other)

14.8.4.2 Plants which are poisonous when eaten:

- a. Some fungi (mushrooms)

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- b. Aconite
- c. Belladonna
- d. Wake robin
- e. Henbane
- f. Pokeweed
- g. Tansy
- h. Foxglove
- i. Indian tobacco
- j. Jimson weed
- k. (other)

14.8.4.3 The saps of the following plants are toxic:

- a) oleander,
- b) poinsettia,

- c) trumpet vine and
- d) other.

Refer to section 13.2.3 in the Biology Laboratory Safety manual for other cautions regarding plant handling and care, and to the Family Safety Magazine of the National Safety Council for a list of common poisonous plants.

14.8.5 Plant Diseases

The best way to avoid disease problems is to provide ideal conditions (good air circulation, watering, and fertilizing practices, etc.) for your indoor garden and to practice strict garden hygiene. It's difficult to eradicate diseases once they become established, so prevention pays off!

Below are a list of disease problems and control mechanisms obtained from the National Gardening Association's "Grow Lab."

DISEASE CONTROL

1. Powdery Mildew - Leaves appear dusted Increase air circulation by uncovering with white powder and eventually turn brown garden. Allow the garden to dry and wither, killing the plant. out between waterings.
2. Gray Mold - Plants develop brown patches Clean up dead plant debris. Remove that eventually are covered with gray or brown and discard all affected materials to fuzzy mold. It can migrate to healthy plants. prevent spreading.
3. Damping off - This fungal disease causes Cover newly planted seeds with 1/8 seedling to rot suddenly at the soil line and inch sphagnum peat moss. Remove fall over. It may prevent germination and affect affected plants and the soil around them flowering and vegetable seed plants. Discard/sterilize potting mix and containers where affected plants were growing.
4. Bean Mosaic - This viral disease is carried No control - prevent by keeping by aphids or seeds of infected plants. Bean leaves aphid population down. Remove appear puckered, yellow, and die. It weakens the affected plants immediately.
5. Fungi and Algae - Fuzzy white, dry brown, or If you notice growths, stir soil or green (algae) growths appear on the soil or base base material with a fork or fingers material surface. They're not real problems, but once a week. Also, dry out garden indicate moist conditions and poor air circulation, by uncovering it to increase air which could lead to other problems. circulation. To avoid algae growth, cover exposed portions with aluminum foil, heavy cardboard, or dark plastic sheets.

14.8.6 Plant Disposal

Teachers should be aware of appropriate plant disposal methods, especially with exotic or nonnative plants. Refer to Biology Laboratory Safety 13.2.4 for general disposal procedures and 13.2 for other considerations regarding the care and use of plants.

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14.9 Microorganisms in the Classroom

It is important to practice good safety measures when handling microorganisms in the classroom. Refer to the Biology Laboratory Safety manual 13.4.1 for further information regarding the use and safety of microorganisms in the classroom. Below are general safety guidelines regarding the use of microorganisms in the classroom.

14.9.1 General Microorganism Safety Guidelines

1. Only nonpathogenic bacteria should be used in the classroom. Indiscriminate culturing and handling of pathogenic or nonpathogenic organisms are discouraged.
2. Petri dish cultures should be sealed with tape.
3. Bacterial cultures should be killed before washing petri dishes. Most cultures can be killed by heating for 20 minutes at 15 pounds/inch squared (138 kPa) of pressure or by flooding the surface with chlorine bleach.
4. Contaminated culture media should be sterilized with a strong disinfectant and washed with a strong cleaning agent.
5. Always flame wire loops prior to and after transferring organisms.
6. Wear proper equipment (apron and rubber gloves) when washing bacteriological or chemical ware.
7. Use utmost caution when using a pressure cooker for sterilization of equipment. Turn off the heat source, remove the cooker, and allow the pressure to gradually reduce to normal atmospheric pressure prior to removing the cover.
8. When using the microscope, students should never use the mirror to reflect direct sunlight through the microscope. The bright light can cause permanent eye damage.
9. All live protozoan cultures should be maintained in bright light, but not direct sunlight. Jar lids should be loose so that oxygen can circulate. If an infusion develops mold, tighten the lid and discard it.
10. Students should be instructed that it is unsafe to touch the face, mouth, eyes, and other parts of the body while they are working with plants, animals, microorganisms, fungi, or chemical substances and afterwards, until they have washed their hands and cleaned their nails.
11. Be aware of any allergies that students might have to certain foods, plants, fungi, microorganisms, chemicals, or other substances used in class. For example, breathing spores or pollen can cause reactions in many individuals which may later lead to allergies or diseases.
12. Molds grown or discarded in bags should be killed first before they are thrown away.

Refer to the Biology Laboratory Manual, section 13.0, for more information regarding the use of microorganisms in the classroom.

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14.10 Earth Science in the Classroom

Proper safety precautions are necessary when students are engaged in Earth Science related activities in the classroom. General information on earth science safety in the classroom is found in *Rocks and Minerals*, and Champaign Unit 4's *Our Place In Space* for information on solar safety.

14.10.1 General Safety Guidelines

14.10.1.1 Rocks, minerals - Proper protective devices (eyes, body) should be used when hammering, chipping, or grinding rocks, minerals, or metals. See section 14.4 for further information on eye protection and rocks and minerals.

14.10.1.2 Solar system - The following suggestions will help students protect their eyes when they study the solar system.

1. It is extremely dangerous to look at the sun with the naked eye or even very dark sun glasses. Eye damage or blindness may occur.
2. Never use optics such as binoculars or telescopes to look at the sun. This only magnifies the intensity of the sun and can cause permanent damage or blindness.
3. Looking at an eclipse of the sun is even more dangerous because of the intensity of light. This can only be done safely by experts.
4. Use proper illumination for microscopes. Reflected sunlight can damage the eye.

References

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From *Science for Life and Living: Integrating Science, Technology, and Health - Systems and Analysis* by BSCS. Copyright (c) 1994 by BSCS. Used by permission of Kendall/Hunt Publishing Company.

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14.11 Physical Science in the Classroom

Below are general safety measures regarding the storage of equipment and materials and the handling and maintenance of various equipment and chemicals. It is important that teachers and students follow proper procedures when dealing with potentially dangerous equipment and chemical substances.

14.11.1 Storage of Equipment and Materials

Poor storage invites accidents. One of the most important essentials for safety in the classroom is adequate, efficiently planned storage. The following should be considered when storing equipment and materials.

14.11.1.1 Area - Enough space should be available so that there is no crowding. Shelving should be deep enough that the articles are not easily dislodged. A bar on the shelf edge is often desirable as an added safety measure to prevent items from falling off.

14.11.1.2 Height of Storage Shelves - Low levels are preferred. Toxic chemicals, large glassware, and heavy articles should always be stored on a lower shelf that is not accessible to students. When shelving cannot be reached from a standing position, a step stool should be available and used.

14.11.1.3 Containers - Materials should be kept in containers which are easily handled, e.g., acids are kept in small bottles for student use rather than in large gallon jars. Plastic is preferable to glass because of breakage.

14.11.1.4 Placement of Hazardous Materials - Volatile liquids should be stored away from

sunlight, electrical switches, or heat sources. Reacting chemicals should not be stored near each other. Hazardous materials should be kept under separate lock.

14.11.1.5 Labeling - At the elementary school level, it is prudent to label both the storage area where the equipment and materials are stored as well as the individual item. Marking pens or electric markers may be used to identify equipment name. Usually temporary type labels are more appropriate for containers used for materials, including dry and liquid chemicals.

14.11.1.6 Dispensing - Teachers should dispense substances into temporarily marked containers for student use and only in such quantities as will be used. Pouring dry chemicals or liquids back into the original containers will almost certainly contaminate the entire supply.

14.11.1.7 Identification of Chemicals - Chemicals should be identified by common name as well as the scientific name, formula, precautions for use, and antidote. Substances which have lost their identity labels or for which there is confusion as to their identity should be carefully discarded. They should never be used in experiments.

14.11.1.8 Liquid storage - Liquids should be stored in separate storage areas, not near equipment or other materials. Storage should further be separated by placing acids, bases, and salts in separate areas. Volatile substances, if any, should be placed in a cool storage area that has proper ventilation.

14.11.1.9 Transportation and Control - A system should be developed for transporting equipment and materials to the classrooms. A rolling cart with lips on each shelf is highly recommended. Hazardous materials should only be transported through the halls under direct supervision of a teacher. In addition, a method for checking in and out what is needed should be put into practice.

Refer to Chapter 7 for more detailed information regarding storage and labeling of chemicals.

14.11.2 General Safety Guidelines

14.11.2.1 General - Below are general safety tips when doing physical science related activities in the classroom:

1. Constant surveillance and supervision of students activities are essential.
2. Teachers should set good safety examples when conducting demonstrations and experiments.
3. Always practice activities yourself before performing them with your class. This is the only way to become thoroughly familiar with an activity, and familiarity will help prevent potentially hazardous mishaps. In addition, you may find variations that will make the activity more meaningful to your students.

4. Read each activity carefully and observe all safety precautions and disposal procedures.
5. Special safety instructions are not always given for everyday classroom materials being used in a typical manner. Use common sense when working with hot, sharp, or breakable objects such as flames, scissors, or glassware. Keep tables or desks covered to avoid stains. Keep spills cleaned up to avoid falls.

14.11.2.2 Match Safety

1. Only wooden safety matches, the kind sold in packets of small individual boxes, should be used. Book matches are not recommended.
2. Be sure the box is closed before the match is struck.
3. Always strike the match away from you.
4. Strike the match near the candle you are going to light.
5. If the match breaks while you are trying to light it, don't use it. Dip it into water and place it in a jar.
6. If the candle has not lit and the match is burning low, blow the match out and get another.
7. After the match has been used, dip the hot end into water and place it in a jar.

14.11.2.3 Plastics

Below are general safety procedures that should be followed when handling plastic materials in the classroom:

1. If you are going to try breaking plastics with something like a hammer, wrap them in a cloth first because you don't know how they will behave.
2. Polystyrene, as used in clear "glasses" or other containers which give a ring when tapped, shatters with very jagged edges so take care.
3. When cleaning plastic tubes or boxes, remove caps and place the emptied tubes/boxes and caps in a dish with a solution of warm water and detergent. After the tubes have soaked at least ten minutes, push the large bottles brush up and down in the tubes to clean them.
4. Repair plastic box cracks using liquid plastic cement. The cement is applied by painting it on both sides of the crack. Several applications may be necessary in some instances. Allow one hour for drying.

14.11.2.4 Glass Tubing - See the chemistry chapter, section 9.1.1, on the safe use of glassware in the classroom.

14.11.3 Physical and Chemical Science

14.11.3.1 General Guidelines - The following guidelines will help students use equipment and substances safely in the classroom.

1. Students should be taught that chemicals must not be mixed "just to see what happens."
2. Students should be instructed never to taste chemicals and to wash their hands after use.
3. Students should not be allowed to mix acid and water
4. Combustible materials should be kept in a metal cabinet equipped with a lock.
5. Chemicals should be stored under separate lock in a cool, dry place, but not in a refrigerator.

6. Only minimum amounts of chemicals should be stored in the classroom. Any materials not used in a given period should be carefully discarded, particularly if they could become unstable.
7. Never eat or drink in the laboratory or from laboratory equipment.
8. Never allow the open end of a heated test tube to be pointed toward anyone.
9. When alcohol is heated, it must be in a water bath container with the top of the beaker, etc., holding the alcohol below the top of the water bath container.
10. Chemicals should not be tasted for identification purposes.
11. When heating materials in glassware by means of a gas flame, the glassware should be protected from direct contact with the flame through use of a wire gauze or asbestos-centered wire gauze.
12. When working with flammable liquids
 - Have a carbon-dioxide or multipurpose fire extinguisher available,
 - Work in a well-ventilated area,
 - Keep the liquid over a pan or sink,
 - Use no flames or high-temperature heating devices, and
 - Do not store in a home-type refrigerator. Fumes may be ignited by sparks produced in the electrical switching system. (*Explosion-proof refrigerators are available from science supply houses.*)
13. Alcohol lamps are not recommended for use in the classroom.
14. Thermometers for use in the elementary classroom should be filled with alcohol, not mercury.
15. When working with chemicals, it is imperative that teachers understand the properties, hazards, and appropriate emergency procedures to follow in the event of an accident. *Material safety data sheets (MSDS) and the Merck Index provide this comprehensive information from chemical manufacturers, including physical property data, toxicity information, and handling and disposal specifications for chemicals.*

14.11.3.2 Toxic Chemicals

1. Rubbing alcohol is known to be toxic to the intestines and is intended for external use only. Be sure to discard the used mixture after each class by pouring it down the sink drain.
2. Iodine is considered toxic when ingested in large quantities. Students should be warned not to put iodine in their mouth, as it is poisonous. Also, it can stain paper and clothes. To remove iodine stains, soak the item in a mixture of vitamin C and water.
3. Never mix products containing ammonia with chlorine bleach, toilet bowl cleaners, rust removers or oven cleaners. These products will produce poisonous gases when combined.

Refer to Chapter 8 in the Chemistry Laboratory Safety section for information on proper disposal of chemical substances.

14.11.4 Electrical Science

Teachers and students should be constantly alert to the following safety precautions while working with electricity.

1. Students should be taught safety precautions for use of electricity in all everyday situations.
2. At the start of any unit on electricity, students should be told not to experiment with the electrical current of home circuits.

3. Check your school building code about temporary wiring for devices to be used continuously in one location. Friction of extension cords could easily cause a short circuit.
4. Connecting cords should be short, in good condition, and plugged in at the nearest outlet.
5. To remove an electrical plug from its socket, pull the plug, not the electric cord.
6. Tap water is a conductor of electricity. Students' hands should be dry when touching electrical cords, switches, or appliances.
7. Students should understand that the human body is a conductor of electricity.
8. Batteries or cells of 1.5 volts or less are safe for elementary classroom use. However, the battery may explode if heated or thrown into an open fire. The chemicals inside the battery can be dangerous if taken internally or exposed to the skin.
9. Work areas, including floors and counters, should be dry.
10. Do not use electrical wires with worn insulation.
11. Use 3-prong service outlets.
12. Some D-cell batteries used in the classroom will not give even a mild shock unless more than two dozen are connected in a series. However, these batteries can generate significant amounts of heat if a wire is connected to both ends, and can cause burns. Teachers and students should take proper precautions when using D-cell batteries.
13. Do not use rechargeable batteries. These batteries can cause wires to be very hot when they are short-circuited.
14. Never grasp any electrical device which has just been used. Most electrical devices remain hot after use and serious burns may result.

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14.12 Art in the Classroom

The Toxic Art Supplies in Schools Act (P.A. 84-725) prohibits the purchase of toxic art and craft materials for the use in grades kindergarten through six. The act further requires that art and craft materials containing toxic substances purchased for use by students in grades seven through twelve be labeled in accordance with Section 5 of the Act. In addition, federal law regarding non-toxic art supplies became effective November 18, 1990. (See 15 U.S.C. 1277.)

In accordance with Sections 9 and 10 of the Toxic Arts Supplies in Schools Act, the Illinois Department of Public Health has provided us with lists of art and craft materials which can be used in grades kindergarten through six. The lists of non-toxic art and craft materials, which are published annually, are expanded as more art and craft materials are evaluated. Refer to ISBE's List of Non-toxic Art and Craft Materials (1995) for products which can be purchased for use by students in grades kindergarten through twelve and to the P.A. 84-725 Toxic Art Supplies in Schools Act. (J.A. Spagnolo, personal communication, March, 1995)

The American Association for the Advancement of Science (AAAS) has recommended a major emphasis on themes in science curricula. Themes are the overarching ideas that integrate the concepts of different scientific disciplines, such as life science, earth science, and physical science. They also integrate the elements and principles of the visual arts and connect the concepts of science and art in meaningful ways. Many teachers are concerned about the management of materials and supplies during art and science lessons. Occasionally, such concerns actually prevent teachers from devoting as much time to art and science as they would like. Listed below are general safety guidelines when working with art materials in the classroom.

14.12.1 General Safety Guidelines

14.12.1.1 Safety

1. Use white glue or paste instead of resin-based glues and rubber cement.
2. Use acrylic paints rather than enamel or oil paints.
3. Use water-based printing inks rather than oil- or solvent-based inks.
4. Use water-based felt markers rather than solvent-based markers.
5. Have students wash their hands thoroughly with soap and water after art activities.
6. Check all art and craft materials for toxic substances.
7. Read and adhere to warning labels before using art or craft materials.
8. Especially in the primary grades, be sure students use only nonpointed scissors. If students must walk around carrying scissors, remind them to point the tips of the scissors toward the floor.
9. When working with chemicals, it is imperative that teachers understand the properties, hazards, and appropriate emergency procedures to follow in the event of an accident. *Material safety data sheets (MSDS) and the Merck Index provide this comprehensive information from chemical manufacturers, including physical property data, toxicity information, and handling and disposal specifications for chemicals.*

14.12.1.2 Set up

1. Cover desks and tables with newspaper. Students can fold odds and ends into the newspaper at cleanup time.
2. Before beginning any lesson, make sure that students understand cleanup procedures and know where to put finished work.

14.12.1.3 Cleanup

1. Collect brushes, pencils, or other implements as a first step in cleaning up. (This stops the art activity). One monitor can wash brushes later and stand them on their handles in a can to dry.
2. Avoid sink congestion by providing each student with one wet paper towel and one dry paper towel. These can be distributed loose or in a shallow tub. Have students wipe their hands with the wet towels and dry them with the dry towels, thus avoiding the sink altogether.

Refer to specific cleanup procedures outlined under the maintenance/use of various art materials (i.e. clay, tempera, etc.).

Below are general tips concerning the safety and use of specific art materials.

14.12.2 Tempera

1. When mixing powdered tempera, add several drops of dishwashing soap to the paint. This will cause the powdered paint to dissolve more quickly in the water. A few drops of dishwashing soap in liquid tempera will cause the paint to wash off hands more easily.
2. Arrange tempera paints in low containers such as cut-off milk cartons or margarine tubs with plastic lids. Arrange containers in shoe boxes for easy storage.
3. Collect a variety of plastic containers to use for water. Containers of different sizes can be stored inside each other.
4. Individual palettes for color mixing can be made of coffee can or margarine lids, plastic foam trays, and so on.
5. When mixing colors, show students how to rinse their brushes and dry them on paper towels so as not to muddy the paints.

14.12.3 Clay

1. Use one 25-pound sack of moist clay per class. Check the clay before the lesson to be sure it is still moist.
2. Use individual oilcloth place mats to cover desks. If oilcloth is not available, have students use masking tape to fasten fabric-backed wallpaper samples, heavy-duty aluminum sheets, or large flattened paper bags to their work surfaces.
3. Use a length of wire for cutting the clay.
4. Use plastic bags and rubber bands to store unused clay.
5. Provide each group of students with a tub or bucket to wash their hands, and a dry paper towel for each student.

14.12.4 Paste

1. Distribute paste on a small scrap of paper for each student.
2. When demonstrating collage, show students how to spread the paste on the back of the smaller piece of paper and then stick it to the larger piece.
3. Provide wet and dry paper towels for cleanup.

14.12.5 Watercolor

1. Demonstrate how to rinse the brush thoroughly with water when mixing colors, so as to avoid muddying colors.

2. Show students how to lightly dip the end of a facial tissue onto a wet watercolor pan to remove any muddy color.
3. When using crayon-resist techniques, note that some colors resist wax better than others. Different colors are made with different pigments. For instance, browns are heavier than other pigments and tend to lie on the crayon rather than resist it.
4. Old, dried-out watercolor pans should be discarded. After several years, the binding agent in the pigments deteriorates, and colors lose their luster.

14.12.6 Chalk

1. Reduce the amount of chalk dust produced when students use chalk. Before the activity, soak chalk pieces in water for one or two minutes, and then lay them on newspaper to dry. Using wet chalk will result in brighter colors and less dust, both in the air and on clothing.
2. Another way to reduce chalk dust is to have students dip their chalk into liquid starch before applying the chalk to paper. The starch will spread the chalk color over the paper without raising the dust. The same technique can be used with white liquid tempera paint on a colored construction paper background.

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14.13 Field Trips

Field trips are a valuable, positive addition to the science program. A good field trip is a well planned trip, where educational objectives are identified and the activities conducted are intended to achieve those objectives. When the study in the field is well organized, the possibility of accidents occurring is greatly reduced. A few relatively simple precautions can ensure safety for all participants.

14.13.1 Field Trip Guidelines

1. Teachers should never take anything for granted where students are concerned and should always be alert for the unexpected.
2. If possible, a second responsible adult, known and approved by the school administration, should accompany the teacher on the trip.
3. Parent permission should be solicited and received before a student is allowed to go on a field trip.
4. Decide what to see, how long to spend in each place, and how long it takes to get from place to place.
5. First aid kits should be checked to see that they contain the essential first aid items.
6. Visit the site prior to the actual field trip. The teachers should have a thorough knowledge of the field trip area, including obvious dangers such as poisonous plants, snakes, water dangers, fall areas, and electrical hazards.
7. No trip should be taken to any body of water unless at least one person in the party is familiar with the latest methods of artificial respiration and with the rules of ordinary water safety as described in first aid handbooks, scouting manuals, and the American Red Cross Senior Life Saving.
8. Develop a list to be sent home identifying the proper clothing to be worn and the necessary equipment or supplies to be taken on the trip.

9. To prevent the risk of mite and tick infestation, plant poisoning, or scratches, students should wear clothing that covers the legs and arms.
10. Students taking trips near or into the water of a stream, river, lake or ocean should learn to recognize dangerous aquatic plants and animals common to the area.
11. When taking a field trip involving wading, the buddy system should always be used. Life jackets should also be available.
12. Trips to factories and laboratories must be well supervised and an experienced plant representative should conduct the tour.
13. Establish rules for safe conduct prior to taking the trip.
14. Glass collection jars or containers should be avoided. The use of plastic, paper, or cloth containers may prevent cuts and loss of specimens due to breakage.
15. Obtain up-to-date medical information and emergency telephone numbers for each student.
16. Establish clear physical boundaries and time limits.
17. Students should not put their hands into holes.

Refer to Chapter 15, The Outdoor Learning Area, for more information about safety and the outdoor classroom.

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