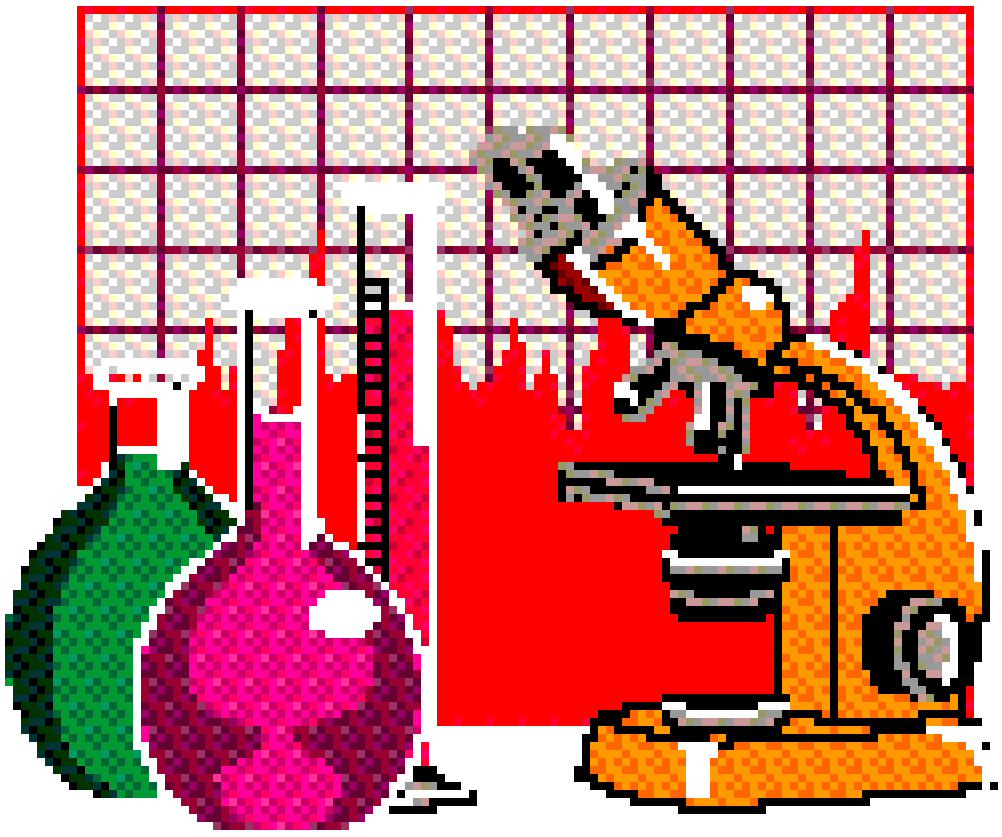
Safe Science

Science Safety for Schools

Grades PreK–12



Summer 1998
Brevard Public Schools
David E. Sawyer, Ed.D., Superintendent

In Case of
Emergency

Fire

Police **9-1-1**

Ambulance

Florida Poison Information Center 1-800-282-3171

Brevard County Animal Control 633-2024

Hazardous Spill

District Industrial Hygienist 633-3496
Plant Operations Director 633-3580

Contact school administrator first unless delay is life-threatening

Acknowledgments

PreK-12 Science Safety Task Team

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Table of Contents

Introduction

To be educational, meaningful, and valuable to students, science instruction must include a wealth of hands-on experiences that guide students to discover and construct science concepts. The National Science Teachers Association (NSTA) recommends that forty to eighty percent of science classroom instruction time should be spent in hands-on activities and labs. It is through this variety of hands-on experiences that students gain a true understanding of science.

A science program that includes many laboratory and hands-on activities inherently requires a comprehensive safety program. The purpose of this publication is to articulate and promote appropriate practices to ensure that science classroom experiences at all grade levels are both educational and safe.

This manual provides current safety information about materials, equipment, activities, organisms, chemical substances, and practices in PreK–12 science classrooms. This publication also reflects the Brevard Public Schools' commitment to hands-on learning activities as an integral part of science instruction. The intent of this manual is to advocate hands-on classroom instruction in a safe and appropriate manner.

We must ask many
of the significant questions
before we start
the research.

Edgar Dale

Safe Science

Listed below are some key concepts for ensuring a safe science program.

Safety: Student safety is always the highest priority.

Awareness: Be aware of Florida Statutes regarding the use of science equipment.

Forseeability: Anticipate potential safety problems and plan interventions and solutions.

Establish Rules: Post and discuss clear rules for science activities.

Supervision: Carefully supervise students during hands-on activities and labs.

Caution: Inform students of any precautions (general, equipment, and material) that are necessary for student safety.

Instruction: Teach and review proper safety rules and techniques.

Equipment: Use appropriate and safe science equipment.

Notice: Take note of potential hazards and take reasonable precautions.

Chemicals: Use only approved chemicals and store them properly.

Environment: Maintain a safe and orderly classroom.

Connections: Science Safety and the Sunshine State Standards

Grades PreK–2

Strand 1: Nature of Matter

Sample Appropriate Materials

Bubble-ology Kits
Collections of different liquids
Collections of leaves, shells, or rocks
Hand lenses
Oobleck (cornstarch and water)
Slime Chemistry Kits

Cautions

- Students should never taste any substance unless the teacher gives specific permission.
- Teach students the appropriate method for using the sense of smell: Keep the chemical substance at arm's length, and "waft" the vapors toward the nose. Never place the nose directly over a chemical substance.

Strand 2: Energy

Sample Appropriate Materials

electric circuit materials (batteries, wires, light bulbs, propellers)
electric motors
flashlights
solar cells
thermometers

Cautions

- Instruct students to never look at the sun.
- Use thermometers that contain alcohol. Do not use mercury thermometers.
- Use regular D cell batteries. Avoid alkaline batteries which can generate enough heat to cause burns.

Strand 3: Force and Motion

Sample Appropriate Materials

iron filings
magnets
toy cars
toys (windup or battery powered)

Cautions

- Purchase iron filings from an approved supplier.
- Keep iron filings away from fans or windy areas in the classroom.

Strand 4: Processes that Shape the Earth

Sample Appropriate Materials

soil testing kits
water testing kits
rock and mineral samples and kits
weather instruments

Cautions

- Wash hands after handling soil or water samples.
- Students should not inhale dust from soil samples.
- Instruct students on severe weather safety precautions.

Strand 5: Earth and Space

Sample Appropriate Materials

globes
light sources
model spacecraft
solar system models
solar system planetaria

Cautions

- Students should never look directly at the sun. For viewing eclipses, use a pinhole camera, or other projection techniques.

Strand 6: Processes of Life

Sample Appropriate Materials

Animals Appropriate for the Elementary Classroom

ants (within an enclosed Ant Farm container)
brine shrimp
butterfly larvae/butterflies
crickets
earthworms
pillbugs
Tenebrio beetle larvae (mealworms)

Classroom observation only:

aquarium fish	finches	lovebirds	rabbits
button quail	gerbils	mice	rats
canaries	guinea pigs	myna birds	reptiles
cockatiels	hamsters	parakeets	tadpoles

Aquaria	light sources	mushroom kits
paper cups	seeds	soil

Cautions

- Live vertebrates for activities other than observational studies are not appropriate for elementary students.
- Students should not handle reptiles. Many carry *Salmonella*.
- Some butterfly gardens contain plants that are toxic. Ingestion of Lantana berries, for example, can be fatal.
- Wash hands after handling plants and animals.
- Use appropriate heavy gloves when handling animals that could bite or scratch.
- Discourage students from bringing personal pets to school. If they are brought into the classroom, they should be handled only by their owners.
- Handle animals with care and respect.
- The study of animals, plants, microbes, and humans requires special precautions. See page 38-43.
- Animal hair, scales, and waste can cause allergic reactions in some students.
- Incubators should have properly working thermostats and heating elements.
- Aquaria should be free of cracks, chips, and leaks. They should be set up on stable, strong furniture away from student traffic. Electrical accessories should be free of defects and plugged into a ground-fault interrupter (GFI) outlet. Students should be cautioned about the potential for electric shock.

Strand 7: Living Things Interact with the Environment

Sample Appropriate Materials

aquaria
butterfly growth kits
terraria

Cautions

- Alert students about toxic plants in the local environment.
- Students should not bring in plant specimens from ponds, ditches, canals, etc. Algae cultures should be purchased from a reputable supplier to avoid microorganisms that may cause disease.
- Some butterfly gardens contain plants that are toxic. Ingestion of Lantana berries, for example, can be fatal.

Strand 8: Nature of Science

Sample Appropriate Materials

centimeter rulers
hand lenses
metric masses (weights)
metric volume and capacity containers
pan balances, scales
safety goggles
stopwatches
thermometers

Cautions

- Students must use eye protection whenever a heating element is used or when mixing potentially hazardous chemicals. See page 35.

Did you ask any good questions in school today?

Frances Bellow

Connections: Science Safety and the Sunshine State Standards

Grades 3–5

Strand 1: Nature of Matter

Sample Appropriate Materials

Hydrion strips (pH tests)
Kool-Aid Colors kits
pH test kit
"Slime" kits
soil sampling and testing kits
water testing kits

Cautions

- Use only test kits (water, soil, pH, etc.) that include chemicals that are on the District Approved Chemicals List. See pages 60-78.
- Check labels of all containers before using.
- Wear appropriate gloves when using potentially hazardous chemicals.
- Do not return unused chemicals to original containers. Dispose of the unused chemicals properly. See pages 58.
- Store chemicals in an approved storage area See pages 54-57.
- Never smell, touch, taste, or eat any chemical substance without teacher permission.
- Students should wear eye protection when working with hazardous chemicals. See page 35.
- Scissors or plastic knives are appropriate cutting tools for the elementary classroom. Classroom use of Exacto knives or razor blades should be limited to teacher use.

Strand 2: Energy

Sample Appropriate Materials

electric circuit kits (batteries, insulated wire, bulbs, sockets, switches)
electric motors
flashlights
hand-held generators
iron filings
lenses
magnets
mirrors
optics kits
prisms
solar cells with attached wires
voltmeter/ammeter

Cautions

- Limit the movement of students within a darkened room.
- Replace glass mirrors with polished metal mirrors or plastic mirrors.
- Review proper safety precautions prior to initiating activities which involve the use of batteries or electricity.
- Use regular dry cell batteries when teaching electrical circuits. (Avoid alkaline batteries. They can quickly generate enough heat to cause burns.)
- Use low amperage and low voltage dry cell batteries (12 volt direct current maximum).
- Dispose of batteries that are leaking or corroded.
- Students must wear eye protection anytime a heating agent is used (hot plate, candles, etc.). See page 35.
- Purchase iron filings from an approved supplier.
- Take precautions to ensure that students do not inhale or ingest iron filings.
- A multipurpose ABC dry chemical fire extinguisher should be available during any activity in which a heating agent is in operation.

Strand 3: Force and Motion

Sample Appropriate Materials

NASA Toys in Space kits
pipe insulation roller coasters (with marbles)
pulleys
Slinky toys
spring scales
windup or battery operated toys

Cautions

- Use caution when using levers or heavy masses/weights.
- Students should wear eye protection when working with metal springs.

Strand 4: Processes that Shape the Earth

Sample Appropriate Materials

crystal growing kits
Find-a-Fossil kit
fossil mold making kit
rock and mineral collections
streak plates
weather instruments

Cautions

- Place porcelain or glass streak plates on flat surfaces when conducting streak or scratch tests
- Wear eye protection when breaking rocks
- Samples of asbestos may only be used if they are embedded in plastic.

Strand 5: Earth and Space

Sample Appropriate Materials

bottle water rockets
model rocketry kits
spectroscopes/diffraction gratings
spectrometry kits

Cautions

- Do not allow students to look directly at strong light sources (sun, ultraviolet lights, "black" lights, laser pointers)
- To view an eclipse, use projection methods (sun boxes, pinhole projectors) to show the image of the solar eclipse.
- Use only factory-prepared, solid propellant engines when launching model rockets.
- Students should wear eye protection when launching model rockets.
- Never launch model rockets in high winds, near buildings or tall trees, around low-flying aircraft, or under any conditions that would endanger people or property.

Strand 6: Processes of Life

Sample Appropriate Materials

aquaria
aquatic/terrestrial plants and animals
seed germination supplies
terraria
Wisconsin Fast Plant kits

Cautions

- Use fertilizers in low concentration forms such as liquid solutions or slow release pellets or sticks.
- Store plant food/fertilizer secure from students and away from oxidizers (bleach).
- Do not use fungicides or insecticides. Pesticides or insecticides may contain toxic substances and therefore should not be used in the classroom. Pest treatments should be performed by professional pest control personnel.
- Alert students of the types and locations of poisonous plants prior to field work.
- Animal, plant, microbe, and human study require special precautions. See pages 38-43.
- Use commercially prepared slides for examinations of human tissue.
- Monitor students when conducting activities designed to increase the heart rate.
- Algae should be ordered from a biological supply company.

- Aquaria should be free of cracks, chips, and leaks. They should be set up on stable, strong furniture away from student traffic. Electrical accessories should be free of defects and plugged into a ground-fault interrupter (GFI) outlet. Students should be cautioned about the potential for electric shock.

Strand 7: Living Things Interact with the Environment

Sample Appropriate Materials

Animals Appropriate for the Elementary Classroom

- ants (within an enclosed Ant Farm container)
- brine shrimp
- butterfly larvae/butterflies
- crickets
- earthworms
- pillbugs
- Tenebrio beetle larvae (mealworms)

Classroom observation only:

- aquarium fish
- button quail
- canaries
- cockatiels
- doves
- finches
- gerbils
- guinea pigs
- hamsters
- lovebirds
- mice
- myna birds
- parakeets
- rabbits
- rats
- reptiles
- tadpoles/

- aquaria
- light sources
- mushroom kits
- paper cups
- seeds
- soil

Cautions

- Live vertebrates for activities other than observational studies are not appropriate for elementary students.
- Students should not handle reptiles. Many carry *Salmonella*.
- Some butterfly gardens contain plants that are toxic. Ingestion of Lantana berries, for example, can be fatal.
- Wash hands after handling plants and animals.
- Use appropriate heavy gloves when handling animals that could bite or scratch.
- Discourage students from bringing personal pets to school. If they are brought into the classroom, they should be handled only by their owners.

- Handle animals with care and respect.
- The study of animals, plants, microbes, and humans requires special precautions. See pages 38-43.
- Aquaria should be free of cracks, chips, and leaks. They should be set up on stable, strong furniture away from student traffic. Electrical accessories should be free of defects and plugged into a ground-fault interrupter (GFI) outlet. Students should be cautioned about the potential for electric shock.
- Animal hair, scales, and waste can cause allergic reactions in some students.
- Incubators should have properly working thermostats and heating elements.
- Microscope eyepieces should be regularly sanitized with an alcohol-based lens cleaner.
- Microscope mirrors should never be aimed directly at the sun.
- Fertilizers and plant food should be handled with caution since they may contain corrosive oxidizers such as nitrates. These items should not be stored in metallic containers.

Strand 8: Nature of Science

Sample Appropriate Materials

alcohol thermometers
beakers
gloves (heat and chemical resistant)
goggles
graduated cylinders
liter containers
meter sticks
pan balance
petri dishes
pipettes
spring scale
stopwatches
test tubes
triple-beam balance

Cautions

- Thermometers that use mercury should not be used.
- Hot plates with enclosed coils are the recommended source of heat.
- Candles placed in pie tins filled with sand may be used if hot plates are not available.
- Canned heat (Sterno) may be used for teacher demonstrations.
- The use of alcohol burners is strongly discouraged.
- Store masses/weights below eye level and in a secure area.
- Students should wear closed-toe shoes to reduce the risk of foot injury.

- Plastic or polypropylene containers (graduated cylinders, beakers) are preferred over glass containers. If glass graduated cylinders are used, they should have plastic safety rings in place near the top lip of the container.
- If glassware is used, Pyrex, Kimax, or other tempered glassware is preferred.
- If materials are being heated in a test tube, the test tube mouth should be pointed away from people.
- Cleaning agents (detergents, soaps, chalkboard cleaners, glass cleaners, polishes, bleaches, ammonia, etc.) must be used and stored with caution. The use of these substances by students should be monitored closely, since they pose potential hazards to students who may be allergic to them. Do not mix cleaning agents since some chemicals may react with others to produce highly toxic fumes. For example, if any cleaner that contains chlorine(Comet) is mixed with one containing ammonia (Windex), chlorine gas is produced.
- Use caution when using volatile (evaporates quickly at room temperature) and flammable substances.
- Extreme caution must be observed when using any substance in powder or dust form. The hazards associated with dusts and powders include fire, explosion, toxicity, and allergic reactions. Examples of substances which require precautions are chalk, charcoal, pastels, Plaster of Paris, cornstarch, and cooking flour.
- Always read the hazard caution on product labels.

In the science classroom, wondering should be as highly valued as knowing.

American Association for the Advancement of Science

Connections: Science Safety and the Sunshine State Standards

Grades 6 - 8

Strand 1: Nature of Matter

Sample Appropriate Materials

aprons
assorted glassware
chromatography paper
crystal growing kit
face masks
goggles
spectrophotometer

Cautions

- Students must wear goggles anytime liquids or chemicals are mixed or combined.
- Crystal kit ingredients must be on the Brevard Public Schools Approved Chemical List.

Strand 2: Energy

Sample Appropriate Materials

batteries
calorimeter
conductivity apparatus
hot plates
lasers
lenses
mirrors
power supplies
solar cells
spectrometer
UV light source

Cautions

- Lenses and mirrors must be inspected for chips and cracks.
- The use of lasers, ultraviolet light sources, strobe lights and light sources in general in the classroom requires special precautions. See page 35.
- The use of electrical devices requires special precautions. See page 29.
- Only hot plates designed for laboratory applications should be purchased and used. The heating element should be fully enclosed. There should be an indicator light showing when the hot plate is on and the power cord should be grounded.

Strand 3: Force and Motion

Sample Appropriate Materials

gyroscopes
incline planes
magnetic compass
model rockets
pulleys

Caution

- The launching of model rockets requires special precautions. See pages 46-47.

Strand 4: Processes that Shape the Earth

Sample Appropriate Materials

rock testing kits
rock samples
weather station
maps
soil test kits

Cautions

- Wear goggles when breaking rocks.
- Wash hands after handling soil or water samples.
- Make sure that rock samples or kits contain only those rocks or minerals that are on the Brevard Public Schools Approved Chemical List.
- Field studies require special guidelines. See page 37.

Strand 5: Earth and Space

Sample Appropriate Materials

light source
telescope
celestial globe
astronomical charts
globe of the earth

Cautions

- Do not allow students to look directly at the sun or strong light.
- To view an eclipse, use projection methods (sun boxes, pinhole projectors) to show the image of the eclipse. NEVER LOOK DIRECTLY AT AN ECLIPSE OF THE SUN.

Strand 6: Processes of Life

Sample Appropriate Materials

plants
incubators
prepared slides
microscopes
Drosophila
aquaria

Caution

· The use of incubators require special precautions. See page 33.

Strand 7: How Living Things Interact with the Environment

Sample Appropriate Materials

animal cages
terrarium
aquarium
petri dishes

Caution

· The use of animals in the classroom requires special precautions. See pages 38-43.

Strand 8: Nature of Science

Sample Appropriate Materials

microscopes
balances
glassware
hot plates
refrigerator
thermometers

Caution

· Foods for human consumption should never be kept in laboratory refrigerators.

Information isn't knowledge till you can use it.

Edgar Dale

Connections: Science Safety and the Sunshine State Standards

Grades 9 -12

Strand 1: Nature of Matter

Sample Appropriate Materials

aprons
approved chemicals
assorted glassware
cathode ray tube
cloud chamber
electronic balance
emission tubes
face masks
fume hood
radiation detectors
goggles
pH meters
magnetic stirrer
radioactive samples

Cautions

- Radioactive sources used in the classroom are limited. See page 46.
- The handling of all chemicals requires special precautions. See pages 22-27.
- Do not return unused chemicals to original containers. Dispose of the unused chemicals according to the disposal methods described on page 58.
- Students must wear goggles anytime liquids or chemicals are mixed or combined.
- Use a fume hood when potentially hazardous vapors or gaseous substances are used or produced in laboratory activities.

Strand 2: Energy

Sample Appropriate Materials

calorimeter
conductivity apparatus
lasers
magneto generator
oscilloscopes
power supplies
solar cells
spectrometer
UV light source

Cautions

- The use of lasers , ultraviolet light sources, strobe lights and light sources in general in the classroom requires special precautions. See page 33.
- The use of electrical devices requires special precautions. See page 29.

Strand 3: Force and Motion

Sample Appropriate Materials

air table
force tables
incline planes
model rockets
multi-meters
pendulums
springs
timing device
vacuum pump
Van de Graff generator

Cautions

- The launching of model rockets requires special precautions. See pages 46-47.
- The use of pendulums and objects used to demonstrate circular motion require special precautions.

Strand 4: Processes that Shape the Earth

Sample Appropriate Materials

water testing kits
rock testing kits
rock samples
sling psychrometer
maps
soil test kits

Cautions

- Wear goggles when breaking rocks.
- Wash hands after handling soil or water samples.
- Make sure that rock samples or kits contain only those rocks or minerals that are on the Brevard Public Schools Approved Chemical List.
- Field studies require special guidelines. See page 37.

Strand 5: Earth and Space

Sample Appropriate Materials

light source
telescope
spectroscope kit
sextant
celestial globe
astronomical charts

Cautions

- Do not allow students to look directly at the sun or strong light sources.
- To view an eclipse, use projection methods (sun boxes, pinhole projectors) to show the image of the eclipse. NEVER LOOK DIRECTLY AT AN ECLIPSE OF THE SUN.

Strand 6: Processes of Life

Sample Appropriate Materials

preserved specimens
incubators
centrifuge
simulation blood kits
DNA kits
genetics kits
dissecting instruments
prepared slides
microscopes
Drosophila

Cautions

- Order preserved specimens from an appropriate supplier.
- The use of incubators require special precautions. See page 33.
- The use of centrifuges require special precautions See page 28.
- Blood simulation kits should be used instead of human blood. See pages 43.
- Biological substances require special care and handling. See pages 38-43.

Strand 7: How Living Things Interact with the Environment

Sample Appropriate Materials

terrarium
aquarium
autoclave
inoculating loops
petri dishes
microbial media

Cautions

- The use of animals in the classroom requires special precautions. See pages 38-40.
- Microbiological activities require special precautions. See pages 42-43.

Strand 8: Nature of Science

Sample Appropriate Materials

microscopes
balances
glassware
refrigerator
probeware
spectrophotometer
centrifuge

Cautions

- Foods for human consumption should never be kept in laboratory refrigerators.
- Flammable solvents should not be kept in a refrigerator unless it is specifically designed to be "explosion-proof."

That knowledge which is of most worth
which enables us
to get or generate more knowledge and to test it
to make sure it is knowledge.

Edgar Dale

Emergencies

The most important functions of a teacher in preventing accidents are the effective management of instructional activities and the proper supervision of all students. Even under the best conditions, accidents and emergencies may occur. Prompt, calm, and professional handling of emergencies is imperative The safety of students and teachers is the primary concern.

- The teacher should be familiar with district and building level emergency procedures.
- Always notify an administrator when a laboratory accident occurs.
- Depending on the nature of the emergency, the teacher may also need to complete an accident report form and to contact a school nurse, parents, and the science department chairperson. **Whenever there is a life-threatening emergency, dial 9-1-1.**

Some problems the science teacher may encounter are described below.

Burns

Burns should be flushed with cold water until the burning sensation subsides. Contact the school nurse or an administrator, if appropriate.

Chemical Spills and Fire

At no time should a teacher attempt to fight a chemical fire or deal with a chemical spill that presents any significant threat to health or safety

A small spill or fire is defined as one that poses no significant health or safety hazard to faculty or students. In the event of a small chemical spill:

- Evacuate the area
- All gas outlets should be turned off at the master gas shutoff button.
- Electricity to the classroom lab tables should be turned off at the master electrical shutoff button.
- Notify the principal immediately and give:
    a. the location of the spill
    b. the name of the substance spilled
    c. other pertinent information regarding the spill
- Put on appropriate personal protective equipment before entering the contaminated area.
- Absorb liquids with an appropriate absorbing material.
- Pick up materials with a non-sparking tool.
- Place materials in a suitable storage container and label.
- Wash down affected area with soap and water.
- Consult the Approved Chemical List for proper disposal and coordinate the disposal with the appropriate administrator.

A small chemical fire can be quickly extinguished with a hand held fire extinguisher. In the event of a small chemical fire, turn off the gas and electrical supply to the lab area, evacuate all students from the area and extinguish the fire. Once the fire has been extinguished, follow the small spill clean up procedure. After a chemical incident, all emergency equipment must be restored to full working order before a lab class is allowed to continue.

In the event that a chemical fire or spill threatens health or safety, immediately:

- Evacuate all persons from the affected areas.
- All gas outlets should be turned off by hitting the master gas shutoff button.
- Electricity to the classroom lab tables should be turned off at the master electrical shutoff button.
- Secure the affected areas from accidental entry.
- Disconnect ignition sources at the main power panel.
- Begin decontamination procedures for affected individuals.
- Notify the principal immediately. Provide the following information:
    a. your name and the location of the emergency
    b. the trade and chemical name of the substance
    c. volume of spill or release
    d. known hazards of the substance (flammable, corrosive, toxic)
    e. identify other chemicals in spill and affected areas.
    f. report injuries, fire and damage.
- Assist your supervisor and authorities if your help is requested.
- Do not enter evacuated areas until they are declared safe.

Eye Injury
If chemicals are splashed in the eye, the eye should be flushed with running water for at least 15 minutes. Contamination should be washed from eyes and from under the eyelids. The eye should not be rubbed if a foreign object is present in the eye. Contact the school nurse or an administrator.

Fainting
Fresh air should be provided and the head should be positioned lower than the rest of the body. If breathing stops, artificial resuscitation is indicated. Contact the school nurse or an administrator.

Fire
All gas outlets should be turned off at the master switch. A fire blanket or a fire extinguisher may be used.

Minor Cuts
Wash with soap and water. Contact the school nurse or administrator, if appropriate.

Poisoning
Contact the school nurse and an administrator. If life threatening, call 911. Help is also available from the **Florida Poison Information Center (1-800-282-3171).** Be prepared to identify the toxic chemical, the amount, and the concentration. Notify the parents as soon as possible.

Laboratory Safety

Chemical Safety

The possibility of accidents in the school laboratory may be reduced by understanding some of the possible dangers inherent in specific laboratory activities. For example, harmful substances can enter the body by being inhaled, absorbed through the skin and exposed mucous membranes, and ingested

The following procedures will minimize the risks associated with the use of chemicals:

- Review the Material Safety Data Sheets for each chemical.
- Read the labels on all chemical containers carefully before use. Special attention must be paid to warnings on labels concerning specific health hazards, flammability, reactivity, conditions of use, and precautionary measures to be taken to ensure safe handling.
- Eye protection devices and appropriate protective attire, including gloves, should be worn when there is a danger of splashing during the preparation and use of reagents.
- Alternative chemicals and equipment must often be substituted for those recommended in the laboratory manual. The teacher should perform all experiments prior to allowing students to perform them so that special safety precautions and potential hazards may be noted and passed on to the students.
- Students should never handle, taste, or smell a chemical unless directed to do so by the teacher. To smell the contents of a test tube or other container, students should be instructed to waft some of the escaping vapors towards themselves. The container should never be brought close to the nose.

The U.S. Department of Health and Human Services has classified general categories of chemistry experiments according to their health and safety hazards.

Acids and Bases

The hazards associated with this class of experiments are related to diluting concentrated acids, to pipetting procedures, and to the filling of glassware such as burets. The teacher should dilute the acids or bases in advance of the lab. If the student must dilute the reagents, care must be taken since the dilution of acid with water is highly exothermic. *Acid* should always be added to *water*.

A convenient way to remember the order of mixing acids and water is: "Always Add Acid". The dilution should be performed in a shielded fume hood in a heat resistant beaker immersed in an ice bath. Extreme care must be taken to avoid splashing highly corrosive acids or bases on the skin or into the eyes.

Chemical and Physical Change
When burning magnesium and aluminum, care must be taken not to look directly at the flame since intense ultraviolet light is produced.

Conductivity and Ionization
This class of experiments is relatively safe and can be made even less hazardous by limiting the use of active metals. Use extreme care when using conductivity apparatus with exposed electrodes.

Crystals
Few dangers are presented in the study of crystals, and these can be controlled. If sublimation of iodine is to be done, it should be carried out in the fume hood. Also, care must be taken if attractively colored crystals are grown since they might be mistaken for candies. Crystal kits should contain only approved chemicals.

Density Measurements
If the density of organic liquids is to be determined, some safe liquids to use are glycerol or aliphatic alcohols of larger molecular weights. If the density of air is to be determined, evacuated glassware must have appropriate thick-walled construction and must be taped to minimize damage in case of implosion.

Gas Laws
This class of experiments can be hazardous if dry ice/acetone baths are used or if liquid nitrogen is used. Use proper gloves, protective eyeware, and protective clothing when handling these substances.

Heat of Reaction
The greatest danger in this class of experiments is in handling the reagents. Typically, hydroxides are used. Their caustic nature makes it essential that students clearly understand they are not to touch the pellets with their fingers. Injuries may also result from using the thermometer as a stirring rod and from ingesting any of the chemicals. Eyes are particularly vulnerable to hydroxides and acids, especially in dust and vapor forms. For this reason, the use of contact lenses during such labs is strongly discouraged.

Organic Chemistry
Organic synthesis experiments are greater health and safety hazards than high school inorganic experiments. Increased hazards result from the higher volatility and flammability of organic compounds. If experiments are performed in a fume hood, the risk may be lowered. The risk may also be lessened by using hot plates for heating.

Oxidation and Reduction
There are several sources of possible hazard in this class of experiments. Most can be reduced to a minimum. Cobalt compounds may be used in redox reactions in place of chromium compounds. Most other compounds used in these experiments are safe in dilute solutions. If gases will be generated during the reactions, the fume hood

should be used. In any procedure that calls for the use of concentrated acid, extreme care must be used. Special precautions must be taken when disposing of redox chemicals. Do not dispose of them by pouring them down the drain or by placing them in plastic waste containers or waste cans containing paper. Instead, follow the recommended disposal procedures described by the Material Safety Data Sheet for that substance.

Qualitative Analysis
Little potential danger exists for this class of experiments if dilute chemical solutions are distributed in dropper bottles and if extreme care is taken when using concentrated acids.

Radiation Chemistry
Experiments in this class are usually not performed in a school setting. If experiments with radiation are included, care should be exercised with pipetting, chemical handling, and equipment use (e.g., radiation detectors).

Stoichiometric Reactions
All nitric acid dissolution and reactions should be carried out in a fume hood. Since hot acid produces worse burns than cold acid, extra care should be used if the reagents are heated. Whenever gas generators are used, they must be properly vented to avoid increased internal pressure that can cause explosions. NEVER LEAVE GAS GENERATOR REACTIONS UNATTENDED. If the solutions for these labs are prepared in advance, the potential dangers are reduced.

Reaction Rates
Most of the dangers in this type of reaction result from the reagents used. If these are given to the students in diluted form, this class of experiments is relatively safe.

Thermal Chemical Measurements
Since several of the low melting point substances used in these measurements are flammable, toxic, or suspected carcinogens, use only substitute chemicals which are on the Approved Chemicals list. Water baths should be used in place of open flames whenever possible.

There are some other demonstration experiments that have consistently presented safety problems. These include:

- **The production of hydrogen:** Because the hydrogen/air mixture is explosive, be sure that there is no open flame near the generator. It is recommended that a hydrogen jet not be ignited.

- **The reaction of active metals with water:** If the reaction of active metals with water is to be demonstrated, use calcium metal in place of alkali metals such as sodium and potassium.

Chemical Use In Biology

All chemicals used in the biology laboratory must be handled with care. Many substances with which students and teachers will come into contact are highly reactive, flammable, and potentially carcinogenic. Although many are non-toxic and require no special precautions, the habits students should develop regarding chemical safety must be consistently applied.

The following chemicals are frequently used in biological application. Teachers should pay special attention to their inherent hazards. The Material Safety Data Sheets on these chemicals should be carefully studied to maximize safety in their handling and use.

Acetone
Acetone is used as a general laboratory solvent and in experiments involving paper chromatography. It is highly flammable and produces explosive vapor. Inhalation may produce narcosis. Contact with the skin or eyes or by ingestion is toxic. It should be handled cautiously and only under well-ventilated conditions. When practical, dispense acetone in small containers under a fume hood. Proper gloves should be worn when using this chemical.

Adrenaline
Both Adrenaline and Adrenaline chloride are toxic by ingestion.

Antibiotics
Students who are allergic to an antibiotic should not handle antibiotic discs or antibiotic solutions used to test the resistance of bacteria.

Benedict's Qualitative Solution
Benedict's solution is used in the identification of reducing sugars. It contains copper II sulfate and is toxic and caustic, especially when hot.

Biuret Reagent
Biuret reagent is used in protein identification. The solution contains sodium hydroxide, is caustic, and requires caution, especially when hot. Proper eye protection is required when working with this solution.

Bleach
Bleach is used as a disinfectant in seed germination experiments and in skeletal preparations in the biology lab. Bleach contains sodium hypochlorite and is irritating to the skin and eyes. It will react violently with acids and will form toxic fumes in the presence of ammonia. A 10% solution of bleach in water is commonly used as a disinfectant.

Buffer Solutions
Buffer solutions that stabilize solutions at high and low pH are strongly alkaline and acidic. They should be treated as strong acids or bases.

Fehling's Solutions A and B
Fehling's solutions are used in the identification of reducing sugars. The solutions are caustic and toxic, and require caution, especially when hot.

Hydrogen Peroxide
3% Hydrogen Peroxide is commonly used. Even though this is a relatively weak solution, it should still be considered a skin and eye irritant.

Iodine Solutions
Iodine, whether in it elemental form, or in solution, as in Gram's Iodine, Lugol's Iodine, or iodine-potassium-iodide solutions, is toxic and corrosive. Contact with the skin, and especially the eyes, should be avoided.

Limewater
Limewater is used as a common laboratory test for carbon dioxide. It contains calcium hydroxide and is a mild skin irritant. Contact with the skin and eyes should be avoided.

Ninhydrin
Ninhydrin is used to identify proteins, amino acids, and plant pigments in paper chromatography experiments. This chemical is a severe irritant, is flammable because of the butanol carrier, and presents a serious health hazard in its vapor form. Care must be taken to avoid inhaling the vapor, especially when the ninhydrin is dispensed from an aerosol can. (Ninhydrin is not on the Approved Chemical List).

Penicillin
If penicillin solutions or impregnated disks are used to test the antibiotic resistance of bacteria, their allergenic properties should be kept in mind.

Petroleum Ether
Petroleum ether contains low molecular weight alkanes, and is often used as a solvent in plant pigment chromatography experiments. It is highly flammable, causes narcosis, and should be used only in a well-ventilated area.

Plant Growth Hormones
Indole-3-acetic Acid (IAA), 3-indolebutyric acid (IBA), and gibberellic acid are possible mutagens and must be handled cautiously. Both IAA and IBA are contained in commercially available rooting powders. Inhalation of the dust or contact with the skin should be avoided.

Potassium Hydroxide
Potassium hydroxide is used to absorb carbon dioxide in cellular respiration experiments and to clear tissues for subsequent staining. Like sodium hydroxide, it is highly toxic and extremely caustic. Contact with the skin and especially the eyes may cause severe damage.

Stains
Many staining solutions contain staining agents dissolved in acetone or alcohol. Use appropriate cautions.

Thymol
Thymol is occasionally used as an antifungal agent when preserving specimens. It is irritating to mucous membranes and should be used under well-ventilated conditions.

Triethylamine
This is the active ingredient in insect anesthetics such as Fly-Nap and Lull-A-Fly. It is flammable and is an irritant to the eyes, skin, and respiratory tract. It should be used only under well-ventilated conditions.

We cannot create observers by saying "observe", but by giving them the power and the means for this observation.....

Maria Montessori

Laboratory Equipment

Assembling Apparatus

- Keep work spaces uncluttered. Only authorized materials should be present. Keep work space clear of chemical containers and scraps of paper.
- Keep tall measuring equipment, such as glass cylinders, near the rear of the work space where they will not be easily knocked over.
- When attaching equipment to a ring stand, position it so that the center of gravity of the system is over the base, with adequate provision for removing burners or baths.
- Thoroughly check glassware assembly and auxiliary equipment prior to adding reagents and carrying out any reactions.
- Whenever possible, use hot plates in place of open flame burners.

Centrifuges

- Centrifuging should be done in a location where vibrations will not cause bottles or equipment to fall off shelves.
- Suction cups must be in good condition and capable of firmly gripping the laboratory bench.
- Students must be taught to correctly balance the rotor before starting the motor to minimize vibration.
- The rotor must be completely stopped before removing the tubes.
- Centrifuge tubes should match the contour of their metal sleeves.

Chromatography

- Special precaution should be taken when working with solvents. Make sure to close solvent containers after use.
- Dispose of all solvents properly.

Compressed Gas Cylinders

Compressed gas cylinders must be handled and stored in accordance with the following guidelines:

- Cylinders permitted inside buildings must be stored at least twenty feet from highly combustible materials and must be placed in a secure, temperature-controlled environment.
- Empty cylinders must have valves closed while in storage or shipment.
- Valve caps shall be in place except when cylinders are in service.
- Oxygen cylinders in storage must be separated from fuel gas cylinders by at least twenty feet or by a noncombustible barrier at least five feet high having a thirty-minute fire resistance.
- Compressed gas cylinders must be secured with a chain or base to prevent accidental overturning.
- Gas cylinders must be operated, handled and stored according to NFPA 51, Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes (1983).

Deionizing Cartridges

Deionizing cartridges, which are intended to remove cations and organics from tap water, usually are designed to operate at low water pressures. High water pressures may cause the cartridge to explode. Teachers should read the manufacturer's instructions carefully to determine the recommended flow rate.

Electrical Equipment/Electricity

Electricity is a potential hazard in the laboratory because of the possibility of shock or fire.

Low voltage direct current (0-12 volt) sources are most frequently used in the science laboratory. Although this voltage range is the least hazardous, it must be pointed out that there is an inherent hazard associated with any electrical device. Most science laboratories are equipped with electrical outlets of 120 and 240 Volts AC Extreme care should be used around any electrical outlet. Students must have dry hands and skin as well as a dry area on which to stand.

Common sense in using any electrical equipment in the science laboratory is essential. Some of the basic conditions for safe use of electricity are listed below:

- A master cut-off switch for the electrical supply or the posted location of the nearest master cut-off switch.
- Insulated material on the floor when using equipment that generates electricity.
- Three-prong service outlets with proper grounding for the electrical equipment.
- All circuits in the proximity of water splash areas equipped with a ground fault interrupt (GFI) device.
- Two-prong electrical equipment may be used if UL approved.
- Caution students about the dangers of grasping electrical wires improperly. Students should be cautioned that electrical shock remains a possibility even when voltage is low, particularly if the skin is broken or the connecting wire creates a puncture wound.
- Check insulation of all equipment, wires, plugs and outlets before any connection is made, to prevent any shock or fire.
- Do not use switches or equipment that may produce sparks near any volatile, flammable substances.
- Properly discharge a capacitor or Leyden jar before handling.
- Be aware that experiments with resistive heating may produce high temperatures.

Electrophoresis

- Electrophoresis experiments are potentially very hazardous because of the presence of ionic solutions in proximity to high voltage and currents.
- Never disconnect the leads from the electrophoresis box with the power supply turned on.

Glassware

Glassware should never be used for any purpose other than that for which it is specifically designed. Due to the varying qualities of laboratory glassware, care should be taken in selecting glassware appropriate for laboratory activities.

- Borosilicate glassware (Pyrex or Kimax) should be used for all laboratory experiments unless otherwise indicated.
- All glassware should be inspected for nicks, cracks and jagged edges. Broken glassware should be disposed of carefully in a specially marked container. Small pieces and shards of glass should be swept up or picked up with dampened paper towels, never fingers.
- When heated over a flame, glass apparatus should be placed on wire gauze.
- A Pyrex or Kimax glass test tube can be heated directly as long as it is heated at approximately a 45-degree angle with its mouth pointed away from people.
- Never heat a closed system such as a stoppered flask or stoppered test tube.
- Students should be reminded that glass retains heat. Any glass that has been heated should never be placed in direct contact with a tabletop, but rather on a ceramic wire gauze screen. Extra care should be taken when fire polishing and bending glass tubing.
- Students must never eat or drink from laboratory glassware.
- Graduated cylinders should have plastic bumpers near the top lip. The bumpers are not to be used as quantity indicators but are to prevent breakage if the cylinder is accidentally knocked over.
- Frozen glass-to-glass surfaces and glass tubing adhered to rubber present a particular hazard unless extreme care and patience are exercised.

Glass Tubing/Rods

Whenever glass tubing must be prepared by the student for use in the laboratory, the following safety procedures should be observed to reduce the risk of laboratory accidents.

Cutting soft glass tubing

- Place the length of soft glass tubing flat on the laboratory table. Make a deep scratch across the tubing, using the cutting edge of a sharp triangular file.
- Wrap the scratched glass with either a cloth or damp paper towel as well as wearing an apron, gloves and goggles or a face shield. Align both thumbs directly over the scratch and "snap" the tubing by pushing thumbs outward. Glass must be pointed away from any other persons as it is broken.
- Do not use force if the glass does not break easily. Deepen the scratch with another stroke of the file and the glass should break easily.

Fire polishing the cut ends of the tubing

- Light the burner and adjust the air supply so that two blue cones are visible in the flame. This is considered to be a hot flame.
- Holding the glass tubing horizontally, place the cut end at the tip of the inner blue cone and rotate constantly. An orange colored flame indicates that the glass is melting.
- Constant rotation will assure that the melted glass evenly coats the edge being fire polished.
- Cool 5-10 minutes on a ceramic mat before polishing the other end of the tubing.

Inserting glass tubing/thermometers into holed stoppers

- Use a slit stopper or thermometer clips.
- Never attempt to force tubing through a hole that is too small for the tubing.
- Glass tubing or thermometers must be inserted into stoppers and hoses by using a drop of glycerin or water on both the tubing and stopper.
- Wrap the tubing and the stopper in layers of cloth or paper towel to protect the hands if the glass shatters in spite of precautions.
- Slowly and gently work the tube into the stopper with a twisting motion. Do not hurry.

Removing glass tubing/thermometers from holed stoppers

- Remove stopper as soon as possible to avoid "freezing" the tubing in the stopper.
- If freezing occurs, soak tubing and stopper overnight in soapy water before attempting to remove tubing.
- If a tube or thermometer cannot be removed, it may be necessary to cut the stopper.

Heating Equipment

Whenever a heating agent is used in the laboratory, students and teachers should be properly attired for safety.

- The location of fire safety equipment and techniques for their use must be clearly communicated.
- Laboratories should be properly vented.
- Volatile or pulverized materials are easily ignited by open flames and intense heat can burn hair, clothing or skin.
- When flammable liquids such as alcohol are being used, all flames in the laboratory should be extinguished.
- An operating heating agent should NEVER be left unattended.

Alcohol Burners

- Ethyl alcohol with a pinch of sodium chloride (to make the flame more visible) is the fuel of choice because of its high flashpoint. Do not use methyl alcohol, duplicating fluid, or any flammable liquid other than ethyl alcohol.
- The lamps should be filled from a small squeeze bottle rather than from a large open container of fuel and should never be filled in the same room in which any flame is present.
- They should be placed on a non-flammable surface or in a pan of sand. Once lit, the lamps must never be carried from place to place.
- The teacher should inspect the wicks periodically to make sure that they are kept trimmed and short.
- Students should be cautioned to make sure that no fuel is present on the outside of the lamp and that the top is screwed on tightly before ignition.
- Extinguish the burner by placing a glass or metal cap over the flame at an angle from the side. Caps should remain in place when the burner is not in use.
- Emptying the burners of fuel before storing is recommended.

Candles

- Candles should be placed on a stable, non-flammable surface, such as a metal jar lid, a small metal tray or in a pan of sand.
- Students should be cautioned to avoid contact with hot wax.

Canned Heat

- Not recommended as a heat source for use by students.
- Canned heat sources (such as Sterno) may be used by the teacher to demonstrate heat energy from a fuel. Make sure arrangement is stable and extinguish it when not in use.

Gas Burners

- It is important that students understand how to operate gas burners before using them. The location and function of the gas supply inlet, air adjustment vent/valve, and gas adjustment valve should be clearly communicated.
- Rubber tubing should be inspected periodically for cracks and hardening.
- Portable propane burners are less stable than Bunsen burners and produce a much hotter flame. The heat is sufficient to melt porcelain crucibles. Their use by students is discouraged.

Hot Plates

- Only hot plates designed for laboratory applications should be purchased for student use. The heating element should be fully enclosed. There should be an indicator light showing when the hot plate is on and the power cord should be grounded.
- Hot plates should be plugged into GFI protected circuit. Be careful to keep the cord away from water sources or the hot surface.
- When using the hot plate check for properly working thermostats to prevent dangerous overheating. Use only heat-resistant gloves and/or tongs when placing or removing samples from heating apparatus.
- When laboratory exercise is completed, allow sufficient time for the device to cool; warn students to be wary of the residual heat. When the hot plate is cool, clean the surface with steel wool or a damp cloth, making sure the power source is disconnected from the wall outlet.

Steam Generating Equipment

There are some particular hazards that are associated with steam heating apparatus not encountered with open flames. The extreme pressures and temperatures are hazardous if not properly controlled.

- Steam generators must be inspected periodically to ensure that openings and vents are clear. If the container openings are blocked, the container may explode.
- Pressure cookers, steam generators, distillers, autoclaves, sterilizes and other such devices usually have accompanying instruction manuals. Anyone using such equipment should be familiar with its operation and the specific precautions listed by the manufacturer.

- Pressure relief valves should be tested before each use to ensure smooth operation. Final pressure should never exceed 184kPa (20 psi). The pressure in an autoclave must be allowed to gradually return to normal atmospheric pressure on its own.
- Even when pressure gauges read zero, the pressure relief valve should be opened prior to opening the door or lid. Caution should be exercised when opening to avoid escaping steam.

Immersion Heaters

- Immersion heaters other than aquarium heaters are not permitted in the lab.

Incubators

- Care must be taken to avoid breaking the thermometer when placing containers in the incubator.
- The incubator must have a UL approved, grounded plug. GFI protected service should be used.
- Students should be cautioned never to touch the heating element.

Insect Killing Jars

- Any wide-mouthed jar which can be tightly closed is acceptable. The anesthetic should be ethyl alcohol or triethylamine (Fly Nap, Lull-A-Fly) and should be placed on a tissue or paper towel at the bottom of the jar. The saturated medium should then be covered with a clean tissue to keep the insect dry.
- Insect killing jars should be labeled with the name of the chemical used and with the words *Danger: Poisonous Fumes*. The teacher should store them in the same manner as any hazardous chemical container.

Light Sources / Lenses / Mirrors

- Lenses and mirrors must be inspected for ships and cracks.
- Lasers used in the classroom must be of low power (Class II or IIIa). Prolonged exposure to reflections from door knobs, glass plates, diamonds or other polished surfaces can cause retinal damage.
- When UV light is used, appropriate UV protective safety goggles must be worn if there is any possibility of direct exposure to the ultraviolet rays.
- Strobe lights can trigger seizures in susceptible people. Caution students not to look directly at the strobe.

Microscopes and Telescopes

- A microscope's mirror should never be aimed directly at the sun. If an electric illuminator is used, it should be grounded or UL approved and plugged into a GFI protected circuit.
- Telescopes without proper filters should not be used to examine bright objects such as the sun.
- Lenses may be disinfected with an alcohol-based lens cleaner.

Plastics

Plastic containers should never be used for any purpose other than that for which they are specifically designed. The integrity of plasticware cannot be maintained in temperature extremes.

Refrigerators

- Foods for human consumption should never be kept in laboratory refrigerators.
- Flammable solvents should not be kept in a refrigerator unless it is specifically designed to be "explosion-proof.".

Thermometers

- Mercury thermometers are not permitted.
- Anti-roll devices should be placed on thermometers so that they do not roll off a counter.
- Use a rubber safety grip when inserting a thermometer into a stopper and lubricate the end of the thermometer before insertion. The teacher, not the student, should remove a thermometer stuck in a stopper. This can be done by slitting the stopper or inserting a cork borer.

The essence of science is validation by observation.

F. J. Rutherford

Safety Equipment

Laboratory Dress

To promote safety in the school laboratory setting, students, teachers, and visitors should dress in a manner that will reduce the likelihood of an accident and also serve as a protective barrier in the event of an accident.

Closed-toe shoes

Closed-toe shoes must be worn. This provides a protective barrier against broken glassware and chemical spills.

Clothing

Loose fitting clothing with bulky sleeves should be avoided. Cotton shirts and blouses are preferable to synthetic materials that tend to be more reactive to certain chemicals and will burn rapidly and melt if caught on fire.

Contact lenses

Students should be made aware of the possible hazards associated with wearing contact lenses. Soft contact lenses have a potential of reacting with vapors produced during a lab. Both soft and hard contacts have a tendency to absorb and concentrate liquids and vapors behind the lens. Contacts also impair the cleansing of the eyes in case of a chemical splash.

Long hair

Long hair should be tied back and dangling jewelry should be restrained or removed.

Personal Protection Equipment

It is the responsibility of the school to provide special protective attire and to require its use during classroom laboratory activities involving chemicals, heating agents or potentially flying agents.

Aprons

Chemical resistant laboratory aprons should be provided to protect clothing and underlying skin from chemicals spills and splattering.

Gloves

Hands should be protected by using proper chemical resistant gloves or heat resistant gloves when necessary.

Face shields

Eye protection must be worn during certain laboratory activities and teacher demonstrations. Face shields are designed to protect the eyes, face, neck and ears from splashes, flying objects and material fragments. Face shields *do not* provide protection against hazardous mists and vapors.

Goggles

Goggles with cupped side vents are designed to protect the eyes from chemical mists, splashes and splattering, flying objects and material fragments. Goggles must be sanitized and cleaned before each use. Goggles may be sanitized by placing them in an UV sanitizing cabinet or by dunking them into a bucket of Lysol solution (20 mL of Lysol per liter of deionized water) and allowing them to air dry.

Science Laboratory and Demonstration Room Safety Equipment

It is the responsibility of the school to equip all science classrooms with proper safety equipment. Students should know where they are located and how to use them. Good laboratory practice requires regular inspection of the equipment by the teacher to insure the equipment is in good working order.

Rooms used for laboratory investigations should be equipped with the following items. (A safety equipment check list is provided in the appendix).

- ABC type fire extinguisher.*
- bucket of dry silica sand for dry chemical fires.
- chemical spill control kit
- containers for broken glassware and chemical waste, clearly labeled
- deluge shower*
- emergency exhaust fan separate from the regular air system*
- emergency lighting
- eye wash station*
- fire blanket*
- first aid kit - use as a source of bandages, remove medications.
- ground fault interrupter circuit (GFI) for electrical outlets in proximity of water splash areas.*
- master electrical cut-off switch, readily accessible and clearly labeled.*
- master gas cut-off switch, readily accessible and clearly labeled.*
- signs clearly marking all safety equipment, hazardous areas and fire exits.*

The following equipment should be available to the teacher at least as a department set:

- broom and dust pan
- sanitizing cabinet for goggles
- fume hood with a spark proof motor
- demonstration safety shield

* These items are based on State Board Regulations

What you do speaks so loudly, they can't hear what you say.

Ralph Waldo Emerson

Field Studies/Trips

Careful planning is required before a field trip in order to maximize the use of time and to assure the safety of the students. The school district has policies governing means of transportation, parental permission forms, licensing of drivers, chaperones, collection of student money and accident reporting procedures. These procedures and forms are available at each school and must be followed.

Field trips may involve taking students to natural areas. The following actions are suggested:

- Notify the school administration of the nature of the trip in advance.
- Submit the appropriate field trip approval form, student/parent agreement, and/or bus requisition.
- If at all possible, the teacher should visit the area prior to taking the entire class. Obvious hazards should be noted, such as poisonous plants, dangerous reptiles and other invertebrates, unsafe water, strong currents, electrical hazards and unsafe areas for walking.
- The teacher should inform the students of any special hazards present at the field trip sit and establish required rules for safe conduct.
- Students should be advised of the appropriate clothing to be worn.
- The limits of the study area must be clearly defined by the teacher. Students should be informed of a prearranged signal, such as a blast on a whistle, that will indicate that they are to return to a certain location.
- The buddy system should be used to help the teacher keep track of all students. The students must not be allowed to wander off alone.
- The trip leader must follow school policy regarding first aid. The teacher must check the parental permission forms to assure that any unusual health problems, such as allergies, have been noted and that any required emergency procedures have been anticipated. Students should be instructed to report any injury, no matter how slight, to the teacher at once.
- A first aid kit is a necessity when visiting a natural area. The kit should be checked and restocked prior to the trip.
- Cloth, plastic bags or plastic jars should be used for collecting plant and animal specimens. Breakable containers should not be used because of hazards associated with breakage.
- Students should be taught to recognize and avoid poisonous plants and animals in the field trip area. They should not touch any specimen that they cannot positively identify as being safe.
- Students with cuts, scratches or open sores should be cautioned about increased risk of infection from water or soil.
- Most accidents occur as the result of student horseplay and/or carelessness, rather than of willful disregard for safety procedures. By being observant, attentive, and alert to what the students are doing, and by dealing with misbehavior as soon as it occurs, the teacher will minimize many of the risks of field study.

Live Organisms

Animals

Guidelines for Animals in the Classroom

Experiences with live animals in the classroom can provide excellent learning opportunities and encourage respect for life. Teachers should be aware of student allergies and not keep animals that cause problems for sensitive students.

The decision to keep live animals in the classroom requires compliance with Florida laws, Florida Game and Fresh Water Fish Commission rules and Brevard County School District policies. Some of the regulations from these agencies are summarized below.

- Protected animals (such as indigo snakes, gopher tortoises, alligators and American crocodiles) may **not** be kept.
- No more than two box turtles and/or one Florida pine snake may be kept.
- Venomous animals may **not** be kept.
- These animals may be kept without a permit:
  a. Reptiles (except protected species)
  b. Gerbils, rats, mice, rabbits, guinea pigs, and hamsters
  c. Amphibians
  d. Parakeets, canaries, love birds, cockatiels, finches, myna birds, doves (ringed, ruddy & diamond), button quail
- All aspects of animal care and treatment shall be supervised by a qualified adult who is knowledgeable about research methods, biology, care and husbandry of the species being studied.
- Animals must be housed in clean, ventilated, comfortable environments appropriate for the species. Animals must have adequate lighting, humidity and controlled temperature (See Housing Requirements for Common Classroom animals in Appendix XX).
- Proper care for the animals must be provided at all times, including weekends, holidays and vacation periods.
- Behavior studies should use only reward (such as providing food) and not punishment in training programs. When food is used as a reward, it should not be withheld for more than 12 hours.
- The feeding of live vertebrate animals to reptiles should not be viewed by students.
- Adequate plans should be made to control unwanted breeding of classroom animals.
- Appropriate plans should be made for future care of animals at the conclusion of the study. As a general rule, laboratory-bred animals should not be released into the wild as they may disturb the natural ecology of the environment.
- Animals should be ordered from reputable suppliers when they are to be used in class experiments to minimize the risk of parasites and diseases. Only those animals that appear to be healthy should be kept in the classroom. Should an animal show any signs of illness, it should be isolated from the other animals.

- Pregnant or nursing animals should not be handled or disturbed. Even the tamest laboratory animal may inflict a painful bite.
- The wearing of heavy gloves is recommended when handling animals that may become excited, such as untamed rodents or new additions to a cage.
- A student bitten by an animal should be attended to in accordance with school procedures and sent to the school clinic with an accident report. The animal must not be destroyed, but should be kept isolated until any required examination is performed.
- Dried wing scales and exoskeletons from insect collections, mammalian hair and dander and toxic secretions of many animals have all been implicated as allergens.
- If animals of suspect origin are handled, protective gloves must be worn.
- After handling any animal, hands should be thoroughly washed.

Animal Care Resources

The following books are recommended sources of information about the suitability, maintenance and care of various animals. Care booklets accompanying live animals ordered from major suppliers may also be good sources of information.

Barrett, Katharine. *Animals in Action*. Berkeley, California: LHS GEMS, 1991.

Frye, Fredric. *Captive Invertebrates*. Malabar, Florida: Krieger Publishing, 1991.

Kramer, David C. *Animals in the Classroom*. Menlo Park, California: Addison-Wesley, 1989.

Lockey, Richard R. and Lewis S. Maxwell. *Florida's Poisonous Plants, Snakes and Insects.* Tampa, FL: Lewis S. Maxwell, Publisher, 1986.

National Institutes of Health, *Guide for the Care and Use of Laboratory Animals*, National Institute of Health Publication 85-23, 1998. (To order: oprr@od.nih.gov)

Orlans, Barbara F. *Animal Care from Protozoa to Small Mammals*. Menlo Park, California: Addison-Wesley, 1977.

Injured Animals And The Science Teacher

Wild mammals and birds, whether healthy or injured, brought in by students should not be accepted by the teacher for classroom housing. However, students continue to bring sick or injured animals to the science teacher with the expectation of humane and knowledgeable help. Educators may encourage respect and concern for the well-being of animals by offering assistance, but must protect students from potential hazards such as disease transmission or infections from bites. The injured animal should be isolated until it can be transferred to a licensed rehabilitator.

The Florida Game and Fresh Water Fish Commission regulates licensed rehabilitators for the care and rehabilitation of injured animals and prohibits the possession of sick or injured wildlife by unlicensed persons. Contact Animal Control for assistance in locating a licensed rehabilitator. Animal Control Dispatch phone number is 633-1765.

Plants

Plants provide us with food, furnish us with oxygen, beautify our surroundings, and produce some of the most deadly substances to which humans can be exposed. Over 700 poisonous species and thousands of toxic plant principles have been identified. Since it is not possible to list each one, and since all plants have not been researched for their toxicity, the following general rules should be followed:

- Never eat unknown berries, seeds, fruits, or any other plant part.
- Never rub any sap or plant juice into the skin, eyes, or open wound.
- Never inhale or expose the skin or eyes to the smoke of any burning plant or plant parts.
- Never eat food after handling plants without first washing the hands.

Any part or an unknown plant may be toxic. Conversely, simply because a plant is known does not mean that it is safe. Many of Florida's commonly grown ornamental plants are highly dangerous when ingested. Seeds of common garden fruits and vegetables purchased for planting are generally not fit for human consumption. Often they have been treated with hormones, fungicides, and insecticides, and their ingestion may produce allergic reactions, digestive upset, or death.

The list of dangerous plants that follows is far from complete. All of the plants named below are found growing in Florida, and all are toxic to some degree. Teachers should familiarize themselves with the many pamphlets published by the Florida Division of Forestry, the University of Florida, and county agricultural services for more extensive surveys. Be aware that some plants that are recommended for butterfly gardens, such as lantana, are toxic. Take all precautions to protect students from harm.

- **Allamanda**: Ingestion of any part may be hazardous. The sap may cause a rash.
- **Azalea**: Ingestion of any part may produce digestive upset, difficulty in breathing and eventual coma.
- **Balsam Pear**: Ingestion of seeds causes vomiting and diarrhea.
- **Brazilian Pepper**: Allergic reactions may occur after contact with any part of the plant.
- **Castor Bean**: One or two seeds may approach the lethal dose for an adult.
- **Cherry Trees**: Ingestion of bark, or chewing on twigs or leaves, may result in difficulty in breathing, coma and death.
- **China berry**: All parts of the plant are toxic and can cause paralysis.
- **Dieffenbachia**: (Also called Dumb Cane) Is an intense irritant of the mouth. Ingestion of any part of the plant may be fatal.
- **Elderberry**: Ingestion of the shoots, leaves, or bark may lead to nausea and digestive upset.
- **Holly**: Ingestion of the berries may lead to nausea, vomiting, diarrhea and stupor.
- **Iris**: Ingestion of the underground stem causes severe, but rarely fatal digestive upset.
- **Jimson Weed**: (Also called Thornapple) All parts are toxic, and ingestion of any part can be fatal.
- **Lantana**: Ingestion of the berries can be fatal.
- **Melaleuca**: Allergic reactions may occur after contact with any part of the plant.
- **Milkweed**: Contact with the sap may cause skin irritation. Ingestion of any plant part can be fatal.

- **Mistletoe**: Ingestion of the berries can be fatal.
- **Mushrooms**: All mushrooms should be considered poisonous in the absence of a positive identification. the differences between edible and poisonous mushrooms should only be learned directly from an expert. Although mushrooms are not plants, they are included here because of their potential toxicity.
- **Nightshade**: Ingestion of the leaves or berries can lead to severe digestive upset, nervous system failure and death.
- **Oak**: Ingestion of leaves or acorns can have an effect on kidney function.
- **Oleander**: Ingestion of leaves and branches may lead to severe digestive upset, circulatory collapse and death. Avoid smoke from burning plants.
- **Poinsettia**: the sap may cause skin irritation. Ingestion of leaves may cause serious digestive upset.
- **Poison Berry**: The green fruit and leaves are toxic causing headache, vomiting, diarrhea, stomach pains, and convulsions.
- **Poison Ivy**: Poison ivy (poison oak, poison vine, three-leafed vine) and poison sumac all contain toxic chemicals. Severe allergic reactions may occur after contact with any part of the plant.
- **Pokeberry, Pokeweed**: Most parts are toxic and cause severe nausea, vomiting, convulsions.
- **Rhubarb**: Ingestion of the leaf blades may lead to convulsions and death.
- **Rosary Pea**: Ingestion of a single seed has caused death.
- **Spanish Moss**: While the plant itself poses no threat, it may harbor ticks and mites.
- **Stinging Nettle**: Not a true nettle but in the poinsettia family. Contact with any part of the plant may produce a severe rash with blistering.
- **Trumpet Vine**: The sap is toxic and possibly fatal if ingested.
- **Water Hemlock**: Ingestion of any part of the plant may be fatal.

Students with known allergies to pollen or spores should not be required to participate in plant-related activities. The teacher should always be alert for any signs of serious illness: constriction of the pupils, increase in nasal and salivary secretions, sweating, gastrointestinal distress, tightness in the chest with difficulty in breathing, muscle tremors, itching and swelling of the skin, redness of the eyes and bluish discoloration of the lips and nails. In the case of contact, the area should be washed, and if skin or eye irritation persists, a physician should be contacted.

Sources Of Information About Dangerous Plants:

Brevard County Cooperative Extension Service. *Poisonous Plants*. Cocoa, FL..

Lockey, Richard F. and Lewis S. Maxwell. *Florida's Poisonous Plants, Snakes, Insects.* Tampa, FL: Lewis S. Maxwell, Publisher, 1986

Poisonous Plants Wall Chart., Fairchild Tropical Garden Bookshop, 10901 Old Cutler Rd., Miami, FL 33156.

Tampa Bay Poison Control Center, Tampa General Hospital, Davis Island, P.O. Box 1289, Tampa, FL, 33601. Two posters are available:

Poisonous Plants (Florida) Skin Irritants and

Poisonous Plants (Florida) Internal.

Microbes

Virulent pathogens should never be used for class study, and special care must be taken to avoid accidental contamination of student and stock cultures.

- Treat all microorganisms as if they were pathogenic.
- Maintain aseptic conditions when using microbiological media.
- Plastic petri dishes should be used to facilitate disposal.
- Culture dishes, once inoculated, should be sealed with tape and not reopened. Transfers must be made by experienced students under the supervision of a knowledgeable teacher.
- All cultures and their containers must be autoclaved before disposal. Plastic dishes should be wrapped in aluminum foil, or an autoclaavable bag, autoclaved before disposal. Plastic dishes should be wrapped in aluminum foil, autoclaved for twenty minutes at 184 kPa (20 psi) and discarded without opening the foil. Alternatively, they may be soaked in concentrated disinfectant and then discarded. Plates may be dried completely and disposed of in trash container.
- Laboratory surfaces should be cleaned with a disinfectant before and after any microbial procedure.
- Students and teachers should wear a laboratory apron, coat or other appropriate protective attire to prevent contaminating clothing.
- There should be no eating or drinking in the microbiology laboratory. Food or drink should never be stored in refrigerators containing laboratory materials.
- If bacterial cultures are accidentally spilled, the area should be disinfected with an appropriate germicide (e.g., one percent bleach).
- Wire inoculating loops and needles must be flamed both before and after use.
- Solutions should never be pipetted by mouth. A rubber pipette bulb or similar device should be used.
- Microorganisms are ubiquitous and are easily obtained from the environment. These may be dangerous and dishes should be sealed with tape so that students do not touch the colonies.
- The teacher should caution students to keep their hands away from the mouth, nose and eyes when doing microbiological work. Washing the hands thoroughly at the end of every laboratory period is important.
- Inhalation of infectious aerosols is by far the most frequent mode of laboratory infection. Any actions that might result in the generation of an aerosol must be avoided. (e.g., shaking an inoculating loop or agitating media).

The following cultures are approved for student use with appropriate adult supervision. (Additonal microorganisms maybe appropriate for advanced students):

- *Micrococcus luteus* (gram - coccus)
- *Staphylococcus epidermidis* (gram - coccus)
- *Bacillus cereus* (gram - rod)
- *Escherichia coli* (non-enteropathogenic) (gram - rod)
- *Spirillum serpens* (gram - spirillum)

Human Studies

Experiments on the human organism can be among the most motivating and satisfying of laboratory activities for students. They can also be the most dangerous. It is impossible to be too cautious when planning activities that directly affect the health of the students.

Cheek cells
Removing cheek epithelial cells for microscopic examination is a standard laboratory exercise with little inherent danger. The teacher must nevertheless caution students not to gouge deeply, but to scrape gently with the blunt end of a toothpick or wooden split. Sharp instruments, such as dissecting needles, should never be used. The toothpick or splint should be broken in half to identify it as used and then discarded immediately in an appropriate container.

Exercise
Experiments involving changes in respiratory rate, blood pressure and pulse rate (e.g. running in place, climbing stairs, stepping up on chairs, or other strenuous activities) should be monitored closely by the teacher. No student should be forced to take part in such activities during science class.

Genetics
In any work involving human genetics, the student's right to privacy must be respected. It is advisable for teachers to have an alternative activity available for students who may be reluctant to divulge family history.

Ingestion of Dyes
Activities that involve the ingestion of dyes intended to appear later in the student's saliva or in the urine are <u>not acceptable</u>.

Spirometers
Disposable spirometer mouthpieces should be used and replaced prior to each use. Students should be cautioned to exhale only (NEVER INHALE) when using a spirometer.

Tissues and Fluids
Laboratory activities involving human blood, fluids. or tissues (except for cheek cells) are <u>not acceptable.</u>

The task of
a teacher is
to help students
become their own teachers

Edgar Dale

Dissections

Philosophy

These studies are intended to foster an appreciation for the animal's intrinsic value, its place in the ecosystem and its intricate complexity of form and function. The use of animals in the classroom is sanctioned if the following four criteria have been addressed by the teacher. These criteria can be remembered as the Four R's.

Respect

Teachers should model respect for animals. Discussions on the rationale for animal use and sources of dissection specimens help the student make an informed decision about participation in activities. Taking time to address the proper treatment and careful handling of both live and preserved animals demonstrates respect for the animal.

Teachers must also respect the diversity of opinion and feelings about the use of animals. Students who object to the dissection of animals should be treated with dignity and given meaningful alternative assignments to accomplish the objectives of the lesson.

Refine

Refine teaching strategies to ensure that the instruction has a relevant, clearly defined intended outcome.

Reduce

The number of animals (living or preserved) should be reduced to eliminate unnecessary waste. One significant way to reduce waste is to eliminate the duplication of dissections at different grade levels. A list of recommended specimens for each level has been developed. See pages XX. In addition, students may be able to work in groups or examine fewer species.

Replace

Reexamination of traditional dissections in light of currently available strategies may result in a decision to substitute a more relevant and effective activity. Professional journals are also good source of specific and creative laboratory activities.

Safety Guidelines for Dissection

- All laboratory activities include hazards that teachers and students must recognize and avoid.
- During dissection activities rinse dissection equipment in a disinfectant at least once a day.
- Gloves, goggles and aprons should be worn at all times.
- Special care should be taken to prevent bacterial contamination from unpreserved specimens. Unpreserved specimens should be refrigerated and used within 24 hours. All equipment and lab surfaces must be disinfected, and students should be cautioned against touching their faces with contaminated gloves.
- Rules for lab procedures and behavior should be posted, and specific precautions should be brought to each student's attention.

- Order preserved specimens from a biological supply house. Specify a delivery date close to the planned date of use in order to reduce exposure. Use only specimens in good condition. Roadkills or fresh specimens of questionable origin are inappropriate.
- Do not use specimens packed in formalin. Soak specimens in water for 24 hours prior to use.
- Rinse specimens before distributing them to the students.
- Dissections should be done in well-ventilated rooms.
- As internal organs are exposed, they should also be rinsed.
- Remains of specimens should be wrapped in paper or placed in plastic bags, then discarded in garbage containers.
- When the dissection is to be carried out over a period of weeks or months, the specimen must be carefully packed away in preservative after each laboratory period. Small specimens should be placed in individual plastic bags and refrigerated overnight if they are to be used a second day.
- When using scissors, cut away from the body whenever possible. Scalpels should be used for incision only; scissors are the tool of choice.
- The most dangerous dissecting tools are those which are dull and therefore require the most force. Only sharp cutting tools should be used.
- If razor blades are used, only the single-edged type with a rigid, reinforced back should be used.
- The hands should be washed thoroughly with soap and water, especially under the fingernails, at the end of the laboratory period.

…Let the student be asked for an account not merely of the words of his lesson, but of its sense and substance…

Montaigne

Other Science Activities

Dry Ice And Liquid Nitrogen

The sublimation point of dry ice (solid carbon dioxide) is -78.5˚ C (-178˚ F) and the boiling point of liquid nitrogen is -195.5˚ C (-384˚ F). Proper insulating gloves, eye protection, and protective clothing MUST be worn when handling these substances. NEVER handle extremely low-temperature substances with bare hands. Always store (only temporary storage is possible in school laboratories) dry ice and liquid nitrogen in well-insulated, vented containers such as Dewar Flasks. NEVER place dry ice or liquid nitrogen in a sealed container since the resulting increase in gas pressure may cause an explosion. Always transport dry ice and liquid nitrogen in well vented vehicles. There is a potential danger of asphyxiation due to the displacement of oxygen by nitrogen and carbon dioxide in an enclosed area.

Radioactive Materials

The State of Florida Department of Health and Rehabilitative Services has approved the possession of small quantities of low yield radioisotopes for educational purposes.

Radioactive sources used in Brevard classrooms must be limited to alpha and beta emitters that contain 1 microcurie of activity or less. Radioactive sources must be encapsulated in labeled discs which are sealed and packaged in their own individual plastic containers. Radioactive sources must be secured in the chemical storage room when not in use.

Information concerning radiation safety, accidents, and disposal of radioactive materials is available from:

Florida Department of Health and Rehabilitative Services
Office of Radiation Control
1323 Winewood Boulevard
Tallahassee, Florida 32301
Phone: (904) 487-1004

Rocketry

The use of model rockets requires a consideration of safety in several areas: construction, engines, flying conditions, launch, and recovery. Construction of the rocket should be of lightweight, non-metal materials. Follow all instructions exactly and secure all joints carefully with glue.

The rocket should be tested for stability before flight; the swing test may be used. To conduct a swing test, place a new engine in the rocket and tie a string around the middle of the rocket so that it is balanced. Swing the rocket in circles overhead. If the rocket goes around nose first, it is ready to fly. If it does not, then it is not stable and is not safe to fly.

Use pre-loaded factory made model rocket engines as recommended by the manufacturer. Never use damaged or modified engines. To dispose of an unused engine, soak it in water until the engine disintegrates. For the first flight, use the smallest engine recommended by the manufacturer. Use only engines that will allow the rocket to land within the recovery area.

Flying conditions must be considered so as to avoid a launch that could be dangerous to people or property. Do not launch in high winds, near buildings, power lines, tall trees or low flying aircraft.

The launch area should be cleared and free of flammable materials. The launch pad should have a launch rod at least 3 feet long and a blast deflector to prevent the engine exhaust from starting a fire. There should be an electrical launching system with a cord that will reach at least 15 feet so that no one will be within 15 feet of the launch pad when the rocket is ignited. Have students wear safety goggles during launch.

Designate a recovery crew to retrieve the rockets. The recovery crew should be equipped with heat-resistant gloves. The crew should also be familiar with all of the safety rules and know the proper way to handle a rocket when returning it to the launch area.

The use of air or water rockets also requires care to assure that people and property are protected from dangers inherent to projectiles.

Rocks and Minerals

There are several safety guidelines that are related to geology and the earth sciences.

Carbonate Tests
Use a maximum 2% hydrochloric acid solution.

Cleavage tests
Eye protection should be used when performing cleavage or fracture tests on rock or mineral samples. Small fragments can be injurious to the unprotected eye.

Crystal-Growing Kits
Be sure that all chemicals in the kits are on the District Approved Chemicals List. Most crystal growing kits contain highly toxic and corrosive chemicals. Water-based crystal growing kits—using salts or sugar—are recommended for elementary school students.

Fossil Molds
Use caution with Plaster of Paris when making casts and molds. Students should avoid inhaling the powder.

Hardness tests/Scratch tests
Be sure that the glass slides are on a hard flat surface, and that only minimal pressure is applied when conducting the tests. Have students exercise caution when using nails to conduct scratch tests.

Peels of Plant Fossils
Use caution with acetone.

Rock and mineral sample kits
Many older kits contain samples that have asbestos. Those rocks and minerals should be removed from kits. Talc and soapstone are hazardous in powdered form, but are permitted in kits if they are in solid, non-powdered form. Serpentine and hematite samples should not be present in the classroom.

Streak tests

Avoid testing talc and soapstone. Hazardous powder is produced when testing these minerals.

Solar Studies

- Students should never look directly at the sun during a solar eclipse or when doing astronomical or spectrographic studies.
- When making observations through a spectroscope, telescopes or pin hole camera, students should use indirect or projection methods

Teachers of the past were skilled in handling words. The teachers of the future must be skilled in handling experiences.

Edgar Dale

Chemical Storage and Handling

Chemical Labels

The label on a stock chemical is one of the most valuable sources of information. Typically, a stock chemical label will supply the following information

- Name of the chemical
- Chemical formula
- Degree of hazard
- Health and physical hazards
- Precautionary measure to prevent misuse
- First aid information
- Many of the chemical companies are also including the NFPA hazard symbol and suggested storage on the label.

The degree of hazard is indicated by the use of appropriate signal words, which call attention to the severity of the potential hazard of the chemical. The major signal words are:

Danger - high degree of hazard
Warning - intermediate degree of hazard
Caution - lowest degree of hazard

Exposure to chemical substances can be hazardous to health. The Occupational Safety and Health Administration (OSHA) has defined seven classes of health hazards:

Carcinogens (Car)
Substances that are suspected or proven to produce cancer in humans or laboratory animals.

Corrosives (Cor)
Substances that cause irreversible damage to skin or eyes at the site of contact.

Highly or Acutely Toxic (ATX)
Substances that cause death or severe injury when absorbed through the skin, inhaled or ingested in very small doses. The lethal dose of highly or acutely toxic substances is less than 50 milligrams per kilogram of body weight.

Irritants (Ir)
Substances that are not corrosive in nature, but cause a visible inflammation to human tissue at the site of contact. Irritants normally affect the skin, eyes, nose, mouth and respiratory system.

Sensitizers (Sn)
Substances that cause allergic reactions upon repeated exposure.

Target Organ Effecters (TOE)
Substances that when absorbed into the body cause damage to selected body organs (e.g. brain, heart, kidney, liver)

Toxic (Tx)
Substances that cause death or severe injury if absorbed through the skin, inhaled or ingested in concentrations between 50 and 5000 milligrams per kilogram of body weight.

In addition to health hazards, many chemicals are physically hazardous. The physical hazards are:

Corrosives (Cor)
Materials such as acids, bases and oxidizers that vigorously attack metals or other materials on contact.

Explosives (Ex)
Materials that detonate or explode when subjected to heat, sudden shock or friction.

Flammables (Fla)
Materials that will readily burn if subjected to heat, sparks, flame or other sources of ignition.

Reactives (Rea)
Materials that produce a chemical reaction or react violently when exposed to air, water or other materials. Chemical reactions are capable of producing heat, fire or explosion.

NFPA Labels

The National Fire Protection Association (NFPA) has established a labeling system that provides a quick and simple method of identifying the type and relative degree of chemical hazard. This system allows individual who are not familiar with the hazardous nature of chemicals a ready method of identification. An example of the NFPA label is located in the appendix on page A-10.

The NFPA label includes a diamond-shaped symbol and ***must*** *be placed on every stock bottle* once it is received by the Science Department.

The label is divided into four color-coded areas (Health, Fire, Reactivity, and Special) that represent major areas of hazard. The degree of hazard in each area is represented by numbers (0 - none, 1 - minor, 2 - moderate, 3 - severe, 4 - extreme). The Special Hazards area is reserved for symbols that represent special handling and storage precautions that need to be observed.

We are often searching for better answers when we should be developing better questions.

Edgar Dale

Material Safety Data Sheet

The Material Safety Data Sheet (MSDS) is designed to provide the teacher with guidelines concerning the proper handling and safe use of substances. The format and information provided by a MSDS may vary depending on the source but usually includes the following data

- melting point
- boiling point
- density
- specific gravity
- flash point
- viscosity
- vapor pressure
- appearance
- odor
- toxicity
- health
- fire
- reactivity hazards
- proper storage
- spill/leak cleanup
- disposal procedures
- protective equipment

To gain an understanding of the kind of information that can be found on a MSDS and how such knowledge can be applied to the science classroom environment, an example of a MSDS for wood alcohol has been provided in the appendix on page A-9

It is important to become familiar with the chemical name and its various synonyms since different sources (vendors, chemical container labels, text and lab books, reference and safety manuals, and emergency personnel) may use different names for the same chemical. The Chemical Name and Synonym section of the MSDS example indicates methyl alcohol as having two other common synonyms: methanol and wood alcohol. The chemical may also be referred to by its formula, which can be found in the Formula section

A review of certain key sections on the MSDS will usually give a teacher a good understanding of the potential danger and risks involved with using the substance in the science classroom.

DOT Class

This is a classification of the substance by the Department of Transportation (DOT). DOT classifications may include terms such as oxidizer, poison, flammable substance, irritant, and corrosive. The example shows that methanol has been classified as a flammable liquid.

Reactivity

This section indicate that methanol is normally stable if stored and handled properly. Substances that are identified as unstable may react when exposed to normal conditions such as air, humidity, low temperatures, and slight to moderate physical shock. Unstable substances are therefore more dangerous to work with and more difficult to store.

Conditions to Avoid
This section can be very helpful to the teacher as a source for planning the safe use of the chemical substance. For example, this section advises that methanol be secured from any ignition source. Thus the teacher now knows that sources of heat and electrical sparks must be either eliminated or controlled before the use of this chemical in the classroom or laboratory.

Heath Hazard
This section warns that ingestion of methanol can cause serious injury (blindness) alerting the teacher to consider restricting the use of the substance to more mature experienced students in as small a quantity and concentration as possible. Such control will limit the student's exposure time to an absolute minimum.

This section offers critical information including how the chemical can enter your body (inhalation, swallowing, skin absorption), and what health hazards could result from the exposure. Substances which are absorbed through the skin and which may result in acute symptoms are generally more dangerous to use due to the risk of accidental exposure.

Tolerance Limit Value (TLV)
Developed by the American Conference of Governmental Industrial Hygienists, this section describes the maximum chemical concentration allowed for a person who is exposed to a particular chemical on a daily basis. No one should be exposed to a level above the TLV for any amount of time. It is important to keep in mind that TLV's were originally created as general guidelines for industrial workers and do not represent absolute limits. TLV's are updated as new data is developed. In most cases, students will not be exposed to a chemical on a daily basis. The teacher may incur more significant exposure time at higher concentrations than the students. TLV's may be expressed in different units depending on the physical form of the substance. For particular matter such as dust or fine mist, concentrations are expressed in units of milligrams per cubic meter. For gases and vapors given off by volatile substances such as methanol, concentrations are usually reported as parts per million in air.
Another useful measure of toxicity often reported on the MSDS is the research based **LD_{50}** value. LD means Lethal Dose. The subscript 50 in indicates that 50% of the test animals (usually rats) died when administered the lethal dosage. For example, the LD_{50} for potassium cyanide is 10 mg/kg of body mass. Therefore 50% of the test animals died when administered a dosage of 10 mg/kg of potassium cyanide. By contrast the LD_{50} for mercuric chloride is 1 mg/kg, indicating its toxicity to be approximately ten times greater that potassium cyanide. Methanol's LD_{50} is 3180 mg. **The lower the TLV or LD_{50} the more toxic the substance and thus the greater the potential danger in the science classroom environment**.

Fire Hazard
This section describes the flammability of the substance. For methanol the flash point is reported to be 54 degrees Fahrenheit. The flash point is the lowest temperature at which a combustible liquid will generate a flammable vapor. Since the flash point is well below average classroom temperature, the teacher knows that potentially dangerous fumes will be given off when this substance is being used. This section also recommends the type of fire extinguisher to use if the substance ignites.

Special Precautions

This section reinforces the information in the previous sections and advises steps that can be taken to ensure safer use of the substance. The example MSDS recommends that methanol be dispensed in small containers under a fume hood to control the flammable fumes and to reduce the air concentration to a level below the TLV. It also advises the use of proper gloves and goggles to protect the skin and eyes. This section is therefore useful when planning for chemical hygiene practices which may prevent accidental exposure.

First Aid

This section offers procedures that are structured to diminish the exposure time to a dangerous substance. The teacher and students should know this information before beginning the lab activity. This section in the methanol MSDS example recommends washing exposed parts of the body with copious quantities of water. If internal ingestion occurs, methanol must be washed out of the mouth and a physician needs to be consulted.

Spills, Leaks, and Disposal

In case of accidental spills or leaks, this MSDS section recommends specific procedures for the safe cleanup and disposal of the substance. To clean up methanol, for example, sand or special absorption pads are required, mandating the presence of these materials before the lab activity.

CAS No.

The teacher can find additional information on a substance by using the Chemical Abstracts Service registry number. Each substance has its own registry number that can be used to find information on that substance when accessing the Chemical Abstracts Service Database.

The MSDS provides both useful and critical information on a substance which can help to ensure a safe science classroom environment. Awareness of information on the MSDS is essential if chemicals are to be used.

Science is no more a collection of facts than a house is a collection of bricks.

Jules Henri Poincare

Chemical Storage

Chemicals should be stored according to compatibility on stable shelving with proper ventilation. Science departments can reduce potential hazards in storage by maintaining a small dynamic inventory with limited quantities. This assures fresh supplies and helps to alleviate the problem of disposing of old, out-of-date chemicals. Purchasing disposable and safe laboratory supplies should be a major consideration.

Another consideration in the storage of chemicals is whether the storeroom itself is safe. Fire protection, chemical exposure protection and security are important concerns. The storeroom must have certain safety features, including at least one Type ABC dry chemical fire extinguisher, a pail of silica sand and material to neutralize and contain liquid chemical spills (spill control kit). A smoke detector is also recommended.

Teachers should not prepare laboratory materials inside the storeroom because of the hazardous nature of chemical incompatibility. Teachers must also be aware that many chemicals have a limited shelf life. Many chemicals becomes more or less reactive over time. Teachers should refer to a suitable reference to determine the shelf life of the chemicals in their storeroom.

CHEMICALS MUST NOT BE STORED ALPHABETICALLY. The safest and most efficient storage pattern for chemicals is to separate the chemicals into their organic and inorganic families. Each family is then subdivided into compatible sub-families. The storage pattern diagram in the appendix on page XX shows the recommended shelf storage pattern for both the organic and inorganic chemical families using Fling's sub-family grouping numbers. Chemicals should be stored according to this pattern.

Storage pattern codes:

IN - inorganic chemicals on open shelves.
OR - organic chemicals on open shelves.
AC - acid cabinet
FC - flammable cabinet

Keep a current inventory of all chemicals. The inventory should include the following information:

- Chemical name
- Chemical formula
- Date purchased
- Storage pattern code (IN, OR, AC, FC)
- Quantity
- Hazard
- Disposal method
- Purchase restrictions (if any)

Other storage considerations:

The chemical storeroom must be locked at all times.

Students should not have access to the chemical storeroom.

An **NFPA label** *must* be placed on all stock chemicals. Prepared chemicals must be appropriately labeled.

All flammables (materials with an NFPA Flammability Rating 3 or 4) *must* be stored in a dedicated flammables cabinet.

All inorganic and some organic acids should be stored in a dedicated acid cabinet.

Isolate concentrated nitric acid from organic acids in an isolation cube or in a styrofoam shipping container. It may be stored on a storeroom shelf near the floor if organic acids are stored in the cabinet.

Isolate ammonium nitrate in the solid form from all other chemicals.

Chemicals must never be stored on the floor, even temporarily.

Chemicals must never be stored on the top of a storage cabinet.

Chemicals must never be stored above eye level.

Shelf assemblies must be firmly attached to the wall.

All shelving must have anti-roll-off one-half inch lips.

All shelving units should be made of chemically resistant material.

All chemicals ordered for AP/second year courses/Research are to be labeled "AP/II".

Incompatible Chemicals

A wide variety of chemicals react dangerously when mixed with certain other chemicals. The chemical storage patterns are designed to prevent such occurrences.
Some of the more widely used incompatible chemicals are listed below, but the absence of a chemical from this list should not be taken to indicate that it is safe to mix it with any other chemical.

Although many of the chemicals on this list are not on the approved chemical list, they are listed for reference purposes.

Chemical	Incompatibilities
acetic acid	chromic acid, nitric acid, hydroxyl compounds, perchloric acid, peroxides, permanganates
acetone	concentrated sulfuric and nitric acid
acetylene	chlorine, bromine, copper, fluorine, silver, mercury
alkali and alkaline earth metals (powdered calcium, magnesium, etc.)	water, chlorinated cydrocarbons, carbon dioxide, halogens, alcohols, aldehydes, ketones, acids
anhydrous ammonia	mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
ammonium nitrate	acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, finely divided organic combustible materials
aniline	nitric acid, hydrogen peroxide
arsenic compounds	reducing agents
azides	acids
bromine	ammonia acetylene, butadiene, hydrocarbons
calcium oxide	water
carbon (activated)	calcium hypochlorite, oxidizing agents

carbon tetrachloride	sodium
chlorates	ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
chromic acid and chromium	acetic acid, naphthalene, camphor, glycerin, turpentine, alcohols, flammable liquids in general
chlorine	ammonia acetylene, butadiene, hydrocarbons, hydrogen, sodium carbide, turpentine, benzene, finely divided metals
chlorine dioxide	sulfide ammonia, methane, phosphine, hydrogen
copper	acetylene, hydrogen peroxide, nitric acid
cumene hydroperoxide	acids, organic or inorganic
cyanides	acids
flammable liquids	ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
hydrocarbons (butane, benzene, etc.)	fluorine, chlorine, bromine, chromic acid, sodium peroxide
hydrocyanic acid	nitric acid, alkali
hydrofluoric acid	aqueous or anhydrous ammonia
hydrogen peroxide	copper, chromium, iron, most metals or their salts, acetone, organic materials, aniline, nitromethane, flammable alcohols, liquids, oxidizing gases
hydrogen sulfide	fuming nitric acid, oxidizing gases
hypochlorites	acids, activated carbon
iodine	acetylene, ammonia (aqueous or anhydrous), hydrogen
mercury	acetylene, fulminic acid, ammonia
nitrates	sulfuric acid
nitric acid (conc.)	acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
nitrites	acids
nitroparaffins	inorganic bases, amines
oxalic acid	silver, mercury

oxygen	oils ,greases, hydrogen, flammables
perchloric acid	acetic anhydride, bismuth and its alloys, ethanol, paper, wood
peroxides (organic)	acids, avoid friction or shock
phosphorus (white)	air, alkalies, reducing agents, oxygen
potassium	carbon tetrachloride, carbon dioxide, water
potassium chlorate	acids
potassium perchlorate	acids
potassium permanganate	glycerin, ethylene glycol, benzaldehyde, sulfuric acid
selenides	reducing agents
silver	acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
sodium	carbon tetrachloride, carbon dioxide, water
sodium nitrite	ammonium salts
sodium peroxide	ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
sulfides	acids
sulfuric acid	potassium chorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)
tellurides	reducing agents
matter	antimatter

A wise question is half of knowledge.

Lord Bacon

Chemical Disposal and Spills

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) which directed the U.S. Environmental Protection Agency (EPA) to develop and implement a program to protect human health and the environment from improper hazardous waste management practices. The program is designed to manage hazardous waste from its generation to its ultimate disposal.

Disposal Techniques

The Approved Chemical List contains the information for the appropriate disposal of each chemical. See page 60. These disposal techniques are to be used only for chemicals used or produced during laboratory experimentation. Large quantities of chemicals of old stock chemicals are to be properly labeled and stored for pickup by a licensed hazardous waste hauler.

The disposal codes:

D Indicates the material is to be diluted. The dilution must be 100 volumes of water to one volume of chemical.

P Pour the material down the drain to a public sanitary sewer system. No chemical may be discharged to a septic tank system.

T Wrap the material in paper and dispose of it in the trash can.

N Neutralize hazardous properties. (The chemical can be chemically neutralized on school site).

SW-1 Special Waste 1: These chemical wastes are to be stored in a closed metal container (approximately 1 gallon capacity) which bears the label "Hazardous Waste Liquid - Satellite Container." At the end of each school semester, or when the container becomes full, pour its contents into the "Waste Paint" storage drum that is located in the school's Flammable Storage Building. (see below)

SW-2 Special Waste 2: Silver containing wastes are to be stored in a closed plastic container (approximately 1 gallon capacity) which bears the label, "Hazardous Waste - Recoverable Silver Solution - Satellite Container." When the container becomes full, notify the Office of Plant Operations or your school administrator. (see below)

R Return to vendor.

Chemical Waste Storage

The following information applies to those chemicals with disposal codes of SW-1 and SW-2 on the Brevard Public Schools Approved Chemical List.

Flammable Waste Organic Solvents (SW-1)

- Flammable Waste Organic Solvents are to be stored in a common, closed metal container which has a capacity of one gallon or less. The container must bear the label "Flammable Hazardous Waste - Satellite Container." The lid must be kept tightly closed except when waste is being transferred to or from the container. This container must be secured in the Flammable Storage cabinet at all times when not in use.
- At the end of each semester, or when the container becomes full (whichever comes first), the contents of the Flammable Hazardous Waste Container are to be poured into the "Paint Waste" drum which is kept in the Flammable Storage Building at each school. The contents of the "Paint Waste" drum must be removed by a licensed hauler of hazardous waste. The waste hauler will transport the waste to a licensed disposal facility where it will be reclaimed as a fuel product.

Waste Silver Containing Solution (SW-2)

- Waste solutions that contain silver are to be stored in a common, closed plastic container which has a capacity of one gallon or less. The container must bear the label, "Hazardous Waste - Recoverable Silver Solution - Satellite Container." The lid must be kept tightly closed except when waste is being transferred to or from the container. This container is to be kept secured in the chemical storage room.

- When the container becomes full, notify the Office of Plant Operations or your school administrator.

All my experiences have prepared me for this day.

Winston Churchill

Approved Chemical List

The following is a list of those chemicals approved for use in the Brevard County School System. A more complete description of hazards is listed on the MSDS forms which are available at the school site. Approval of the chemicals and quantities on this list was based on safety and storage parameters. The teacher should carefully consider information summarized for each chemical in order to make the best possible decision concerning purchasing and usage of that chemical.

Internet source for MSDS information for chemicals is http://www.nwfsc.noaa.gov/msds.html.

All chemicals at the school site must be on the Approved Chemical List regardless of the manner purchased. Approved chemicals may be purchased in two ways: (1) by sending a purchase order to the Brevard County District Purchasing Department, (2) by purchasing consumer chemicals locally (such as hydrogen peroxide, baking soda, salt, etc.). All acids should be ordered in safe bottles when available. To order any chemical not on the list, send a Chemical Purchase Approval Form (see Appendix page A-8) along with a copy of the MSDS to the Secondary Science Resource Teacher at Curriculum Services. To prevent excessive build up of inventory, purchase only those quantities required for the annual laboratory curriculum. Schools should not accept chemical donations.

All chemicals listed as [AP/II] can only be ordered by teachers of AP Biology, AP Chemistry, AP Physics, 2nd-year courses, and Research.

The table of approved chemicals includes the following information:

- Chemical Name (Common Name)
- NFPA Numbers (Health, Flammability, Reactivity, Special Hazards)
- Flinn Storage Code (In, Or, AC, FC)
- Disposal Code (D, P, T, N, SW-1, SW-2)
- Health and Physical Hazards:

Atx	Acute Toxic	Rea	Reactive
Cor	Corrosive	Sn	Sensitizer
Fla	Flammable	Tx	Toxic
NW	No Water	X	Oxidizer
Ir	Irritant		

- Special Notes
  - (1) purchase only in needed amounts
  - (2) dispense in fume hood
  - (3) use only with adequate ventilation
  - (4) severe eye irritant
  - (5) toxic by skin absorption; use appropriate gloves
  - (6) students will not use concentrated solutions; teacher will make dilutions
  - (7) substance should be ordered in prepared kits only
  - (8) dispose of excess on completion of activity
  - (9) do not use for flame test
  - (10) Special Handling - handle only with proper gloves or instruments.
  - (11) do not allow this substance to be exposed to concentrated acids.
- Recommended maximum storage quantities. (Purchase quantities that will not result in excessive build up of inventory).

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Acacia (Arabic Gum)	0-0-0	Or-M	T	Ir		
Acacia Gum (Acacia)	0-0-0	Or-M	T	Ir		
Acacia Gum (Arabic Gum)	0-0-0	Or-M	T	Ir		
Acetic Acid (Glacial)	2-2-1	Or-1	N-D-P	Tx-Cor-Rea	1-3	250mL
Aceto-CarmIne	2-0-0	Or-4	D-P	Tx-Ir		
Aceto-OrceIn Solution	1-0-0	Or-1	N-D-P	Ir	3	
Acetone (Dimethyl Ketone)	1-3-0	Or-4	D-P	Tx-Fla-Ir	1-2-3	4L
AcetylcholIne Bromide Solution	1-0-1	Or-2	D-P	Rea-Ir		
AcetylcholIne Chloride	1-1-0	Or-2	D-P	Ir		
Acetylsalicylic Acid (AspirIn)	0-0-0	Or-1	D-P	Sn		
AdenosIne Triphosphate	0-0-0	Or-2	D-P			
Adipic Acid (Hexanedioic Acid)	1-1-0	Or-2	N-D-P/T	Ir	4	
AdrenalIne	0-0-0	Or -2	D-P	Tx-Ir		
AdrenalIne Chloride	0-0-0	Or -2	D-P	Ir		
Agar Agar (Culture Media)	0-0-0	Or-M	D-P/T			
Agarose	0-0-0	Or-M	D-P/T			
AlanIne	0-0-0	Or-2	D-P			
AlbumIn	0-0-0	Or-2	D-P			
Alcojet	0-0-0	In-M	D-P	Ir		
Alconox	0-0-0	In-M	D-P	Ir		
AlizarIn Red S	0-0-0	Or-2	D-P	Ir		
AlizarIn Yellow R	0-0-0	Or-2	D-P	Ir		
AlkaSeltzer	0-0-0	In-M	D-P			
Almond Oil (Benzaldehyde) [AP/II]	2-2-0	Or-3	SW-1	Tx-Ir	5	
Alpha Emitter (Sealed Source)	2-0-0	In-M	R	Tx		1 µcurie
Alum, Ammonia (AlumInum Ammonium Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Alum, Ferric (Ferric Ammonium Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Alum, Potassium (Aluminum Potassium Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Alum, Sodium (Aluminum Sodium Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Alumina (Aluminum Oxide)	1-0-0	In-4	T	Tx-Ir		
Aluminon (AurIn Tricarboxylic Acid)	1-0-0	Or-1	D-P	Tx-Ir		
Aluminum (No powder)	0-0-0	In-1	T			
Aluminum Acetate	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Ammonium Sulfate (Ammonia Alum)	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Chloride (Hydrated only)	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Hydrate (Aluminum Hydroxide)	1-0-0	In-4	N-D-P	Tx-Cor		
Aluminum Hydroxide (Aluminum Hydrate)	1-0-0	In-4	N-D-P	Tx-Cor		
Aluminum Nitrate	1-0-0X	In-3	D-P	Tx-Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Aluminum Oxide (AlumIna)	1-0-0	In-4	T	Tx-Ir		
Aluminum Oxide (Carborundum)	0-0-0	In-4	T	Ir		
Aluminum Potassium Sulfate (Potassium Alum)	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Sodium Sulfate (Sodium Alum)	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Sulfate	1-0-0	In-2	D-P	Tx-Ir		
Aluminum Sulfide	1-0-2NW	In-5	N-D-P	Tx-Ir-Sn	11	
Aminoacetic Acid (Glycine)	0-0-0	Or-2	D-P	Ir		
2-Aminobenzoic Acid	0-0-0	Or-1	T	Ir		
Aminomethane Trishydroxymethyl (TRIS) [AP/II]	0-0-0	Or-2	D-P/T	Ir-Tx		
3-Aminophthalhydrazide (Luminol)	0-0-0	Or-2	D-P	Ir		
Ammonia, Household (Solution) (Ammonium Hydroxide)	2-0-1	In-4	D-P	Tx-Cor-Rea	2-3-4-6	
Ammonium Acetate	1-0-0	In-2	D-P	Tx-Ir		
Ammonium Bicarbonate	0-0-0	In-4	D-P	Ir		
Ammonium Biphosphate	0-0-0	In-2	D-P	Ir		
Ammonium Bisulfite	1-0-0	In-2	D-P	Ir		
Ammonium Bromide	1-0-0	In-2	D-P	Tx-Ir		
Ammonium Carbonate	0-0-0	In-4	D-P	Tx-Ir		
Ammonium Chloride	1-0-0	In-2	D-P	Ir		
Ammonium Citrate	0-0-0	Or-M	D-P	Ir		
Ammonium Formate	0-0-0	Or-M	D-P	Ir		
Ammonium Hydroxide (Household Ammonia)	2-0-1	In-4	D-P	Tx-Cor-Rea	2-3-4-6	
Ammonium Iodide	1-0-0	In-2	D-P	Ir		
Ammonium Metavanadate	2-0-0	In-2	N-D-P	Ir		
Ammonium Molybdate	1-0-0	In-8	D-P	Tx-Ir		
Ammonium Nitrate	2-0-0	In-8	D-P	Ir		
Ammonium Oxalate	2-0-0	In-2	D-P	Tx-Ir		
Ammonium Peroxydisulfate						
Ammonium Persulfate (Ammonium Peroxydisulfate)	2-0-1X	In-2	D-P	Tx-Cor-Rea		
Ammonium Phosphate	0-0-0	In-2	D-P	Ir		
Ammonium Phosphate (Monobasic)	0-0-0	In-2	D-P	Ir		
Ammonium Salt (Aurin Tricarboxylic Acid)	1-0-0	Or-1	D-P	Tx-Ir		
Ammonium Sulfate	0-0-0	In-2	D-P	Ir		
Ammonium Sulfide (Ammonium Persulfate)	2-2-2NW	In-5	N-D-P	Tx-Fla-Rea-Ir-Sn	2-4-5-6-11	
Ammonium Sulfite	0-0-0	In-2	D-P	Ir		
Ammonium Tartrate	0-0-0	In-2	D-P	Ir		
Amyl Acetate (Banana Oil)	1-2-0	Or-4	SW-1	Tx-Fla-Ir		
n-Amyl Alcohol (Pentanol-1)	1-3-0	FC	SW-1	Tx-Fla-Ir	2-3	1L
Amyl Alcohol (3-Pentanol)	1-3-0	FC	SW-1	Tx-Fla-Ir	2-3	1L

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Amylase	0-0-0	Or-2	D-P			
Anesthetic MS-222 (Ethyl m-Aminobenzoate Methanesulfonate)	1-0-0	Or-M	D-P	Tx		
Aniline Blue	1-0-0	Or-2	D-P	Tx-Ir		
Antimony (No dust or powder)	0-0-0	In-1	T	Ir		
Antimony Potassium Tartrate (Tartar Emetic)	2-0-0	In-7	D-P	Tx		
Arabic Gum (Acacia)	0-0-0	Or-M	T	Ir		
Arabinose	0-0-0	Or-2	D-P			
Arginine	0-0-0	Or-2	D-P			
Argon	0-0-0	Secure				
Ascorbic Acid (Vitamin C)	0-0-0	Or-1	D-P			
Asparagine	0-0-0	Or-2	D-P			
Aspartic Acid	0-0-0	Or-2	D-P/T			
AspirIn (Acetylsalicylic Acid)	0-0-0	Or-1	D-P	Sn		
Aurin Tricarboxylic Acid	1-0-0	Or-1	D-P	Tx-Ir		
Azolitmin Solution (Litmus Solution)	0-0-0	Or-2	D-P			
Baking Powder	0-0-0	In-2	D-P			
Baking Soda (Sodium Bicarbonate)	0-0-0	In-4	D-P			
Balsam Canada	0-1-0	Or-3	T	Fla	3-4	
Banana Oil (Amyl Acetate)	1-2-0	Or-4	SW-1	Tx-Fla-Ir		
Barium Chloride (0.1 M)	4-0-0	In-2	D-P	Tx	1-5-9	
Barium Nitrate (0.1 M)	3-0-0	In-3	D-P	Tx	1-5-9	
Basic Fuchsin	0-0-0	Or-2	D-P			
Beef Extract	0-0-0	Or-M	D-P			
Beeswax	0-1-0	Or-M	T			
Benedict's Qualitative Solution	1-0-0	In-2	D-P	Tx		
Benedict's Reagent Powder	1-0-0	In-2	D-P	Tx		
Benzaldehyde (Almond Oil) [AP/II]	2-2-0	Or-3	SW-1	Tx-Ir	5	
Benzoic Acid	2-1-0	Or-1	D-P/T	Tx-Ir		
Beta Emitter (Sealed Cover)	2-0-0	In-M	R	Tx		1 µcurie
Bial Reagent	2-3-0	FC	D-P	Tx-Fla-Ir		1L
Bile Salts	1-0-0	Or-1	D-P			
Biotin (Vitamin H)	0-0-0	Or-1	D-P	Ir		
Bismuth (no powder)	0-0-0	In-1	T			
Bismuth Chloride (Bismuth Trichloride) (0.2M) [AP/II]	0-0-0	In-2	P			
Bismuth Nitrate (1.0 M)	1-0-0X	In-3	D-P	Rea-Cor	4	
Bismuth Trichloride (Bismuth Chloride) (0.2M) [AP/II]	0-0-0	In-2	P			
Biuret Reagent Solution	3-0-1	In-4	D-P	Tx-Cor	4	
Bleach (15% solution) (Sodium Hypochlorite)	2-0-2X	In-6	D-P	Tx-Cor	3-4	
Blood Typing Sera	0-0-0	Or-M	D-P			
Boiling Granules (Tamer-Tabs)	0-0-0	In-M	T			
Boiling Stones/Chips	0-0-0	In-M	T			

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Bone Black (Charcoal)	0-1-0	In-4	T			
Borax (Sodium Tetraborate)	1-0-0	In-8	D-P/T	Tx-Ir		
Boric Acid	2-0-0	AC	D-P/T	Tx-Ir		
Boron (No Powder)	0-0-0	In-1	T	Ir		
Brilliant Green Bile Broth	0-0-0	Or-M	D-P			
Brom Cresol Green (Bromocresol Green)	1-0-1	Or-1	D-P	Ir		
Brom Cresol Purple (Bromocresol Purple)	1-0-1	Or-1	D-P	Ir		
Brom Phenol Blue (Bromophenol Blue)	0-0-0	Or-1	D-P	Ir		
Brom Thymol Blue (Bromothymol Blue)	0-0-0	Or-1	D-P	Ir		
Bromine Water (5% solution)	2-0-1X	In-2	D-P	Cor-Rea-Ir-Tx	3	
Buffer Powders	0-0-0	In-M	T	Ir		
Buffer Solutions	0-0-0	In-M	D-P	Ir		
1-Butanol (Butyl Alcohol) (n-Butyl Alcohol)	1-3-0	FC	D-P	Tx-Fla	1-8	100mL
Butyl Alcohol (1-Butanol) (n-Butyl Alcohol)	1-3-0	FC	D-P	Tx-Fla	1-8	100mL
n-Butyl Alcohol (Butyl Alcohol) (1-Butanol)	1-3-0	FC	D-P	Tx-Fla	1-8	100mL
Butyric Acid	2-2-0	AC	D-P	Tx-Ir	4-5	
Calcium (No powder)	1-1-2NW	In-1	N-D-P	Rea-Ir	1-10	
Calcium Acetate	0-0-0	In-2	D-P	Ir		
Calcium Bromide	0-0-0	In-2	D-P	Ir		
Calcium Carbonate (Marble Chips- Chalk)	1-0-0	In-4	T	Sn		
Calcium Chloride	0-0-0	In-2	D-P	Ir		
Calcium Fluoride	0-0-0	In-2	D-P	Tx-Ir		
Calcium Hydroxide (Slaked Lime)	2-0-1	In-4	D-P	Cor-Tx-Ir	4	
Calcium Hypochlorite (15% solution)	2-0-2X	In-6	D-P	Cor	3-4	
Calcium Lactate	0-0-0	In-2	D-P			
Calcium Nitrate (1.0 M)	0-0-1X	In-3	D-P	Rea-Ir		
Calcium Oxide	1-0-1	In-4	D-P	Ir	1-4	
Calcium Phosphate	0-0-0	In-2	T			
Calcium Phosphate (dibasic)	0-0-0	In-2	T			
Calcium Phosphate (monobasic)	0-0-0	In-2	T			
Calcium Sulfate (Plaster of Paris) (Drierite)	0-0-0	In-2	T	Ir		
Calcium Sulfide	2-0-1	In-5	N-D-P	Rea-Sn	2-3-11	
Camphor	2-2-0	Or-4	SW-1	Tx-Ir	4	
Canada Balsam	0-1-0	Or-3	T			
Carbamide (Urea)	0-0-0	Or-2	D-P			
Carbon	0-1-0	In-4	T			
Carbon Dioxide (Dry ice)	0-0-0				10	
Carbon Dioxide (Gas)	0-0-0	Secure				
Carborundum (Aluminum Oxide)	0-0-0	In-4	T	Ir		
Carmine	1-0-0	Or-1	D-P	Ir		
Carmine Alum Lake	0-0-0	Or-1	D-P	Ir		
Carmine-aceto Solution	2-0-0	Or-1	D-P	Tx-Ir		
Casein	0-0-0	Or-2	D-P			

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Casitone	0-0-0	Or-2	D-P			
Castor Oil	0-1-0	Or-4	D-P			
Catalase	0-0-0	Or-1	D-P	Ir		
Cedarwood Oil	0-1-0	Or-4	SW-1			
Cellosolve (2-Ethoxyethanol)	1-1-0	Or-2	D-P	Tx-Fla-Ir		
Cellulase	0-0-0	Or-1	D-P			
Cellulose	0-0-0	Or-3	D-P			
Cetyl Alcohol (1-Hexadeconol) [AP/II]	1-0-0	Or-2	D	Ir		
Chalk (Calcium Carbonate)	1-0-0	In-4	T	Sn		
Chalk (Marble- Calcium Carbonate)	1-0-0	In-4	T	Sn		
Charcoal (Bone Black)	0-1-0	In-4	T			
Charcoal (Bone Black) (Wood)	0-1-0	In-4	T			
China Clay (Kaolin)	0-0-0	In-4	T			
Chlorine Water*	2-0-1X	In-2	D-P	Tx-Ir-Rea	2-3-4	
Chloroplatinic Acid (Platinum Chloride)	2-0-0	In-2	N-D-P	Tx-Sn		
Cholesterol	1-1-0	Or-2	T			
Chorionic Gonadotropin	0-0-0	Or-2	D-P	Tx	5	
Chromium(iii) Nitrate (1.0 M)	1-0-1X	In-3	D-P	Tx-Rea	5	
Citric Acid	0-0-0	Or-1	D-P	Sn		
Clayton Yellow (Thiazol Yellow G)	1-0-0	Or-2	D-P	Ir		
Clove Oil	0-1-0	Or-3	D-P			
Cobalt Chloride (1.0 M)	1-0-0	In-2	D-P	Tx	5	
Cobalt Chloride Test Papers	1-0-0	In-2	T			
Cobalt Nitrate (100 g)	1-0-0X	In-3	D-P	Tx-Cor-Rea		
Cobalt Oxide	0-0-0	In-4	T			
Cobalt Sulfate	1-0-0	In-2	D-P	Ir		
Cochineal	0-0-0	Or-2	T			
Coconut Oil	0-1-0	Or-4	SW-1			
Congo Red	0-0-0	Or-2	D-P	Ir-Tx	4	
Copper (I) Chloride (Cuprous Chloride)	1-0-0	In-2	D-P/T	Tx-Ir		
Copper (I) Oxide (Cuprous Oxide)	1-0-0	In-4	T	Tx-Ir		
Copper (II) Acetate (Cupric Acetate)	1-0-0	In-2	D-P	Tx-Ir		
Copper (II) Bromide (Cupric Bromide)	1-0-0	In-2	D-P	Tx-Ir		
Copper (II) Carbonate (Cupric Carbonate)	1-0-0	In-4	D-P/T	Tx-Ir		
Copper (II) Chloride (Cupric Chloride)	1-0-0	In-2	D-P/T	Tx-Ir		
Copper (II) Nitrate (1.0 M) (Cupric Nitrate)	1-0-1X	In-3	D-P	Tx-Rea-Ir		
Copper (II) Oxide (Cupric Oxide)	1-0-0	In-4	T	Tx-Ir		
Copper (II) Sulfate (Cupric Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Copper (No Powder)	0-0-0	In-1	T			
Corn Oil	0-1-0	Or-3	D-P			
Cornstarch	0-0-0	Or-M	T			
Cottonseed Oil	0-1-0	Or-4	D-P			
Cream of Tartar (Potassium Bitartrate)	0-0-0	In-2	D-P			
Creatine	0-1-0	Or-1	D-P	Ir		
m-Cresol Purple	0-0-0	Or-2	D-P	Ir		
Cresol Red	0-0-0	Or-2	D-P	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Crystal Violet (Gentian Violet)	0-0-0	Or-2	D-P	Ir		
Crystal Violet Solution	0-1-0	Or-2	D-P	Fla-Ir		
Culture Media	0-0-0	Or-M	T			
Cupric Acetate (Copper (II) Acetate)	1-0-0	In-2	D-P	Tx-Ir		
Cupric Bromide (Copper (II) Bromide)	1-0-0	In-2	D-P	Tx-Ir		
Cupric Carbonate (Copper (II) Carbonate)	1-0-0	In-4	D-P/T	Tx-Ir		
Cupric Chloride (Copper (II) Chloride)	1-0-0	In-2	D-P/T	Tx-Ir		
Cupric Nitrate (1.0 M) (Copper (II) Nitrate)	1-0-1 X	In-3	D-P	Tx-Rea-Ir		
Cupric Oxide (Copper (II) Oxide)	1-0-0	In-4	T	Tx-Ir		
Cupric Sulfate (Copper (II) Sulfate)	1-0-0	In-2	D-P	Tx-Ir		
Cuprous Chloride (Copper (I) Chloride)	1-0-0	In-2	D-P/T	Tx-Ir		
Cuprous Oxide (Copper (I) Oxide)	0-0-0	In-4	T	Tx-Ir		
Cysteine	0-0-0	Or-2	D-P			
DCIP (2-6-Dichlorophenolindolphenol) (Sodium Salt)	1-0-0	Or-8	D-P	Ir		
Dextrin	0-0-0	Or-2	D-P			
Dextrose	0-0-0	Or-2	D-P			
Diastase of Malt	0-0-0	Or-M	D-P			
Diatomaceous Earth	0-0-0	In-4	T			
2,6-Dichlorophenolindolphenol (DPIP) (DCIP) (Sodium Salt)	1-0-0	Or-8	D-P	Ir		
Dimethyl Ketone (Acetone)	1-3-0	FC	D-P	Tx-Fla-Ir	1-2-3	4L
p-Dimethylaminobenzaldehyde	1-0-0	Or-3	D-P	Tx-Ir		
Dimethylglyoxime	1-0-0	Or-2	D-P	Ir		
s-Diphenylcarbazone (Dithizone)	1-0-0	Or-2	D-P	Ir		
Dipotassium Hydrogen Phosphate (Potasium Phosphate (Diabasic)) (Potassium Monohydrogen Phosphate)	0-0-0	In-2	D-P/T			
Disodium Hydrogen Phosphate (Sodium Phosphate (Diabasic)) (Sodium Monohydrogen Phosphate)	1-0-0	In-2	D-P	Tx		
Dodecyl Alcohol (lauryl alcohol)	0-1-0	Or-2	SW-1	Ir		
DPIP (2-6-Dichlorophenolindolphenol) (Sodium Salt)	1-0-0	Or-8	D-P	Ir		
Drierite (Calcium Sulfate)	0-0-0	In-2	T			
Dry ice (Carbon Dioxide)	0-0-0				10	
Dry ice (Carbon Dioxide)	0-0-0				10	
EDTA (Ethylene Diamine Tetraacetic Acid) (Ethylenedinitrilo Tetraacetic Acid)	1-0-0	Or-1	D-P	Ir		
EMB Agar	0-0-0	Or-M	T			
Eosin B	1-0-0	Or-2	D-P	Ir		
Eosin Red	1-0-0	Or-2	D-P	Ir		
Eosin Y (Eosin Yellowish)	0-1-0	Or-2	D-P	Ir-Fla		
Eosin Yellowish (Eosin Y)	0-1-0	Or-2	D-P	Ir-Fla		
Epsom Salt (Magnesium Sulfate)	0-0-0	In-2	D-P	Ir		
Eriochrome Black T	0-0-0	Or-2	D-P	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Erythrosin B	1-0-0	Or-2	D-P	Ir		
Ethanol (Ethyl Alcohol)	0-3-0	FC	D-P	Tx-Fla	2-3	4L
2-Ethoxyethanol (Cellosolve)	1-1-0	Or-2	D-P	Tx-Fla-Ir		
Ethyl Alcohol (Ethanol)	0-3-0	FC	D-P	Tx-Fla	2-3	4L
Ethyl Benzoate	1-2-0	Or-2	D-P	Ir		
Ethyl m-Aminobenzoate Methanesulfonate (Anesthetic MS-222)	1-0-0	Or-M	D-P	Tx		
Ethylene Diamine Tetraacetic Acid (EDTA) (Ethylenedinitrilo Tetraacetic Acid)	1-0-0	Or-1	D-P	Ir		
Ethylene Glycol	2-0-0	Or-2	D-P	Tx-Ir		
Fehlings Solution A	0-0-0	In-2	D-P	Ir		
Fehlings Solution B	1-0-1	In-4	D-P	Tx-Cor-Rea	4	
Ferric Ammonium Citrate (iron (iii) Ammonium Citrate)	0-0-0	In-2	D-P/T	Ir		
Ferric Ammonium Sulfate (iron (iii) Ammonium Sulfate)	0-0-0	In-2	D-P/T	Ir		
Ferric Ammonium Sulfate (Ferric Alum)	1-0-0	In-2	D-P	Tx-Ir		
Ferric Chloride (iron (III) Chloride	1-0-0	In-2	D-P/T	Ir-Cor		
Ferric Nitrate (1.0 M) (iron (III) Nitrate)	1-0-0X	In-3	D-P/T	Rea-Cor		
Ferric Phosphate (iron (III) Phosphate)	0-0-0	In-2	T			
Ferric Sulfate (iron (III) Sulfate)	0-0-0	In-2	D-P/T			
Ferric Tartrate (iron (III) Tartrate	0-0-0	In-2	D-P/T			
Ferrous Ammonium Sulfate (iron (II) Ammonium Sulfate)	0-0-0	In-2	D-P/T	Ir		
Ferrous Chloride (iron (II) Chloride)	0-0-0	In-2	D-P/T	Ir		
Ferrous Oxide (iron (II) Oxide)	0-0-0	In-4	T	Ir		
Ferrous Sulfate (iron (II) Sulfate)	0-0-0	In-2	D-P/T	Ir		
Ferrous Sulfide (iron (II) Sulfide)	1-0-1	In-5	N-D-P	Rea-Ir	11	
Fibrin	0-0-0	Or-2	D-P			
Fluorescein	1-0-0	Or-8	D-P/T	Ir		
Fluorescein Sodium	0-0-0	Or-8	D-P/T		3	
Fly-Nap (Lull-a-Fly) (Triethylamine)	2-3-0	FC	D-P	Tx-Fla-Ir	2-3	
Food Coloring	0-0-0	Or-M	D-P			
Formalternate	1-0-0	Or-2	D-P	Tx-Ir		
Fructose (Levulose)	0-0-0	Or-2	D-P			
Fuchsin- Basic	0-0-0	Or-2	D-P			
Fuchsin-carbol	0-0-0	Or-8	D-P	Ir-Tx		
Fuller's Earth	0-0-0	In-4	T			
Fumaric Acid	1-0-0	Or-1	N-D-P/T	Ir	4-5	
Galactose	0-0-0	Or-M	D-P			
Gallic Acid	0-0-0	Or-9	D-P	Ir		
Gastric Juice	0-0-0	In-2	D-P	Ir		
Gelatin	0-0-0	Or-M	D-P			
Gentian Violet (Crystal Violet)	0-0-0	Or-2	D-P	Ir		
Germanium (no powder)	0-0-0	In-1	T			

Brevard Public Schools Approved Chemical List

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Gibberellic Acid	0-0-0	Or-1	D-P			
Giemsa Staining Solution	1-3-0	FC	D-P	Fla-Ir		500mL
Glucose	0-0-0	Or-M	D-P			
Glucose 1-Phosphate Disodium Salt	0-0-0	Or-2	D-P			
Glutamic Acid	0-0-0	Or-1	D-P			
Glutamine	0-0-0	Or-2	D-P			
Glutathione	0-0-0	Or-2	D-P			
Glycerin (Glycerol)	1-1-0	Or-2	D-P	Sn-Ir		
Glycerol (Glycerin)	1-1-0	Or-2	D-P	Sn-Ir		
Glycine (Aminoacetic Acid)	0-0-0	Or-2	D-P	Ir		
Glycine (Aminoacetic Acid)	0-0-0	Or-1	D-P	Ir		
Glycogen	0-0-0	Or-2	D-P			
Gram's iodine Solution	1-1-0	In-2	D-P	Ir		
Graphite Powder	0-1-0	Or-4	T			
Guaiacol (Methoxyphenol)	1-2-0	Or-8	D-P	Tx-Ir		
Guar Gum	0-0-0	Or-2	D-P/T			
Helium	0-0-0	Secure				
Hemoglobin	0-0-0	Or-2	D-P			
1-Hexadeconol (Cetyl Alcohol) [AP/II]	1-0-0	Or-2	D	Ir		
Hexanedioic Acid (Adipic Acid)	1-1-0	Or-2	N-D-P/T	Ir	4	
Hexanedioic Acid (Adipic Acid)	1-1-0	Or-1	N-D-P	Ir	4	
Histamine Acid Phosphate Solution	1-0-0	Or-2	D-P	Ir		
Histidine	0-0-0	Or-2	D-P			
Holtfreter's Solution	0-0-0	In-M	D-P			
Hydrochloric Acid	3-0-1	AC	D-P	Tx-Rea-Cor	1-2-3-4-6-10	12L
Hydrogen Peroxide (6% Max.) [AP/II]	1-0-1X	In-6	D-P	Ir		
Hydrogen Sulfide [AP/II]	1-0-1	In-5	D-P	Rea-Ir	1-3-8	
Hydroxylamine hydrochloride [AP/II]	2-0-0	Or-2	D-P		1-3-4-10	
Immersion Oil	0-1-0	Or-M	T			
Indigo Carmine [AP/II]	0-0-0	Or-9	D-P	Ir		
3-Indoleacetic Acid	0-0-0	In-1	T			
Indole Nitrate Broth	1-0-0	Or-M	D-P	Ir		
Indophenol Sodium Salt (2-6-Dichloroindophenol Sodium Salt)	1-0-0	Or-8	D-P	Ir		
Ink	0-0-0	In-M	D-P/T			
Invertase	0-0-0	Or-2	D-P			
Iodic Acid	2-0-0X	AC	N-D-P	Cor-Rea-Ir	4	
Iodine	2-0-0	In-2	D-P	Ir-Cor	2-3-4-10	
Iodine- tincture	2-2-0	In-2	D-P	Ir-Fla	4	
Ion Exchange Resin	0-0-0	Or-M	T			
Iron (II) Ammonium Sulfate (Ferrous Ammonium Sulfate)	0-0-0	In-2	D-P/T	Ir		
Iron (II) Chloride (Ferrous Chloride)	0-0-0	In-2	D-P/T	Ir		
Iron (II) Oxide (Ferrous Oxide)	0-0-0	In-4	T	Ir		
Iron (II) Sulfate (Ferrous Sulfate)	0-0-0	In-2	D-P/T	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Iron (III) Ammonium Citrate (Ferric Ammonium Citrate)	0-0-0	In-2	D-P/T	Ir		
Iron (III) Ammonium Sulfate (Ferric Ammonium Sulfate)	0-0-0	In-2	D-P/T	Ir		
Iron (III) Chloride (Ferric Chloride)	1-0-0	In-2	D-P/T	Ir-Cor		
Iron (III) Nitrate (1.0 M) (Ferric Nitrate)	1-0-0 X	In-3	D-P/T	Cor-Rea		
Iron (III) Phosphate (Ferric Phosphate)	0-0-0	In-2	T			
Iron (III) Sulfate (Ferric Sulfate)	0-0-0	In-2	D-P/T			
Iron (III) Tartrate (Ferric Tartrate)	0-0-0	In-2	D-P/T			
Iron (No Powder)	0-0-0	In-1	T			
Iron Pyrites	0-0-0	In-1	T			
Iso-Amyl Alcohol (Isopentyl Alcohol)	1-3-0	FC	SW-1	Tx-Fla-Ir	2-3	1L
Isobutyl Alcohol [AP/II]	1-3-0	FC	D	Ir	1	500mL
Isoleucine	0-0-0	Or-2	D-P			
Isopentyl Alcohol (Iso-Amyl Alcohol)	1-3-0	FC	SW-1	Tx-Fla-Ir	2-3	1L
Isopropyl Alcohol	1-3-0	FC	D-P	Tx-Fla	3	1L
Kaolin (China Clay)	0-0-0	In-4	T			
Kaolin (China Clay)	0-0-0	In-4	D-P/T			
Kerosene	0-2-0	In-2	SW-1	Tx-Fla-Ir	3	1L
Kligher Iron Agar	0-0-0	Or-M	T			
Knop's Solution	0-0-0	In-2	D-P			
Lactic Acid	1-0-0	Or-1	N-D-P	Ir		
Lactose	0-0-0	Or-M	D-P/T			
Lampblack	0-1-0	In-4	T			
Lanolin	0-1-0	Or-2	T			
Latex	0-0-0	Or-3	D-P/T			
Lauric Acid	0-0-0	Or-1	T	Ir		
Lauryl Alcohol (Dodecyl Alcohol)	0-1-0	Or-2	SW-1	Ir		
Lead (no dust- no powder)	1-0-0	In-1	T	Tx		
Lead(II)Chloride (1.0 M)	1-0-0	In-2	D-P	Tx		
Lead(II)Nitrate (1.0 M)	1-0-0	In-3	D-P	Tx-Rea-Ir		
Leucine	0-0-0	Or-2	D-P			
Levulose (Fructose)	0-0-0	Or-2	D-P			
Limewater	1-0-0	In-4	D-P	Ir		
Linseed Oil	0-1-0	Or-1	D-P			
Lipase	0-0-0	Or-2	D-P			
Liquinox	0-0-0	In-M	D-P	Ir		
Lithium Acetate	0-0-0	In-2	D-P	Ir		
Lithium Chloride	1-0-0	In-2	D-P	Tx-Ir		
Lithium Nitrate (1.0 M)	1-0-0	In-3	D-P	Tx		
Lithium Sulfate	0-0-0	In-2	D-P	Ir		
Litmus	0-0-0	Or-2	D-P/T			
Litmus Solution (Azolitmin Solution)	0-0-0	Or-2	D-P			
Litmus Solution (Azolitmin)	0-0-0	Or-2	D-P			
Lugol's Iodine Solution	1-0-0	Or-2	D-P	Ir		
Lull-a-Fly (Fly-Nap) (Triethylamine)	2-3-0	FC	D-P	Tx-Fla-Ir	2-3-4	
Luminol (3-Aminophthalhydrazide)	0-0-0	Or-2	D-P	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Luminol (3-Aminophthalhydrazide)	0-0-0	Or-2	D-P/T	Ir		
Lycopodium	0-1-0	Or-2	T	Fla		
Lysine Monohydrochloride	0-0-0	Or-2	D-P	Ir		
Lysol	1-0-0	Or-8	D-P	Ir		
Magnesium (no dust or powder)	0-1-2NW	In-1	T	Fla-Rea		
Magnesium Acetate	0-0-0	In-2	D-P	Ir		
Magnesium Carbonate	0-0-0	In-4	D-P			
Magnesium Chloride	1-0-0	In-2	D-P	Ir		
Magnesium Hydroxide	0-0-0	In-4	T	Ir		
Magnesium Nitrate (1.0 M)	0-0-0X	In-3	D-P	Rea-Ir		
Magnesium Oxide	1-0-0	In-4	T	Ir- Tx		
Magnesium Sulfate (Epsom Salts)	0-0-0	In-2	D-P	Ir		
Malachite Green	0-0-0	Or-2	D-P	Tx		
Maleic Acid	1-0-0	Or-1	D-P	Ir-Tx		
Malonic Acid [AP/II]	1-0-0	Or-1	N-D-P	Tx-Cor-Ir		
Maltose	0-0-0	Or-M	D-P			
Manganese (no dust or powder)	0-0-0	In-1	T			
Manganese Chloride	0-0-0	In-2	D-P			
Manganese Dioxide (Manganese Peroxide)	1-0-1X	In-4	T	Tx-Rea-Ir		
Manganese Nitrate (1.0 M)	0-0-0X	In-3	D-P	Rea-Ir		
Manganese Peroxide (Manganese Dioxide)	1-0-1X	In-4	T	Tx-Rea-Ir		
Manganese Sulfate	1-0-0	In-2	D-P/T	Ir		
Mannitol Salt Agar	0-1-0	Or-M	D-P			
Mannose	0-0-0	Or-M	D-P			
Marble Chip (Chalk) (Calcium Carbonate)	1-0-0	In-4	T	Sn		
Marble Chips (Calcium Carbonate)	1-0-0	In-4	T	Sn		
M-endo Broth	0-0-0	Or-M	D-P			
Menthol	1-1-0	Or-3	D-P	Ir		
Methanol (Methyl Alcohol)	1-3-0	FC	D-P	Tx-Fla-Ir	2-3	4L
Methionine	0-0-0	Or-2	D-P			
Methoxyphenol (Guaiacol)	1-2-0	Or-8	D-P	Tx-Ir		
Methyl Alcohol (Methanol)	1-3-0	FC	D-P	Tx-Fla-Ir	2-3	4L
Methyl Benzoate	0-0-0	Or-M	T	Tx-Ir		
Methyl Green	0-0-0	Or-2	D-P	Ir		
Methyl Orange	0-0-0	Or-2	D-P	Ir		
Methyl Red	0-0-0	Or-2	D-P	Ir		
Methyl Violet	1-0-0	Or-2	D-P	Ir		
Methylcellulose	0-0-0	Or-2	D-P/T			
Methylene Blue	1-0-0	Or-2	D-P	Tx-Ir		
MFC Medium	0-0-0	Or-M	D-P/T			
Microcosmic Salt (Sodium Ammonium Phosphate)	0-0-0	In-2	D-P/T	Ir		
Mineral Oil	0-1-0	Or-2	D-P			
Mineral Spirits	1-2-0	Or-2	SW-1	Tx-Ir-Fla		
Molasses	0-1-0	Or-M	D-P/T			

Brevard Public Schools Approved Chemical List

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Mueller Hinton Agar	0-0-0	Or-M	T			
Neon	0-0-0	Secure				
Neutral red (Toluylene Red)	0-0-0	Or-2	D-P	Tx-Ir		
Niacin (Nicotinic Acid)	0-0-0	Or-1	D-P			
Nickel(II)Chloride (1.0 M)	1-0-0	In-2	D-P	Tx-Ir	10	
Nickel(II)Nitrate (1.0 M)	1-0-0	In-3	D-P	Tx-Ir	10	
Nicotinic Acid (Niacin)	0-0-0	Or-1	D-P			
Nigrosine	1-0-0	Or-2	D-P		3	
Nitric Acid- CONC.	3-0-1X	In-M	D-P	Tx-Cor-Rea	1-2-3-4-6-	100mL
Nitrogen	0-0-0	Secure				
Nitrogen (Liquid)	3-0-0	N/A	N/A		1	1L
Nutrient Agar	0-0-0	Or-M	T			
Nutrient Broth	0-0-0	Or-M	D-P/T			
1-Octanol	2-1-0	Or-2	SW-1	Fla-Ir		
Oleic Acid	0-1-0	Or-1	D-P/T	Ir		
Olive Oil	0-1-0	Or-M	D-P/T			
Onion's Fusible Alloy	1-0-0	In-1	T			
Orange IV (Tropaeolin OO)	0-0-0	Or-M	D-P	Ir		
Oxalic Acid [AP/II]	2-0-0	Or-1	N-D-P	Tx-Cor	4-5	
Oxygen	1-0-1X	Secure				
Palmitic Acid	0-0-0	Or-1	T	Ir		
Pancreatin	0-0-0	Or-2	D-P			
Paraffin	0-1-0	Or-2	T			
Paraffin Oil	0-1-0	Or-2	T			
Peanut Oil	0-1-0	Or-2	T			
Pentanol-1 (n-Amyl Alcohol)	1-3-0	Or-2	SW-1	Tx-Fla-Ir		1L
3-Pentanol (Amyl Alcohol)	1-3-0	Or-2	SW-1	Tx-Fla-Ir		1L
Pentose Sugar (Arabinose)	0-0-0	Or-2	D-P			
Peppermint Oil	0-1-0	Or-2	D-P			
Pepsin	0-0-0	Or-2	D-P			
Peptone	0-0-0	Or-2	D-P			
Permount	1-2-0	Or-M	T	Fla		
Petroleum Ether	1-4-0	Or-4	SW-1	Fla-Ir	1-2-3	100mL
Petroleum Jelly (Petrolatum)	0-1-0	Or-2	T			
1,10-Phenanthroline [AP/II]	2-0-0	Or-2	D-P	Tx		
Phenol Broth	1-0-0	Or-2	D-P			
Phenol Red	0-0-0	Or-2	D-P	Ir		
Phenolphthalein Powder	0-0-0	Or-2	D-P	Ir		
Phenyl Salicylate	0-1-0	Or-3	D-P/T	Ir-Tx		
Phenylalanine	0-0-0	Or-2	D-P	Ir		
Phloroglucinol	0-1-0	Or-3	D-P/T	Ir		
Phosphate Standard Solution	0-0-0	In-2	D-P			
Phosphoric Acid	2-0-0	AC	D-P	Tx-Cor	4-5	100mL
Photobacterium Medium	1-0-0	Or-M	T			
Plaster of Paris (Calcium Sulfate)	0-0-0	In-2	T	Ir		
Plaster of Paris (Calcium Sulfate)	0-0-0	In-2	T	Ir		
Platinum Chloride (Chloroplatinic Acid)	2-0-0	In-2	N-D-P	Tx-Sn		

Brevard Public Schools Approved Chemical List

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Platinum Chloride (Chloroplatinic Acid)	2-0-0	In-2	N-D-P	Tx-Sn		
Polyvinyl Acetate	0-0-0	Or-2	T			
Polyvinyl Alcohol	1-0-0	Or-2	T		10	
Potash (Potassium Carbonate)	1-0-0	In-4	D-P	Ir		
Potasium Phosphate (Diabasic) (Potassium Monohydrogen Phosphate) (Dipotassium Hydrogen Phosphate)	0-0-0	In-2	D-P/T			
Potassium Acetate	0-1-0	In-2	D-P			
Potassium Acid Phthalate (Potassium Hydrogen Phthalate)	0-0-0	In-2	D-P			
Potassium Bicarbonate	0-0-0	In-4	D-P			
Potassium Bisulfate	0-0-0	In-2	D-P			
Potassium Bitartrate (Cream of Tartar)	0-0-0	In-2	D-P			
Potassium Bromide	1-0-0	In-2	D-P	Ir		
Potassium Carbonate	1-0-0	In-4	D-P	Ir		
Potassium Chloride	0-0-0	In-2	D-P			
Potassium Chromate (1.0 M)	3-0-0	In-8	D-P	Ir-Tx-Cor	5	
Potassium Citrate	0-0-0	In-2	D-P			
Potassium Dichromate (1.0 M)	3-0-1	In-8	D-P	Ir-Tx-Cor	5	
Potassium Dihydrogen Phosphate (Potassium Phosphate (Monobasic))	0-0-0	In-2	D-P/T			
Potassium Ferricyanide (1.0 M)	2-0-0	In-7	D-P	Tx	11	
Potassium Ferrocyanide (1.0 M)	2-0-0	In-7	D-P	Tx	11	
Potassium Hydrogen Phthalate (Potassium Acid Phthalate)	0-0-0	In-2	D-P			
Potassium Hydroxide (pellet only)	3-0-1	In-4	D-P	Tx-Cor	4-10	
Potassium Iodate	0-0-0X	In-2	D-P	Rea-Ir		
Potassium Iodide	0-0-0	In-2	D-P	Ir		
Potassium Monohydrogen Phosphate (Potasium Phosphate (Diabasic)) (Dipotassium Hydrogen Phosphate)	0-0-0	In-2	D-P/T			
Potassium Nitrate (1.0 M)	1-0-0	In-3	D-P	Ir		
Potassium Oxalate	0-0-0	In-2	D-P	Tx-Ir		
Potassium Permanganate (0.1 M)	0-0-0X	In-8	N-D-P	Tx-Ir	4-10	
Potassium Persulfate	1-0-1X	In-6	N-D-P	Rea-Ir-Tx	4	
Potassium Phosphate (Monobasic) Potassium Dihydrogen Phosphate	0-0-0	In-2	D-P/T			
Potassium Phosphate (Tribasic) (Tripotassium Phosphate)	0-0-0	In-2	D-P	Ir		
Potassium Pyrosulfate	2-0-0	In-2	D-P	Ir		
Potassium Sodium Tartrate (Rochelle Salts)	0-0-0	In-2	D-P			
Potassium Sulfate	0-0-0	In-2	D-P			
Potassium Sulfide (1.0 M)	2-0-0	In-5	N-D-P		11	
Potassium Sulfite	0-0-0	In-2	D-P			
Potassium Tartrate	0-0-0	In-2	D-P			
Potassium Thiocyanate (1.0 M)	1-0-1	In-7	D-P	Tx	10	

Brevard Public Schools Approved Chemical List

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Potato Dextrose Agar	0-0-0	Or-M	D-P/T			
Primuline Yellow (Thiazol Yellow G) (Titan Yellow) (Clayton Yellow)	1-0-0	Or-2	D-P	Ir		
Proline	0-0-0	Or-2	D-P			
1,2-Propanediol (Propylene Glycol)	0-1-0	Or-2	D-P			
2-Propanol (Isopropyl alcohol)	1-3-0	FC	D-P	Tx-Fla	3-4	1L
Proprionic Acid	2-2-0	Or-1	D-P	Tx-Cor	4-5	
n-Propyl Alcohol (1-Propanol)	1-3-0	FC	D-P	Tx-Fla	3-4	1L
Propylene Glycol (1,2-Propanediol)	0-1-0	Or-2	D-P			
Ptyalin (Amylase)	0-0-0	Or-2	D-P			
Pumice	0-0-0	In-4	T			
Quinine Sulfate	1-0-0	Or-2	D-P	Ir		
Rennin	0-0-0	Or-M	D-P			
Rhodamine 6G	0-0-0	Or-2	D-P			
Rhodamine B	0-0-0	Or-2	D-P			
Riboflavin (Vitamin B2)	0-0-0	Or-2	D-P			
Ringer's Solution	0-0-0	In-2	D-P			
Rochelle Salts (Potassium Sodium Tartrate)	0-0-0	In-2	D-P			
Rose Water	0-0-0	Or-2	D-P			
Sabouraud Dextrose Agar	0-0-0	Or-M	D-P/T			
Safranin O	0-0-0	Or-2	D-P	Ir		
Salicylic Acid	1-0-0	Or-1	D-P/T	Ir	4	
Saline Solution	0-0-0	In-1	D-P			
Sand	0-0-0	In-M	T			
Serine	0-0-0	Or-2	D-P			
Sesame Oil	0-1-0	Or-2	T			
Shellac Gum	1-1-0	Or-M	T			
Silica	0-0-0	In-4	T			
Silica Gel (Sodium Metasilicate)	0-0-0	In-4	T			
Silicon (no powder)	0-1-0	In-1	T			
Silver	0-0-0	In-1				
Silver Acetate (1.0 M)	1-0-0	In-2	SW-2	Tx-Cor		
Silver Chloride	1-0-0	In-2	SW-2	Tx		
Silver Nitrate (1.0 M)	1-0-1X	In-3	SW-2	Tx-Cor-Rea-Ir	4-10	
Silver Oxide	1-0-0X	In-4	SW-2	Tx-Rea		
SIM Medium	0-0-0	Or-M	D-P			
Slaked Lime (Calcium Hydroxide)	2-0-1	In-4	D-P	Cor-Tx-Ir	4	
Slaked Lime (Calcium Hydroxide)	2-0-1	In-4	D-P	Cor	3-4	
Snyder's Test Medium	0-0-0	Or-M	D-P			
Soap (Tincture Green)	0-0-0	Or-M	D-P	Ir		
Soda Ash (Sodium Carbonate)	0-0-0	In-4	D-P	Ir		
Soda Lime (Sodium Calcium Hydrate)	2-0-0	In-4	D-P	Cor	4	
Sodium Acetate	0-0-0	In-2	D-P	Tx-Ir	5	
Sodium Ammonium Phosphate (Microcosmic Salt)	0-0-0	In-2	D-P/T	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Sodium Benzenoneindophenol (Indophenol Sodium Salt)	1-0-0	Or-8	D-P	Ir		
Sodium Benzoate	0-0-0	In-2	D-P/T	Ir	5	
Sodium Bicarbonate (Baking Soda)	0-0-0	In-4	D-P			
Sodium Bicarbonate (Baking Soda)	0-0-0	In-4	D-P			
Sodium Bismuthate	0-0-0X	In-7	D-P			
Sodium Bisulfate	1-0-0	In-2	D-P	Cor	4	
Sodium Bitartrate	0-0-0	In-2	D-P			
Sodium Bromate	2-0-1X	In-2	D-P	Rea-Ir-Tx	1	
Sodium Bromide	2-0-0	In-2	D-P	Cor-Tx		
Sodium Calcium Hydrate (Soda Lime)	2-0-0	In-4	D-P	Cor	4	
Sodium Carbonate (Soda Ash)	0-0-0	In-4	D-P	Ir		
Sodium Chloride	0-0-0	In-2	D-P			
Sodium Chromate (1.0 M)	3-0-0	In-8	D-P	Ir-Tx	5	
Sodium Citrate	0-1-0	In-8	D-P	Ir		
Sodium Cobaltinitrite	0-0-0	In-3	D-P			
Sodium Dichromate (1.0 M)	3-0-0	In-3	D-P	Ir-Tx-Cor	5	
Sodium Dihydrogen Phosphate (Sodium Phosphate (Monobasic))	0-0-0	In-2	D-P	Tx		
Sodium Fluoride (1.0 M)	1-0-0	In-2	D-P	Ir-Tx		
Sodium Hydroxide (pellets)	3-0-1	In-4	D-P	Cor-Rea	4-10	
Sodium Hypochlorite (Bleach 15% solution)	2-0-2X	In-6	D-P	Tx-Cor	3-4	
Sodium Hypochlorite (Bleach) (15% solution)	2-0-2X	In-6	D-P	Tx-Cor	3-4	
Sodium Iodate	0-0-0X	In-2	D-P	Ir-Tx		
Sodium Iodide	1-0-0	In-2	D-P	Tx-Ir		
Sodium Lactate	0-1-0	In-2	D-P			
Sodium Lauryl Sulfate	0-0-0	In-2	D-P	Ir	4	
Sodium Meta-Bisulfite	1-0-0	In-2	D-P	Tx-Ir		
Sodium Metasilicate (Silica Gel)	0-0-0	In-4	T			
Sodium Molybdate	1-0-0	In-8	D-P	Tx		
Sodium Monohydrogen Phosphate (Sodium Phosphate (Diabasic)) (Disodium Hydrogen Phosphate)	1-0-0	In-2	D-P	Tx		
Sodium Nitrate (1.0 M)	1-0-0	In-3	D-P	Tx		
Sodium Oxalate	1-0-0	In-2	D-P	Tx		
Sodium Phosphate (Diabasic)) (Disodium Hydrogen Phosphate) (Sodium Monohydrogen Phosphate)	1-0-0	In-2	D-P	Tx		
Sodium Phosphate (Monobasic) (Sodium Dihydrogen Phosphate)	0-0-0	In-2	D-P	Tx		
Sodium Phosphate (Tribasic) (Trisodium Phosphate)						
Sodium Polyacrylate	0-0-0	Or-2	T			
Sodium Pyrophosphate (TSPP)	0-0-0	In-2	D-P	Ir		
Sodium Salicylate	0-1-0	In-2	D-P	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Sodium Silicate Solution (Water Glass)	0-0-0	In-2	D-P			
Sodium Sulfate	0-0-0	In-2	D-P			
Sodium Sulfide (1.0 M)	2-0-0	In-5	N-D-P	Ir	11	
Sodium Sulfite	0-0-0	In-2	D-P			
Sodium Tartrate	0-0-0	In-2	D-P			
Sodium Tetraborate (Borax)	1-0-0	In-8	D-P/T	Tx-Ir		
Sodium Tetraborate (Borax)	1-0-0	In-8	D-P/T	Tx-Ir		
Sodium Thiocyanate (1.0 M)	1-0-1	In-7	D-P	Tx	10	
Sodium Thiosulfate	0-0-0	In-2	D-P	Tx		
Standard Methods Agar	0-0-0	Or-M	D-P/T			
Stannic Chloride (Tin (IV) Chloride) [AP/II]	3-0-1	In-2	D-P	Tx-Cor-Ir-Rea	1-2-3-4-10	25g
Stannic Oxide (Tin (IV) Oxide)	0-0-0	In-2	T			
Stannous Chloride (Tin (II) Chloride) [AP/II]	1-0-0	In-2	D-P	Tx-Cor-Ir	1-10	25g
Stannous Oxide (Tin (II) Oxide)	0-0-0	In-2	T			
Starch	0-0-0	Or-M	D-P/T			
Starch Agar	0-0-0	Or-M	D-P/T			
Stearic Acid	0-0-0	Or-1	T			
Steel	0-0-0	In-1	T			
Steel Wool	0-0-0	In-1	T			
Strontium Carbonate	0-0-0	In-4	D-P			
Strontium Chloride	0-0-0	In-2	D-P			
Strontium Hydroxide Solution	2-0-0	In-4	N-D-P		4	
Strontium Nitrate (1.0 M)	0-0-0X	In-3	N-D-P	Tx-Ir		
Succinic Acid	0-1-0	Or-1	N-D-P/T			
Sucrose	0-0-0	Or-2	D-P			
Sudan III	0-0-0	Or-2	D-P/T			
Sudan IV	0-0-0	Or-2	D-P/T			
Sugar	0-0-0	Or-2	D-P/T			
Sulfamic Acid	1-0-0	Or-1	D-P	Ir-Tx		
Sulfanilamide	1-0-0	In-3	D-P/T			
Sulfanilic Acid	0-1-0	AC	D-P			
Sulfur	1-1-0	In-10	T	Fla-Sn		
Sulfuric Acid (18M)	3-0-2NW	In-9	D-P	Tx-Cor	2-4-6-10	2.5L
Sulfurous Acid	2-0-0	AC	D-P	Tx-Cor	2-4-6-10	100mL
Tamer-Tabs (Boiling Granules)	0-0-0	In-M	T			
Tamer-Tabs (Boiling Granules)	0-0-0	In-M	T			
Tartar Emetic (Antimony Potassium Tartrate)	2-0-0	In-7	D-P	Tx		
Tartar Emetic (Antimony Potassium Tartrate)	2-0-0	In-7	D-P	Tx		
Tartaric Acid	0-0-0	Or-1	D-P			
Tes-tape	0-1-0	Or-M	T			
Tetrazolium Chloride (2,3,5-Triphenyl-2H-tetrazolium Chloride)	2-0-0	Or-6	D-P	Ir		

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Thiamine Hydrochloride (Vitamin B1)	0-0-0	Or-2	D-P			
Thiazol (Yellow G) (Titan Yellow) (Clayton Yellow)	1-0-0	Or-2	D-P	Ir		
Thiazol Yellow G (Clayton Yellow)	1-0-0	Or-2	D-P	Ir		
Threonine	0-0-0	Or-2	D-P			
Thymic Acid (Thymol)	0-1-0	Or-8	D-P	Ir		
Thymol Blue (Thymolsulfonephthalein)	0-0-0	Or-8	D-P	Ir		
Thyroxine (Sodium) Pentahydrate	1-0-0	Or-2	D-P			
Tin (II) Chloride (Stannous Chloride) [AP/II]	1-0-0	In-2	D-P	Tx-Cor-Ir	1-10	25g
Tin (II) Oxide (Stannous Oxide)	0-0-0	In-2	T			
Tin (IV) Chloride (Stannic Chloride) [AP/II]	3-0-1	In-2	D-P	Tx-Cor-Ir-Rea	1-2-3-4-10	25g
Tin (IV) Oxide (Stannic Oxide)	0-0-0	In-2	T			
Tin (No dust)	0-0-0	In-1	T			
Tincture Iodine	2-2-0	In-2	D-P	Fla-Ir	4	
Titan Yellow (Primuline Yellow) (Thiazol Yellow G)	1-0-0	In-2	D-P	Ir		
Titan Yellow (Thiazol Yellow G)	1-0-0	Or-2	D-P	Ir		
Titanium (no dust)	0-0-0	In-1	T			
D-alpha-Tocopherol (Vitamin E)	0-0-0	Or-1	D-P			
Toluidine Blue [AP/II]	0-0-0	Or-2	D-P	Tx	1-5	
Toluylene Red (Neutral Red)	0-0-0	Or-2	D-P	Tx-Ir		
Tragacanth Gum	0-0-0	Or-M	T			
Trichlorotrifluoroethane (TTE)	1-0-0	Or-4	D-P	Ir	3-4-10	2L
Triethanolamine	1-1-0	Or-2	D-P	Tx		
Triethylamine (Fly-Nap) (Lull-a-Fly)	2-3-0	FC	D-P	Tx-Fla-Ir	2-3-4	
2,3,5-Triphenyl-2H-tetrazolium (Tetrazolium Chloride)	2-0-0	Or-6	D-P	Ir		
3,5,3-Triiodo-L-thyronine	0-0-0	Or-1	D-P			
Triple Sugar Iron Agar	0-0-0	Or-M	T			
Tripotassium Phosphate (Potassium Phosphate (Tribasic)	0-0-0	In-2	D-P	Ir		
TRIS (Hydroxymethyl) Aminomethane [AP/II]	0-0-0	Or-2	D-P/T	Tx-Ir	7	
TRIS [AP/II] (Aminomethane Trishydroxymethyl)	0-0-0	Or-2	D-P/T	Ir-Tx		
Trisodium Phosphate (Sodium Phosphate (Tribasic))	0-0-0	Or-2	D-P/T	Ir-Tx		
Tropaeolin OO (Orange IV)	0-0-0	Or-M	D-P	Ir		
Trypan Blue	0-0-0	Or-8	D-P	Ir		
Trypsin	0-0-0	Or-2	D-P	Ir		
Tryptic Nitrate Agar	0-0-0	Or-5	D-P			
Tryptic Soy Broth	0-0-0	Or-M	D-P			
Tryptone	0-0-0	Or-M	D-P			
Tryptophan	0-0-0	Or-2	D-P			
TTE (Trichlorotrifluoroethane)	1-0-0	Or-4	D-P	Ir	3-4-8-10	2L

Brevard Public Schools Approved Chemical List

Name (Alternate Name)	NFPA Number	Storage Flinn	Disposal	Hazards	Special Notes	Storage Quantity
Tungsten (no powder)	0-0-0	In-1	T			
Turpentine	1-3-0	FC	SW-1	Fla-Ir	3-5	
Tyrosine	0-0-0	Or-2	D-P			
Universal Indicator Solution	1-3-0	FC	D-P	Fla-Ir		
Urea (Carbamide)	0-0-0	Or-2	D-P			
Urea (Carbamide)	0-0-0	Or-2	D-P			
Valine	0-0-0	Or-2	D-P			
Vanadium (no dust)	0-0-0	In-1	T			
Vanadium Pentoxide	1-0-0	Ir-4	D-P	Ir	3-4-10	
Vanillin	0-0-0	Or-2	D-P			
Vaseline	0-0-0	Or-M	T			
Vegetable Dyes	0-0-0	Or-M	D-P			
Vinegar	0-0-0	Or-1	D-P	Ir		
Vitamin B1 (Thiamine Hydrochloride)	0-0-0	Or-2	D-P			
Vitamin B2 (Riboflavin)	0-0-0	Or-2	D-P			
Vitamin C (Ascorbic Acid)	0-0-0	Or-1	D-P			
Vitamin C (Ascorbic Acid)	0-0-0	Or-1	D-P			
Vitamin H (Biotin)	0-0-0	Or-1	D-P	Ir		
Vitamin H (D-Biotin)	0-0-0	Or-1	D-P	Ir		
Vitamine E (d-alpha-Tocopherol)	0-0-0	Or-1	D-P			
Water Glass (Sodium Silicate Solution)	0-0-0	In-2	D-P			
White Vitriol (Zinc Sulfate)	1-0-0	In-2	D-P/T	Ir		
Winkler's Solution #1 (Manganous Sulfate) [AP/II]	1-0-0	In-2	D-P	Ir		
Winkler's Solution #2 (Alkaline-Iodide Solution) [AP/II]	3-0-1	In-4	D-P	Tx-Cor-Rea	4	
Wright's Stain	0-1-0	Or-2	D-P	Fla		
Xylose	0-0-0	Or-2	D-P			
Yeast	0-0-0	Or-M	T			
Zeolite	0-0-0	In-4	T			
Zinc (not dust)	0-0-0	In-1	T			
Zinc Acetate	0-0-0	In-2	D-P	Ir		
Zinc Carbonate	0-0-0	In-4	D-P-T			
Zinc Chloride Solution (1M) [AP/II]	1-0-0	In-2	P	Ir		
Zinc Nitrate	1-1-1X	In-3	D-P	Tx-Rea		
Zinc Oxide [AP/II]	1-0-1	In-4	T	Tx-Rea		100g
Zinc Stearate	0-1-0	In-2	T			
Zinc Sulfate	1-0-0	In-2	D-P	Ir		
Zinc Sulfide [AP/II]	0-0-1	In-5	N-D-P	Rea	11	

Student Science Safety Contract

Student Name _____ Course/Period _____

For the Student:

A science laboratory is a safe place to work if you are alert and cautious. It is important that you understand and abide by the guidelines below:

- Follow all written or verbal instructions given by the teacher. Ask for clarification if needed.
- Follow procedures as explained and do not perform unauthorized experiments. Work at your assigned station unless instructed otherwise.
- Do not handle equipment or chemicals without the teacher's permission.
- Use appropriate safety attire (goggles, face shields, aprons, and/or gloves).
- Do not wear contact lenses when working with chemicals that may be present as fumes or aerosols.
- Dress appropriately: Tie long hair back. Avoid open shoes, dangling jewelry, and floppy sleeves.
- Use good housekeeping practices.
- Report all accidents and possible hazards to the teacher.
- Know the location and the use of classroom safety equipment.
- Know the primary and secondary exit routes from the laboratory.
- Act in a responsible manner at all times in a laboratory situation.

I understand and agree to abide by the safety regulations described above.

_____ _____

Student Signature Date

For the Parent:

Laboratory activities are integral to the science curriculum. Student safety is our highest priority, and is enhanced by awareness and caution. Please help us to assure a safe and positive learning experience for your child by completing the items below:

- Does the student have any health problems, physical limitations, or allergies? _____
  If yes, please specify:
  _____
- Does the student wear contact lenses?_____

I have reviewed the above student guidelines for laboratory safety with my child. I will direct any questions I may have concerning laboratory activities to the science teacher.

_____ _____

Parent/Guardian Signature Date

Safety Checklist for Science Laboratories*

The teacher should check the operation and/or condition of the following at the beginning of each semester and the end of the school year for the purpose of initiating corrective actions or repairs. Science teachers should regularly check their instructional areas to assure that they are safe.

Concerns about safety conditions related to the facilities, equipment, supplies, curriculum, and classroom occupancy load should be communicated in writing immediately to the science department chairperson and/or site administrator for assistance in correcting the condition.

Recommended in all Science Laboratories

Room Number _____	School Year		
	Date	Date	Date
Fire Extinguishers: A, B, C			
Eye Wash			
Ground-fault circuit interrupters (GFI)			
Approved smoke detectors			
Broom and dust pan			
Designated waste container for glass			
Exists marked and readily accessible			
Equipment properly stored			
Chemicals properly labeled and stored			
Goggles (record number)			
Sanitizing equipment for goggles (record location)			
Lab Aprons (record number)			

Y=Yes, working condition N=No, needed and not working NA= Not Applicable

Safety check completed by_____

Please return form to Science Department Chairperson of Facilities Site Administrator each time checklist is completed.

*This form should be completed for every elementary or secondary non-laboratory classroom in which science activities are conducted.

Safety Checklist for Secondary Science Laboratories

The teacher should check the operation and/or condition of the following at the beginning of each semester and the end of the school year for the purpose of initiating corrective actions or repairs. Science teachers should regularly check their instructional areas to assure that they are safe.

Concerns about safety conditions related to the facilities, equipment, supplies, curriculum, and classroom occupancy load should be communicated in writing immediately to the science department chairperson and/or site administrator for assistance in correcting the condition.

Recommended in all Secondary Science Laboratories

Room Number _____	School Year		
	Date	Date	Date
Fire Extinguishers: A, B, C			
Sand			
Fire Blanket			
Shower			
Eye Wash			
Chemical Spill Kit			
Ventilation exhaust fan			
Fume hood			
Gas master cut-off			
Electrical Master cut-off or posted location of master cut-off			
Ground-fault circuit interrupters (GFI)			
Approved smoke detectors			
Broom and dust pan			
Designated waste container for glass			
Exists marked and readily accessible			
Equipment properly stored			
Chemicals properly labeled and stored			
Goggles (record number)			
Sanitizing equipment for goggles (record location)			
Face Shields (record number)			
Lab Aprons (record number)			
Chemically inert gloves (record number)			
Heat/Flame resistant gloves (record number)			
Demonstration safety shield			

Y=Yes, working condition N=No, needed and not working NA= Not Applicable

Safety check completed by_____

Please return form to Science Department Chairperson of Facilities Site Administrator each time checklist is completed.

Safety Checklist for Chemical Storerooms

The science chairperson or designee should check the operation and/or condition of the following at the beginning of each semester and the end of the school year for the purpose of initiating corrective actions or repairs.

Room Number _____	School Year		
	Date	Date	Date
Storage areas are securable			
Storage area well lighted			
Storage area has separate constant ventilation			
Storage area has temperature and humidity control			
Storage area free of floor clutter			
Acids Storage Cabinet - labeled			
Flammables Storage Cabinet – labeled and ventilated			
Chemicals properly labeled			
Chemical properly arranged by compatibles			
No unapproved chemicals stored in storeroom			
Shelving with 1/2” lip			
Approved smoke detectors			
Emergency lighting			
Emergency alarm & communication device			
Chemical Inventory			

Y=Yes, working condition N=No, needed and not working NA= Not Applicable

Safety check completed by_____

- Chemical storage must be in an area that is locked. This area should not be accessible to students.
- Forced air ventilation to outside is required.
- Chemical storage areas must be maintained at a moderate temperature on a year round basis.
- Chemical storage areas must have adequate lighting.
- Chemical storage areas must be clear of items that prevent ease of access.
- All chemicals must be stored in compatible groups according to recognized shelf storage pattern and NOT alphabetical order.
- Metal storage cabinets used for flammable materials must be labeled “FLAMMABLE KEEP FIRE AWAY” and provided with a three-point lock.
- All stored chemicals must contain the following: Chemical Name, Suppliers Name, date of purchase, concentration, and known hazards
- Each school must keep an inventory of all chemicals, which are on site for science instruction purposes. This inventory must be updated on a yearly basis and should contain the following information: Chemical Name, Suppliers Name, Date Received, Concentration, and Amount on hand
- Certain explosive chemicals and human carcinogens are not allowed for use or storage in chemical storerooms.

Student Name: _____ Course/Period: _____

Instructions:

- Sign either the top section OR the bottom section, but not both.
- If you wish to participate in dissections, read and sign the top section.
- If you do NOT wish to participate in dissections, read and sign the bottom section.

RESPONSIBLE USE OF ANIMAL SPECIMENS
AGREEMENT FORM

I am aware that the purpose of any dissection is to advance my knowledge and appreciation of the structure of living organisms. If I do not learn from the experience, the use of the organisms or tissues is not justified. I also understand that it is my responsibility to complete the activity as directed and to follow all safety rules and procedures.

I understand that careless work on the specimen; improper handling of the specimen or deliberate mutilation of the specimen is **UNACCEPTABLE.**

I understand that I have the right to change my decision, and I accept responsibility for obtaining and submitting another signed form

_____ _____

Student signature Date

_____ _____

Parent/Guardian signature Date

REQUEST FOR ALTERNATE ASSIGNMEN
IN LIEU OF DISSECTION

In accordance with Florida Statue 233.0674, "students may be excused from dissection upon written request of a parent or guardian." My parent/guardian and I request that I be given relevant alternative learning activities in lieu of dissection activities.

I understand that I have the right to change my decision, and I accept responsibility for obtaining and submitting another signed form

I prefer to work on my alternate assignment in the classroom during animal dissections.

I prefer to work on my alternative assignment in another area during animal dissection.

_____ _____

Student signature Date

_____ _____

Parent/Guardian signature Date

Specimen Recommendations

Grades PreK – 5

- Dissection of whole animal specimens is NOT recommended for elementary students.
- Dissection of animal parts commonly used for food, such as beef heart and chicken wings, MAY be appropriate for some elementary students.
- Plants ARE appropriate dissection materials for elementary students.

Grades 6 – 8

Recommended Specimens	Recommended Sources*
Chicken Wing	Grocer or biological supply company
Fish	Fish market, grocer or biological supply company
Organs (bones, kidney, heart, etc.)	Grocer or biological supply company

Grades 9 - 12

Recommended Specimens	Recommended Sources*
Cat	Biological supply company
Clam	Fish market, grocer harvest in approved areas or biological supply
Crayfish	Fish market, grocer or biological supply company
Fetal Pig	Biological supply company
Fish	Fish market, grocer, harvest or biological supply
Grasshopper	Field collection in approved areas or biological supply
Mink	Biological supply company
Rat	Biological supply company
Shark	Fish market, harvest in approved areas or biological supply
Squid	Fish market, grocer or biological supply company
Starfish	Biological supply company
Worms	Pet store, bait shop or biological supply company
Organs (bones, kidney, heart, etc.)	Grocer or biological supply company

NOTE: The use of FROGS is discouraged. Although the decrease in the population of frogs is primarily due to habitat destruction, it seems prudent to reduce the impact of collection for the purposes of dissection.

***Sources should be reputable and conform to licensing/inspection requirements**.

HOUSING REQUIREMENTS
FOR COMMON CLASSROOM ANIMALS

ANIMAL	MINIMUM CAGE SIZE & PHYSICAL REQUIREMENT
Rabbits	For 1 adult or 2 juveniles: Smaller breeds: 2' x 3' floor space and 1 gnawing log Larger breeds: 2' x 4' floor space and 1 gnawing log
Guinea Pigs	For 1 adult: 1.5' x 2' floor space and 1 gnawing log For 2 or more adults: 2' x 2' floor space and 1 gnawing log
Hamsters, mice & gerbils	For 1 - 2 animals: 10" x 10" floor space and 1 gnawing log
Rats	For 1 - 2 animals: 18" x 18" floor space and 1 gnawing log
Snakes *	For 1-4 snakes: a perimeter 1.5 times the length of the longest snake, a resting limb, a large rock and a soaking area For each additional snake, increase cage size 25% of floor area.
Lizards, anoles & skinks *	For 1 - 2 small lizards, 2 - 6" long: 12" x 8" x 10" high with branches and access to ultraviolet light each 2 additional lizards, increase cage size by 2" in length & width. For 1 - 2 lizards, 7 - 12" long: 20" x 10" x 15" high, with branches and access to ultraviolet light For each additional lizard, increase cage size by 4" in length & width. For 1-2 lizards, 13 - 24" long: 30" x 15" x 12" high, with branches and access to ultraviolet light For each additional lizard, increase cage size by 6" in length & width. For 1 - 2 lizards, 2 - 4' long: 36" x 15" x 18" high, with branches and access to ultraviolet light each additional lizard, increase cage size by 10" in length & width.
Turtles & terrapins *	For 1 turtle: an area 5 times body size, with 50% of the area having a pool, sun and shade For soft-shelled turtles, a non-abrasive pool bottom is required. The pool must allow for complete submersion of the largest turtle. For each additional turtle, increase cage area by 5 times body size.
Tortoises *	For 1 tortoise: a land area 10 times body size, with sun and shade, and a sloped pool for immersion For each additional tortoise, increase cage area by 7 times body size.
Birds	For 1 - 2 birds: 1' x 1' x 10" high minimum, depending on species For additional birds, community cages must be sufficient to provide flight space

*Florida State Law, Code # 39-6.004

Chemical Approval Form

Use a separate form for each requested chemical

Approval only valid for a one time order of the requested chemical

Attach the appropriate Material Safety Data Sheet

Teacher:	School:	Phone:

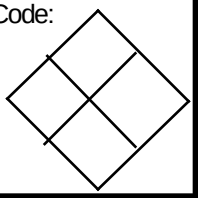
Type of Class: ☐ Regular/Honors ☐ Research ☐ AP/II

Use: Teacher Demo. only ☐ Student use ☐

Chemical Name:	Quantity:	Hazards:

Method of Disposal of Excess:

NFPA Code:



Purpose of Experiment / Activity :

Description of Experiment (include chemical's role in the experiment and safety precautions):

_____
Teacher Signature

_____
Department Chairperson Signature

_____
Principal Signature

Send completed form and MSDS to:
Secondary Science Resource Teacher
Office of Secondary Programs

_____
Approval Signature

Originator: copy to Teacher, Dept. Chairperson, Principal

MATERIAL SAFETY DATA SHEET

NAME & SYNONYMS	FLINN CATALOG NUMBER
METHYL ALCOHOL (Methanol)(Wood Alcohol)	MX054,MX055,MX056

FORMULA	FORMULA WEIGHT (FW)	CAS NO.
CH_3OH	32.04	67-56-1

PHYSICAL DATA (DENSITY, VOLUBILITY,ETC.)

Sp.Gr. 0.7924
Miscible with water, alcohol and ether.

APPEARANCE AND ODOR

Clear, colorless, mobile, highly polar liquid.

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Organic #2	Flammable Liquid	Stable

CONDITIONS TO AVOID

Avoid any source of ignition.

HEALTH HAZARDS (IF ANY)	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Toxic by ingestion (causes blindness).	200 ppm in air

FIRE HAZARD (IF ANY)

Flammable liquid; dangerous fire risk; flash point 54˚ F.
Use triclass, dry chemical fire extinguisher.

SPILLS AND LEAKS	DISPOSAL NO.
Absorb spill using sand or chemical absorption pillows or pads. Avoid any source of ignition, Follow suggested disposal procedure at right.	18 See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY)

Avoid large containers; dispense and use under a hood; store in an approved flammable cabinet. Chemical gloves and goggles.

FIRST AID (IF SUBSTANCE DANGEROUS)

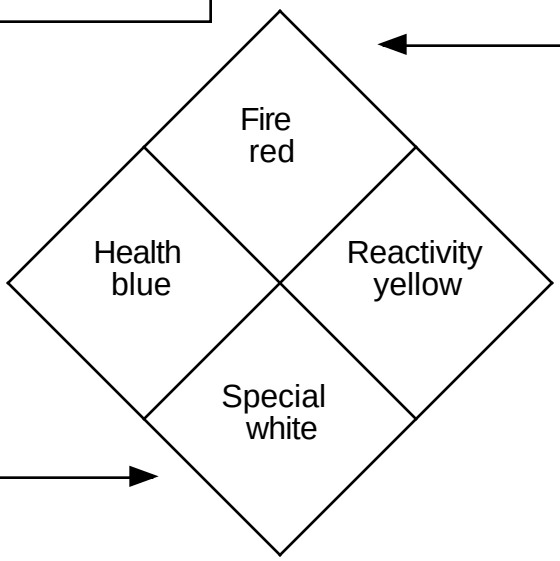
External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.

NFPA Symbol

The NFPA label includes a diamond-shaped symbol and ***must*** be placed on every stock chemical once it is received by the Science Department.

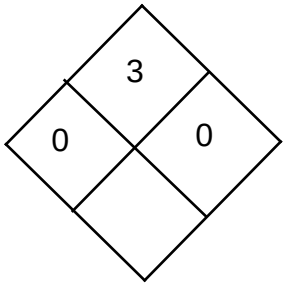
Health Hazard (blue)
0 None
1 Minor, slightly hazardous
2 Moderate, temporarily incapacitate
3 Severe, short exposure may cause residual damage if prompt medical attention is no obtained.
4 Extreme,short exposure may cause death (deadly)

Fire Hazard (red)
0 None, will not burn
1 Minor, must be preheated before ignition.
2 Moderate, some heat required for ignition.
3 Severe, Will ignite under normal temperature conditions.
4 Extreme, flammable liquid Flash point below 22.8^0 C.



Special Hazard (white)
Symbols that represent special storage and storage precautions.
W DO NOT expose to water
OXY oxidize
COR corrosive
COR corrosive
ACID acid

Reactivity (yellow)
0 None, stable
1 Minor, unstable if heated or exposed to water.
2 Moderate, unstable but will not deteriorate, can produce violent chemical reaction.
3 Severe, explosive if heated or water is added, shock may detonate.
4 Extreme, explosive under normal conditions.



Ethyl Alcohol
(store in flammable cabinet

Suggested Chemical Storage Pattern

Open Shelf Storage Patterns

Inorganic Chemical Families

Inorganic #10 sulfur phosphorus phosphorus pentoxide arsenic	**Inorganic #7** arsenates cyanides cyanates (store away from water)
Inorganic #2 halides, halogens sulfates, sulfites thiosulfates acetates phosphates	**Inorganic #5** sulfides, nitrides carbides, selenides phosphides
Inorganic #3 amides, azides nitrites nitrates (NOT ammonium nitrate) *see special storage note	**Inorganic #8** borates chromates manganates permanganates
Inorganic #1 metals hydrides (store away from water)	**Inorganic #6** chlorates, chlorites bromates, iodates hypochlorites peroxides
Inorganic #4 carbon oxides, silicates hydroxides carbonates	**miscellaneous**

Organic Chemical Families

Organic #2 carbohydrates glycols amines, amides imines, imides *see special storage note	**Organic #8** phenols cresols
Organic #3 hydrocarbons oils, esters aldehydes *see special storage note	**Organic #6** peroxides hydroperoxides azides
Organic #4 ethers ketones, ketenes ethylene oxide hydrated hydrocarbons *see special storage note	**Organic #1** amino acids anhydrides
Organic #5 epoxy compounds isocyanates	**Organic #9** dyes stains indicators alcohol-based solutions in flammable cabinet
Organic #7 sulfides polysulfides	**miscellaneous**

Approved Storage Cabinets

Flammable Chemicals

Organic | Compounds

NFPA flammability rating of 3 or 4

(alcohols, etc.)

Acids

Acids

* see special storage note*

*Special storage notes:

ammonium nitrate - *Never Store* <u>solid</u> ammonium nitrate on on IN-2 shelf. Store away from all other substances.

nitric acid - *Never Store* nitric acid in acid cabinet. Isolate on open shelf

flammables(NFPA rating 3 or 4) - *Must* be stored in dedicated flammable cabinet.
Most of these are members of chemical families found on shelves OR-2, OR-3, OR-4 and OR-9.

NSTA Position Statements

Laboratory Science

The inquisitive spirit of science is assimilated by students who participate in meaningful laboratory activities. The laboratory is a vital environment in which science is experienced. It may be a specially equipped room, a self-contained classroom, a field site, or a larger place, such as the community in which science experiments are conducted. Laboratory experience is so integral to the nature of science that it must be included in every science program for every student. Hands-on science activities can include individual, small, and large group experiences.

Problem-solving abilities are refined in the context of laboratory inquiry. Laboratory activities develop a wide variety of investigative, organizational, creative, and communicative skills. The laboratory provides an optimal setting for motivating students while they experience what science is.

Laboratory activities enhance student performance in the following domains:

- process skills: observing, measuring, manipulating physical objects
- analytical skills: reasoning, deduction, critical thinking
- communication skills: organizing information, writing
- conceptualization of scientific phenomena.

Since the laboratory experience is of critical importance in the process of enhancing students' cognitive and affective understanding of science, the National Science Teachers Association makes the following recommendations.

Preschool/Elementary Level

- Preschool/Elementary science classes must include activity-based, hands-on experiences for all children. Activities should be selected that allow students to discover and construct science concepts; and, after the concept is labeled and developed, activities should allow for application of the concept to the real lives of students. Provisions also need to be included for inquiry activities in which students manipulate one variable while holding others constant and establish experimental and control groups.
- Children at all developmental levels benefit from science experiences. Appropriate hands-on experiences must be provided for children with special needs who are unable to participate in classroom activities.
- A minimum of 60 percent of the science instruction time should be devoted to hands-on activities, the type of activities where children are manipulating, observing, exploring, and thinking about science using concrete materials. Reading about science, computer programs, and teacher demonstrations are valuable, but should not be substituted for hands-on experiences.
- Evaluation and assessment of student performance must reflect hands-on experience. The full range of student experience in science should be measured by the testing program.
- Hands-on activities should be revised and adapted to meet student needs and to enhance curricular goals and objectives. There should be ongoing dissemination of elementary science education research results and information about supplementary science curricula.

- Hands-on activities must be supported with a yearly building science budget, including a petty cash fund for immediate materials purchase. Enough supplies, e.g. magnets, cells, hand lenses, etc., should be purchased, permitting each child to have hands-on experiences. Many science activities can also be taught using easily accessible, free and inexpensive materials.
- Reasonable and prudent safety precautions should always be taken when teachers and students are interacting with manipulative materials. (See NSTA publication: Safety in the Elementary Science Classroom)
- /Elementary science should be taught in a classroom with sufficient work space to include flat moveable desks or tables/chairs, equipment, and hands-on materials. Consideration should be made for purchase and storage of materials with convenient accessibility to water and electricity. Computers, software, and other electronic tools should be available for children's use as an integral part of science activities.
- Parents, community resource people, and members of parent/teacher organizations should be enlisted to assist preschool/elementary teachers with science activities and experiences. For example, these individuals could act in the role of field trip chaperones, science fair assistants, material collectors, or science classroom aides.
- The number of children assigned to each class should not exceed 24. Teachers and children must have immediate access to each other in order to provide a safe and effective learning environment.

Middle Level

- All middle level science courses must offer laboratory experiences for all students. Students at all developmental levels benefit from the laboratory experience.
- A minimum of 80 percent of the science instruction time should be spent on laboratory-related experience. This time includes pre-lab instruction in concepts relevant to the laboratory, hands-on activities by the students, and a post-lab period involving communication and analysis.

Computer simulations and teacher demonstrations are valuable but should not be substitutions for laboratory activities.

Investigations should be relevant to contemporary social issues in science and technology. (Note the NSTA Position Paper on Science-Technology-Society.) In those schools where team teaching is practiced, science topics should be integrated with the other academic areas.

- Evaluation and assessment of student achievement in science should reflect the full range of student experiences, especially laboratory activities.
- Laboratory activities in science need to be subjected to continual professional review. A need exists for ongoing research to evaluate the merit of certain laboratory activities, especially some traditional verification labs. Laboratory activities should be screened for safety and new activities need to be developed. An emphasis must be placed on disseminating new information to teachers.
- An adequate budget for facilities, equipment, and supplies must be provided to support the laboratory activities. The budget needs to provide funds for the purchase of locally available materials, as needed, during the course of the school year.

Training in laboratory safety must be provided to the teacher. Necessary safety equipment, such as safety goggles, fire extinguishers, and eye washes, must be provided and maintained.

- Due to the nature of middle level science activities, teachers should not have to share a laboratory with other teachers. A combination science-laboratory room should be used by only one teacher. This room should have at least one resident computer.

In schools where students are grouped together in interdisciplinary teams, it is more important for science to be taught in a well-equipped science laboratory than to have all students in a team in close proximity to one another learning science in a regular classroom.

- A competent student laboratory assistant should be provided to assist with laboratory preparation. It is a valuable experience for the student and helps alleviate some of the teacher's time spent setting up and cleaning up activities.
- The number of students assigned to each class should not exceed 24. The students and teacher must have immediate access to each other for there to be a safe and effective learning environment.

High School Level

- All high school science courses must offer laboratory experiences for all students. Experiences must be provided for students who are unable to participate in specific laboratory activities.
- A minimum of 40 percent of the science instruction time should be spent on laboratory-related activities. This time includes pre-lab instruction in concepts relevant to the laboratory, hands-on activities by the students, and a post-lab period involving communication and analysis. Computer simulations and teacher demonstrations are valuable but should not be substitutions for laboratory activities.

Investigations relevant to contemporary social issues in science and technology should be encouraged. (Note the NSTA Position Paper on Science-Technology-Society.)

- Evaluation and assessment of student performance must reflect the laboratory experience. The full range of student experience in science should be measured by the testing program.
- Laboratory activities in science need to be subjected to continual professional review. A need exists for ongoing research support for evaluating laboratory activities and their appropriate use at particular grade levels, for screening activities to ensure safety, and for developing new laboratory activities. Special emphasis must be placed on disseminating the results of this research to teachers.
- An adequate budget for facilities, equipment, supplies, and proper waste management must be provided to support the laboratory experiences. Equipment and facilities must be maintained and updated on a regular basis. Unique instructional supplies must be provided in sufficient quantity that students have a direct, hands-on experience. For some activities, funds for field experiences must also be included in the budget.
- Science should be taught in a space specifically dedicated to science classes with provisions for laboratory activities. A safe and well-equipped preparation and work space

for students and teacher must be provided. Adequate storage space for equipment and supplies, including a separate storage area for potentially dangerous materials, must be provided. Special considerations should be given to ensure laboratory safety for the teacher and the students. Accommodation must also be made for computers and other electronic equipment in order to provide easy access for students to use these devices as laboratory tools.

- A competent paraprofessional should be provided to assist with preparation for laboratory experiences, including set-up and clean up, maintaining community contacts, resources searching, and other supportive services.
- No more than two different preparations should be assigned to the teacher for any academic term. The development, implementation, and evaluation of effective laboratory activities require extensive time by the teacher.
- The number of students assigned to each laboratory class should not exceed 24. The student must have immediate access to the teacher in order to provide a safe and effective learning environment.

College Level

- All introductory science courses must include laboratory experiences for all students, both science majors and non-majors. Studies in all sciences and at all levels are enhanced by laboratory experience. Appropriate hands-on experiences must be provided for students with special needs who are unable to participate in laboratory activities.
- College science curricula and/or programs must include a minimum of 40 percent and generally more than 50 percent of science instruction time on laboratory-related activities. This time includes pre-lab instruction in concepts and skills relative to the lab, hands-on activities by the students and post-lab discussion.

Computer simulations, video presentations, and teacher demonstrations are valuable and may be desirable at times but should not be substitutions for lab activities.

Investigations relative to contemporary social issues in science and technology should be encouraged.

- Evaluation and assessment of student performance must reflect the laboratory experiences. The full range of student experiences in science should be measured.
- Reduced teaching assignments should be provided for college teachers for the evaluation of laboratory activities and the development, implementation, and evaluation of new, effective, and safe laboratory activities.
- An adequate budget for facilities, equipment, supplies, and proper waste management must be provided to support the laboratory experiences. Equipment and facilities must be maintained and replaced on a regular basis. Computers and other instrumentation must be accommodated in order to provide secure and easy access for students to use in laboratory activities. Instructional supplies must be provided in sufficient quantity that students have a direct, hands-on, experience. Funds for pertinent field experiences, including supplies, transportation, and professional guides, where needed, should be available.
- Special attention should be given to ensure laboratory safety for the teacher and students. Science should be taught in facilities with provisions for laboratory activities. Sufficient

work space and storage space for equipment and supplies, including a separate storage area for potentially hazardous materials, must be provided.

- Competent assistance should be provided to help with laboratory preparation and clean up, activities which represent an inefficient use of teacher time.
- The same teaching credit should be given to one hour of laboratory time as is given to one hour of lecture time. Teachers in the laboratory must constantly monitor student learning and anticipate, recognize, and respond to problems that arise.
- The number of students assigned to each laboratory class should not exceed the allotted work space or available equipment. In general, no more than 25 students should be assigned to a laboratory where a single instructor is present. Students must have immediate access to the teacher to provide a safe and effective learning environment.

-- *Adopted by the NSTA Board of Directors in January, 1990*

Resources

General Science Safety

Association for Science Education, "Safety Articles from ASE Journals". http://www.ase.org.uk/safety0.html, Articles by title on science safety from Association for Science Education Journals.

Fleming, Diane O., Richardson, John H., Tulis, Jerry I., Laboratory Safety : Principles and Practices, 2nd ed. American Society of Microbiology, 1995

The Forum for Scientific Excellence, Inc, Handbook of Chemical and Environmental Safety in Schools and Colleges. J.B. Lippincott Company, Philadelphia, PA 1990

Furr, A. Kieth. CRC Handbook of Laboratory Safety, 4th ed. Boca Raton, FL : CRC Press, Inc., 1995

Manitoba Education and Training, "Science Safety: A Kindergarten to Senior 4 Resource Manual for Teachers, Schools, and School Divisions", http://www.edu.gov.mb.ca/metks4/docs/support/scisafe/index.html, Safety manual for Manitoba, Canada.

Pipitone, David A. Safe Storage of Laboratory Chemicals, 2nd ed. John Wiley & Sons, 1991

Material Safety Data Sheet

Glossary/list of terms used with MSDS
http://www.pp.okstate.edu/ehs/hazcom/hc-def.htm

Glossary of common terms used with MSDS
http://physchem.ox.ac.uk/MSDS/glossary.html

"History of the MSDS". http://www.phys.ksu.edu/~tipping/msdshist.html, History and development of material safety data sheets.

MSDS Guide & Online MSDS Sources, "How to read the MSDS".
http://www.maricopa.gov/sbeap/msdsguid.htm Short guide on how to read MSDS.

MSDS sites,
http://www.yahoo.com/Health/Workplace/MSDS_Material_Safety_Data Sheets/
,several links to material safety data sheet information. /

Northwest Fisheries Science Center, "Material Safety Data Sheet Searches".
http://www.reserach.nwfsc.noaa.gov/msds.html, Links to publicly accessible MSDS information.

Stains File, "MSDS and Safety". http://www.members.pgonline.com/~bryand/safety.htm Links to publicly accessible MSDS information.

Science Laboratory Science

NSTA, "An NSTA Position Statement: Laboratory Science". NSTA position state on laboratory science, preschool/elementary level, middle school level, high school level and college level. http://www.nsta.org/handbook/labsci.htm

Resource Books

Bernstein, Leonard, Teacher's Resource Book for Biology. Englewood Cliffs, NJ: Globe Book Company, 1990.

Bloom, Ann., Focus on Life Science Teacher Resource Book. Merrill Publishing Company, 1989.

School Science Safety and the Law

"Chapter 6A-2, Florida Administrative Code", Rules of Florida State Board of Education Educational Facilities. Tallahassee, FL: Department of Education 1986.

"Florida Right-to-Know Law Chapter 442 Florida Statutes", Florida Statutes. Tallahassee, FL. State Department, 1987.

No one knows what he can do till he tries.

Publius Syrus