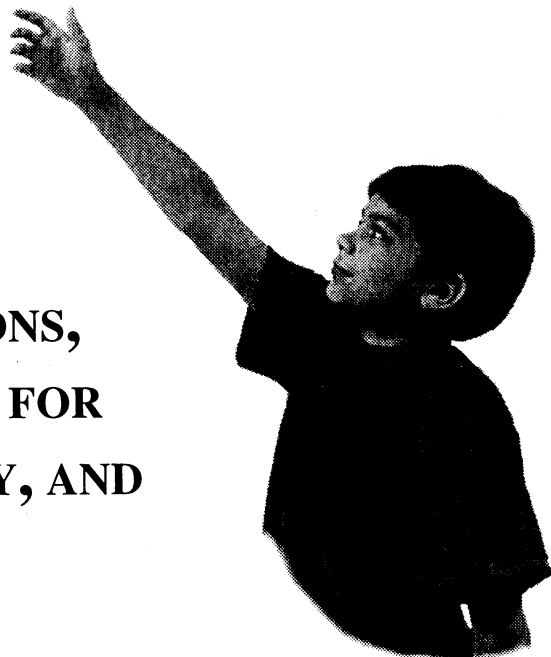


TEXAS SAFETY STANDARDS

Kindergarten
through
Grade 12



**A GUIDE TO
LAWS, RULES, REGULATIONS,
AND SAFETY PROCEDURES FOR
CLASSROOM, LABORATORY, AND
FIELD INVESTIGATIONS**



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TEXAS EDUCATION AGENCY
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TEXAS SAFETY STANDARDS

KINDERGARTEN
THROUGH
GRADE 12



**A Guide to Laws, Rules,
Regulations and
Safety Procedures
for Classroom,
Laboratory, and Field
Investigations**

Second Edition
2000



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INQUIRY OPENS THEIR MIND...



...GUIDE THEIR JOURNEY SAFELY

Dedicated to the children of the Charles A. Dana Center...

Rachael Bushn
Erin Cole
Kim Collins
Traci Collins
Christine Evans
Ruby Youker Shell
Julie Tran
Cara Westbrook
Erica Westbrook
Adan Yanez

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Jim Nelson

Commissioner of Education

January 7, 2000

To the Administrator and Science Teacher Addressed:

Citizens of our state are dependent upon science as never before. Our economy is in the midst of a transformation in which peoples' livelihoods depend less upon what they can produce through their labor and more on what they can produce through their ideas. Science leads the way in this conceptual-based economy. Scientific literacy is an essential tool for every Texas citizen.

The Texas Essential Knowledge and Skills require students to understand and do science. Students must not only learn content, they must understand the processes associated with science, including observation, model building, and inquiry. These science skills can best be understood through active learning practiced in the science classroom as well as in field and laboratory experiences. As we encourage students to collect data and carry out investigations, we must be aware of their safety.

The purpose of this document is to provide guidelines for developing a safety program both at the campus and district level. A commitment to safety demands a team effort with everyone, from administrators to support staff, teachers, parents, and students alike, sharing the responsibility for safety.

As we move forward into the millennium, we must help our students learn and use science in a safe environment.

Sincerely yours,

Jim Nelson
Commissioner of Education

INTRODUCTION

The State Board of Education, during the July 11, 1997 meeting, adopted rules on curriculum in Texas Administrative Code, Title 19, Part II. Chapter 74, Subchapter A, Required Curriculum. As a result, a school district that offers Kindergarten through Grade 12 must offer science as a required curriculum and provide instruction in the Texas Essential Knowledge and Skills at the appropriate levels. These rules allow school districts to add elements to the Texas Essential Knowledge and Skills for Science at its discretion but it must not delete any knowledge and skill or omit instruction in science.

The rules in §74.2 describe the required curriculum for the elementary grades. If a school district offers Kindergarten through Grade 5, it must ensure that sufficient time is provided for teachers to teach and for students to learn science. Likewise, a school district that offers Grades 6-8 must also provide instruction in science and assure

that teachers will have adequate time to teach science and students have time to learn the concepts and use the science processes.

A school district that offers Grades 9-12 must also provide instruction in science and ensure that sufficient time is provided for teachers to teach and students to learn science. The rule further requires that all science courses in secondary grades (9-12) shall devote at least 40% of the instructional time to hands-on laboratory investigations and fieldwork using appropriate scientific inquiry.

The Texas Essential Knowledge and Skills for Science (Kindergarten-Grade 12) require "students to conduct field and laboratory investigations using safe procedures and environmentally appropriate and ethical practices." Students are to know and understand safe practices and be able to demonstrate them in laboratory or field settings.

"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."

NSTA: *Laboratory Science*, 1990

WHAT IS A LABORATORY INVESTIGATION?

Laboratory settings enable different types of instructional strategies to be experienced in which the teacher and student take responsibility for the structure and sequence of an investigation activity.

For example:

- * Verification Laboratory—an instruction procedure in which the cause, effect, nature, or property of any phenomenon is

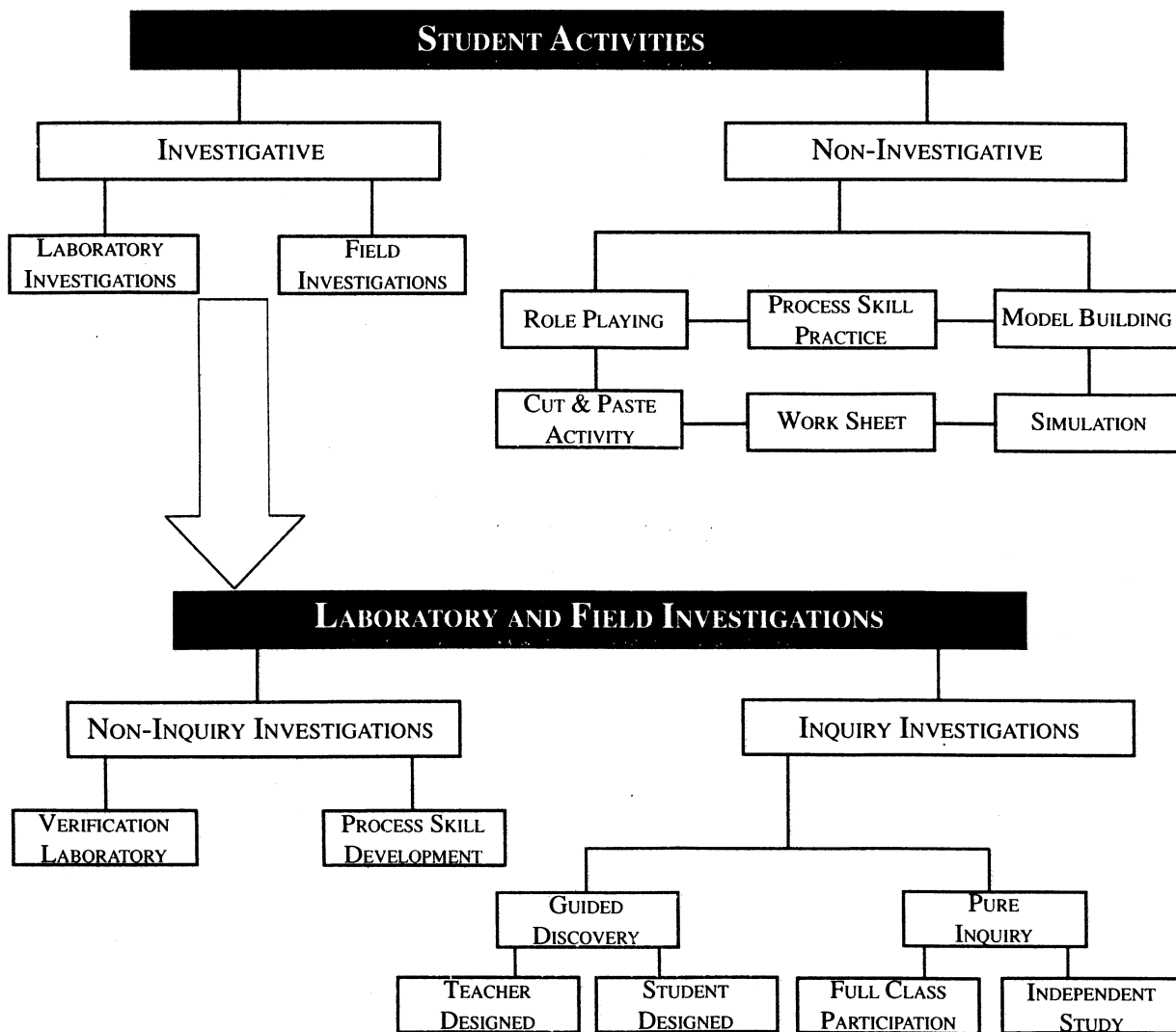
determined by actual experience or experiment under controlled conditions. In this laboratory experience the teacher constructs a laboratory procedure and the student follows the directions and if successful, confirms known results.

- * Guided Discovery—the teacher presents students with a problem and the teacher (teacher designed) or student (student designed) develops a research design to test a hypothesis related to the problem. The teacher guides the process until the student successfully has tested the hypothesis.
- * Pure Inquiry—students find answers for themselves. Students are involved in learning how to learn.

- * Process Skill Practice—the objective is to teach a manipulative laboratory skill. These skills may be integrated with another activity.
- * Process Skill Development—provide opportunities for students to practice scientific processes in science investigations and problem solving.
- * Independent Study—an arrangement that allows students the opportunity to explore in greater depth an area of interest not normally studied by an entire class.

Planning a Safe and Effective Learning Environment, 1985

The following flow charts identify other types of student activities that include laboratory and field investigations.



WHAT QUALIFIES AS LABORATORY INVESTIGATION?

Pre-laboratory activities, the laboratory experience, and post-laboratory activities constitute a laboratory or field investigation. Pre-lab activities introduce students to the laboratory experience. They can gain important information about a science concept, plan strategies for conducting a successful investigation, and discuss techniques that may be used during the investigation. The laboratory experience is the hands-on portion of the investigation that involves the students' direct participation in activities may include analyzing information gathered during the laboratory experience, drawing conclusions, and producing graphs, maps, charts, or spreadsheets to assist with the communication of their findings.

Conclusions may lead to a need for further investigations that can be discussed and planned during the post-laboratory activities.

Demonstrations are an important method of introducing a science concept or reinforcing a student's understanding of the concept, but demonstrations do not count as laboratory investigations.

Similarly, computer laboratory simulations are not to be viewed as a laboratory investigation, but should be considered an important instructional strategy in a hands-on experience.

WHAT IS A FIELD INVESTIGATION?

Field experiences or investigations are an integral part of any science program. The importance and relationship of field investigations to the curriculum of the natural sciences cannot be minimized and, in many cases, is essential for the application of key concepts. Significant gains in learning may only be achieved through field experiences in some instances.

Field investigations take students out of the school setting and into industries, universities, governmental agencies, energy and utility companies, and natural areas to discover the applications of science in technology and research. Career awareness is an important result of these experiences.

A field experience may have several purposes and serve a variety of instructional objectives.

Field investigations should:

- * contribute to the understanding of science concepts in the natural world.
- * allow students to do what real scientists do.
- * provide an opportunity to collect real data.
- * model real applications of science.
- * connect science disciplines to future careers.

Experiences gained during a field investigation can motivate students to learn more about what they have observed and can serve to bridge the gap between the written text and the actual experiences of working in a natural setting.

WHY SAFETY?

Learning science concepts and doing science processes must be achieved in a safe learning environment. It is not the responsibility of the teacher alone to assure that safety practices are followed in the

classroom. Safety is the responsibility of students, teachers, the science department chairperson or lead teacher, the science supervisor, district administrators, and the State Board of Education.

Safety Is Everyone's Responsibility

THE SCIENCE STUDENT

The science student should not expect the teacher to “shoulder the entire responsibility” for a safe learning environment in the science classroom and laboratory. Each student must contribute to the safety of others and help maintain an atmosphere of safe learning. Students can provide this by accepting a few basic responsibilities.

RESPONSIBILITIES

1. Read and study the science activity or laboratory investigation prior to coming to class.
 - * ask questions concerning the activity before beginning the exercise
 - * identify and understand the hazards and necessary precautions you need to take
 - * understand the concept of the investigation and know how to proceed with the investigation
2. Know and follow all safety rules prior to the first investigation.
 - * read, understand, and sign the safety contract (Appendix D: *Safety Forms*)
 - * wear the appropriate protective equipment such as goggles and laboratory aprons
 - * tie back long hair to keep it away from chemicals, open flames, or equipment
 - * tie back or remove articles of clothing or jewelry that could touch chemicals or flames during investigations
 - * wear shoes that enclose the feet—no sandals or open-toe shoes
 - * never eat or drink anything while in the laboratory
 - * locate the safety equipment such as the eyewash station and know how to use it correctly
- * know where the exits are located and the proper procedures to be followed in an emergency
- * wear splash-proof safety goggles until all chemicals have been returned, glassware cleaned, and equipment properly stored
3. Be alert during the laboratory time. Watch for potential problems and report unsafe situations immediately. Do not work alone in the laboratory.
4. Do not attempt unauthorized activities. Work only on authorized activities that are related to the investigation.
5. If a chemical spill occurs, report it immediately and follow the instructions of the teacher.
 - * move quickly from the site
 - * wash off chemicals that have splashed onto the skin or clothing for 15 minutes with large amounts of water, using the safety shower or eyewash
6. Keep your area clean. Clean up the area at the end of the class. Dispose of biological and chemical waste properly.
7. Do not enter preparatory or equipment storage rooms or chemical storerooms.
8. Always wash your hands for at least 20 seconds with soap and warm water before leaving the laboratory.

THE SCIENCE TEACHER

Classrooms and science laboratories may be crowded, increasing the probability of accidents. Advanced planning and preparation can be the best safety practice a teacher can use to reduce accidents.

RESPONSIBILITIES

1. Understand each science laboratory or field investigation in advance.
 - * Carefully read and scrutinize all investigations and activities for safety procedures and materials the students will be handling.
 - * Read and understand the information on Materials Safety Data Sheet (MSDS) related to chemicals or other hazards that will be used in the laboratory.
 - * Seriously consider all the hazards discussed in the MSDS and determine if the chemicals are safe for students to use. Consider substitute chemicals or procedures.
 - * Do a trial laboratory experience if you have not done the investigation before.
 - * Remember, teachers and students are to wear protective eye wear and clothing when appropriate.
 - * Anticipate what could go wrong during a typical laboratory experience and take measures to reduce the probability of an accident occurring.
2. Make pre-laboratory activities a regular routine before taking students into a laboratory setting. Go over all safety precautions in the investigation and answer questions and concerns before beginning the activity.
3. Label all chemicals correctly and clearly. (Chapter VI: *Chemical Safety*)
4. The materials to be used during the laboratory investigation should be arranged carefully and in a safe area for students to use.
5. Maintain order and discipline during the activity. Safety rules are to be obeyed by all students.
6. Monitor the laboratory room or field site. Work with students to correct any procedure or behavior that is not safe.
7. Students should promptly clean up their area while wearing safety goggles. Chemicals and biological wastes should be disposed of correctly.
8. If accidents do occur, follow the school district's policy and guidelines on first aid and reporting the accident. Do not wait to write a report of what caused the accident, injuries, action taken, and results. A more accurate description can be made soon after an accident occurs.

THE SCIENCE CHAIR AND LEAD TEACHER

The science chairperson and lead teacher must have safety as a high priority. They should monitor the safety in laboratory, preparatory, and storage rooms.

RESPONSIBILITIES

1. A monthly schedule for inspecting laboratory facilities, preparatory and equipment rooms, and storage rooms should be developed. Identify problem areas and develop plans to improve safety.
2. The school district's procedures for proper disposal, labeling, and the handling of chemicals should be discussed with the science teachers.

3. Announce additions to the MSDS library as new chemicals and hazardous materials are added to the department. Each teacher should be made aware of the hazards of new chemicals.
4. Work with teachers to keep students in compliance with the safety rules. The chairperson and lead teacher should set and model high standards of safety.
5. Assist with emergency actions that are needed for laboratory accidents, assistance to the injured person, and cleaning up of chemical spills, broken glassware, and fires. Planning and advance preparation will help everyone to stay calm, and think clearly if an accident does happen.
6. Work with science teachers in the reporting and investigating of an accident. The purpose of the investigation is to determine the cause and make corrections if possible, not to place blame.
7. It should be the responsibility of the science chairperson to maintain a file and record of documentation of accidents.

THE SCIENCE SUPERVISOR

The science supervisor has considerable responsibility in directing the science curriculum of the school district. The science supervisor should work closely with chairpersons and lead teachers on the science safety program and be a liaison between central administrators and school campuses. Most of the responsibilities related to safety generally are those of the science supervisor. The science supervisor should conduct annual safety professional development and provide safety updates to the science teachers regularly.

RESPONSIBILITIES

1. Assist the science chairperson and lead teacher on each campus on requirements in the Hazard Communications Act.
2. Monitor all laboratory facilities for required safety equipment. The safety equipment needs to be installed correctly and function properly. An annual check of each campus, including chemical storerooms and preparatory and equipment rooms, should be part of the routine tasks. (Appendix E: *Science Facility Safety Checklist*)
3. Work with the campus science chairperson and lead teacher in reviewing science laboratory and field investigations for safe practices and safe use of materials. Consider alternate investigations where safety might be compromised in existing investigations.
4. Require an annual chemical inventory on each campus. Materials Safety Data Sheets must be kept on all chemicals in the school's science work area.
5. Discuss the school district's process and procedure for properly disposing of chemicals and biological waste with teachers. Teachers should be made aware of their obligations in following designated procedures for chemical waste disposal.
6. Be well informed of the laws, rules, and regulations concerning safety and conduct professional development on safety.
7. Become active in state and national science organizations for access to current information.

THE ADMINISTRATOR

A school district's administrators, whether on the campus or in the district's central offices, have a crucial role in assuring that the students and teachers work and learn in an environment that is safe.

RESPONSIBILITIES

Develop a district safety policy and provide a safety program that includes:

1. implementing the school district's safety program,
2. supporting professional development on safety,
3. developing emergency procedures,
4. ensuring that science classes do not have more than 24 students or science classes do not exceed the number of work stations in a laboratory room,
5. providing laboratory facilities with two exits, proper lighting and ventilation, master utility cutoff valves, safe, sufficient, and properly located electrical outlets,
6. providing necessary safety equipment such as eyewash stations, fume hoods, safety showers, fire extinguishers, safety eye wear, fire blankets, chemical spill kits, etc.,
7. conducting annual inspections and a maintenance program to ensure safe working conditions,
8. producing safety policies that can be adopted by the local school board and implemented on all campuses,
9. maintaining compliance with the Texas Hazard Communications Act, and
10. providing district's procedures for proper disposal of chemicals and biological wastes.

Science Laboratory Safety and Chemical Waste Disposal for Texas Teachers, 1990

LAWS, RULES, AND REGULATIONS

The purpose of this chapter is to present the laws, rules, and regulations necessary for a safe learning environment in science laboratories, classrooms, and field investigations. Providing a safe environment for students is not the responsibility of the teacher, but is shared with students and building and central office administrators as well.

The *National Science Education Standards* recommends approaching safety as...

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

National Research Council, National Academy of Science, 1996

As science educators, teachers have the responsibility to show by example and to teach the need for safe work habits and interaction with the environment. To understand this responsibility, teachers must have a working knowledge of federal, state, and local laws, rules, and regulations including the actions required by you and others under these requirements. The federal and state laws are very specific about what safety requirements are to be used in the science laboratory and classroom. Local safety codes can be acquired from the city government offices in your community.

A summary of the relevant laws, rules, and regulations related to safety in Texas' schools is presented in this chapter. For the complete version of each of these laws, rules, and regulations, please refer to Appendix A: *Laws, Rules, and Regulations*.

FEDERAL LAW

INDIVIDUALS WITH DISABILITIES EDUCATION ACT

Public Law (P.L.) 105-17. A school district must ensure that students with disabilities are not excluded from participation in, or denied the benefits of, its services, programs, and activities (Least Restrictive Environment). It must also ensure that they

are not subjected to discrimination by the school system. Therefore, certain modifications in laboratory design may be necessary to accommodate a students with disabilities so that they may participate in laboratory investigations safely.

STATE LAWS, RULES, AND REGULATIONS



AUTHORITY OF THE STATE BOARD OF EDUCATION

The State Board of Education (SBOE) is assigned specific rulemaking authority under the Texas Education Code (TEC). SBOE rules are codified under the Texas Administrative Code (TAC). The TAC is the official compilation of all final state agency rules published in the Texas Register. Following its effective date, a SBOE rule is entered into the TAC under Title 19, Part II. Title 19 is Education, and Part II is the Texas Education Agency. Under the Texas Education Code, the Commissioner of Education is also authorized to adopt rules governing specified areas of education. Commissioner's rules are also part of the TAC, Title 19, Part II.

TEXAS EDUCATION CODE, TITLE 19

TEXAS EDUCATION AGENCY

REMOVAL OF A DISRUPTIVE STUDENT

Chapter 37. Discipline: Law and Order. A teacher may remove a student from the classroom or laboratory and send the student to the principal's office for disruptive behavior to maintain effective discipline and a safe environment.

PROTECTIVE EYE DEVICES

Chapter 38. Protective Eye Devices in Public Schools. Teachers and students are required to wear protective eye devices during science investigations or activities where harmful materials or substances are being used. Local school districts must adopt rules designating when protective eye devices should be worn and the type necessary under these conditions. This requirement applies to anyone observing a science investigation or activity where protective eye devices are required to be worn by the teacher and students.

EDUCATOR'S CODE OF ETHICS

Chapter 247. The Code of Ethics and Standard Practices for Texas Educators requires educators to:

- * comply with written local board policies, state regulations, and other applicable state and federal laws.
- * make reasonable efforts to protect the student from conditions detrimental to learning, physical health, mental health, or safety.
- * not exclude a student from participation in a program, deny benefits to a student, or grant an advantage to a student on the basis of race, color, sex, disability, national origin, religion, or family status.

TEXAS EDUCATION AGENCY

SCHOOL FACILITIES STANDARDS

Chapter 61. Commissioner's Rules Concerning School Facilities. Standards for science classrooms and combination lecture/laboratories are defined in this chapter of the Texas Administrative Code.

Square feet per room measurements

The net footage of a room that will house 22 students at the elementary level and 25 students at the middle or high school level. The net square footage of a room includes exposed storage space, such as cabinets or shelving, but does not include hallway space or storage space, such as closets or preparation offices.

Space, minimum square footage requirements

Specialized classrooms. Science lecture/lab shall have a minimum of 41 square feet per pupil or 900 square feet per room at the elementary school level; 50 square feet per pupil or 1,000 square feet per room at the middle school level; 50 square feet per pupil or 1,200 square feet per room at the high school level.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS

Chapter 112. Required Curriculum. Safety during laboratory and field investigations is required beginning with Kindergarten and continuing through Grade 12. The Texas Essential Knowledge and Skills for Science require that as part of the regular instruction in science, students participate in and conduct investigations. For example:

- * Kindergarten-Grade 5, students participate and conduct laboratory investigations following home and school safety procedures that are environmentally appropriate and follow ethical practices.

- * Grades 6-8, students conduct field and laboratory investigations using safe, environmentally appropriate, and ethical practices.

- * Grades 9-12, the students, for at least 40% of instructional time, conduct field and laboratory investigations using safe, environmentally appropriate, and ethical practices.

40% LABORATORY AND FIELD REQUIREMENT

Chapter 74. Curriculum Requirements. In addition to the requirements found in the Texas Essential Knowledge and Skills for Science, The State Board of Education defined the percentage of the instructional time that is to be laboratory instruction. High school courses shall include at least 40% hands-on laboratory investigations and field work using appropriate scientific inquiry.

TEXAS DEPARTMENT OF HEALTH

FACE AND EYE PROTECTION STANDARDS

Chapter 295. Standards for Face and Eye Protection in Public Schools. This chapter applies to teachers and students in Texas public schools participating in science courses and laboratories where potentially hazardous activities exist. The law requires that:

- * local school boards and administrators furnish eye protectors of the type suitable for the work performed.
- * eye protection equipment be worn when there is a reasonable probability of injury to the body
- * the eye protectors be kept clean and in good repair.
- * teachers and students who wear corrective lenses must be provided goggles that can be worn over corrective spectacles without disturbing the adjustments of the spectacles.

HAZARDOUS SUBSTANCES

Chapter 501. Description of Hazardous Substance. This chapter defines the kinds of hazardous substances that may be found in the science laboratory. It clarifies that public school employees are not required to comply with the Occupational Safety and Health Administration (OSHA) standard on hazardous substances.

It clarifies that students are not defined as employees for the purpose of the Texas Hazard Communications Act. Therefore, the Act is not applicable to students in their capacity as students. (July 21, 1993 ruling of the Texas Attorney General, Opinion No. DM-239)

HAZARD COMMUNICATIONS ACT (HAZCOM)

Chapter 502. Hazard Communications Act. This chapter requires that:

- * a chemical manufacturer is required to provide Material Safety Data Sheets (MSDS) to employers who acquire hazardous chemicals. It further requires employers to maintain a legible copy of a current MSDS for hazardous chemicals used in the workplace that are legible, accurate, and readily available to employees on request at each workplace.
- * labels are to be on existing containers of hazardous chemicals. Employees may not be required to work with hazardous chemicals from unlabeled containers.
- * an education and training program for all employees who use or handle hazardous chemicals be established. It requires employers to maintain a written hazard communication program that specifies certain contents of the program, who is to receive training and maintain training records.
- * employers post and maintain adequate notice informing employees of their rights under the Hazard Communications Act.

VOLUNTARY INDOOR AIR QUALITY GUIDELINES FOR PUBLIC SCHOOLS

Chapter 297. Voluntary Indoor Air Quality Guidelines. This set of guidelines presents three voluntary recommendations.

- * Establish guidelines for initial program development, a management plan, and school board review for program status and future needs of public schools.

- * Develop a written preventive maintenance program for a healthy learning environment for students.

- * Recommends considerations for students with allergies or chemical intolerances, handling of foods, garbage storage and disposal, smoking, and reporting of conditions that are not conducive to clean air.

CIVIL PRACTICE AND REMEDIES CODE, TITLE 5

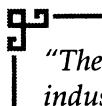
TEXAS STATE LAW

SAFETY AND TORT LAW

The obligation to comply with legal safety requirements and recommendations affords school districts the opportunity and means to provide exemplary science learning in a safe environment. The potential for lawsuits increases when the school district fails to provide these safe conditions for teachers and students.

Texas governmental entities are generally immune from tort liability under the doctrine of sovereign immunity. However, governmental immunity can be waived under certain instances as found in the Texas Tort Claims Act, Civil Practice and Remedies Code 101.001 et. Seq. Professional employees may be held liable in circumstances involving: use of excessive force in the discipline of students; negligence resulting in bodily injury to students; or the operation, use, or maintenance of any motor vehicle.

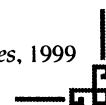
Public educators are expected to minimize the risk of accidents to students in science classrooms and laboratories. According to the National Science Teachers Association...



"The accident rate in schools is 10-50 times higher than that of the chemical industry. Research goes beyond the headlines to look at the factors that accompany school accidents, which include:

- * *inadequate or poorly designed working space, overcrowding, and too few work stations*
- * *teachers with poor course work preparation*
- * *teachers who are teaching more than two preparations at the same time*
- * *inadequate safety training."*

NSTA, *Guide to School Science Facilities*, 1999



CONDITIONS AFFECTING SAFE SCIENCE CLASSROOMS

OVERCROWDING AND SAFETY

Class size has become a real safety issue. Overcrowding in science classrooms and laboratories, where equipment and chemicals are used, must be a safety concern to every teacher and administrator. The connection between safety in science facilities and overcrowded conditions may result in liability problems for the school district.

The National Science Teachers Association recommends the maximum class size for:

Elementary School.....22 per class
Middle School.....24 per class
High School.....24 per class

Overcrowding that results in injury has resulted in negligence in other states. In one case, *Bush v. Oscoda Area Schools, 1981*, the principal and teacher became the focus of a law suit.

(*Bush v. Oscoda Area Schools, 109 Mich.App. 373, 311 N.W.2d 788 (Mich.App. 1981)*)

A 14-year-old girl was severely burned when the plastic jug of alcohol she was carrying exploded. The jug was used to transport alcohol to fill portable alcohol burners in a science class. Because of overcrowded conditions, the science class was being taught in a non-science classroom. The parents sued the school district resulting in a verdict against the principal of the school and the science teacher. The principal was found negligent for scheduling a science class in a room that was not properly equipped for science instruction. The teacher was found negligent for conducting the class in unsafe and inadequate conditions.

The frequency of accidents related to the number of students in a laboratory at one time is supported by data. According to Macomber, 1961, these data show that accidents are more frequent as the class size increases and the more serious the injuries become. Similar results were documented by Ward and West in a study conducted in Texas' schools.

Distribution of Laboratory Accidents by Seriousness and Class Size

Class Size	Number of Instructors	% of Total Instructors	Minor Accidents	Moderate Accidents	Serious Accidents
Under 10	1	0.7	100	0.0	0.0
11 to 20	5	6.4	77.8	22.2	0.0
21-30	95	67.9	60.0	37.9	2.1
Over 30	35	25.0	42.9	40.0	17.1

Ward and West (1990), and West (1991)

"The number of students assigned to each laboratory class should not exceed 24. Students must have immediate access to the teacher in order to provide a safe and effective learning environment."

Council of State Science Supervisors: *Laboratory Safety*

OVERCROWDING AND STUDENT ACHIEVEMENT

There is strong evidence relating overcrowded public schools to student achievement. Students gain a deeper understanding of science concepts and are able to apply science processes in a laboratory setting. The laboratory must be safe and students must have adequate space to do science investigations and activities.

classroom as 22 for elementary school and 25 in both middle and secondary schools. Based on these numbers, the minimum square footage for each type of classroom can be calculated.

Overcrowding may force a teacher into reducing or eliminating the amount of time dedicated for students to do hands-on science. In addition, maintaining discipline becomes more difficult when teachers are supervising larger numbers of students.

General classrooms are required to have a minimum of:

- * 36 square feet per pupil or 800 square feet available per room for Prekindergarten-Grade 1
- * 30 square feet per pupil or 700 square feet available per room for Grades 2-5
- * 28 square feet per pupil or 700 square feet available per room for Grades 6-12

SPACE REQUIREMENTS

Specialized lecture/laboratory rooms shall have a minimum of:

Space is a critical factor in promoting scientific inquiry, hands-on activities, and safety for the students and the teacher. Adequate space is required for safe and effective science instruction. Texas Administrative Code, §61.103. *School Facilities Standards* defines the number of pupils in a


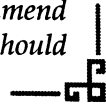
- * 41 square feet per pupil or 900 square feet per room at the elementary level
- * 50 square feet per pupil or 1,000 square feet per room at the middle school level
- * 50 square feet per pupil or 1,200 square feet per room at the high school level

The National Science Teachers Association however, recommends the following square feet per pupil space for specialized classroom/laboratory combinations and a standard science laboratory.


**National Science Teachers Association
Space Recommendations**

Classroom Type	Grade Level		
	Elementary School	Middle School	High School
Classroom/Laboratory	45 square feet/student	50 square feet/student	60 square feet/student
Science Laboratory	40 square feet/student	45 square feet/student	50 square feet/student

Researchers have documented that in a standard science laboratory where students regularly conduct investigations, more accidents occur when students have less than 41 square feet of working space and when there are more than 22 students in one class. (Ward and West, 1990)

 The National Science Teachers Association, National Biology Teachers Association, Texas Science Education Leadership Association, and safety researchers Young (1972), Scholwalter (1984), Ward and West (1990), and West (1991) recommend that a science class be no larger than 24 students. Additionally, every student should have individual lab stations 

LABORATORY INVESTIGATIONS AND ACTIVITIES



Science is an active process of learning that builds on students' abilities to inquire and find out about the natural world. Students are better inquirers when they are allowed to generate their own questions and design ways to find answers to these questions on their own. Scientific investigations allow students to ask questions from which methods, models, and conclusions can be built for better understanding the natural world. Safe practice supports active science learning in environments that allow students to inquire on their own.

"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."

NSTA: *Laboratory Science*, 1990

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS AND LABORATORY EXPERIENCES

Science learning experiences occur in the classroom, in the field, and in the laboratory. In these experiences, students discover facts, concepts, and laws of science for themselves, much as scientists do in their professional lives. Classroom activities require simple, hands-on materials and procedures in order for students to experience various facets of the natural world. Experiences that extend from the classroom into the field allow students to explore, observe, and investigate things in the natural world that cannot be brought into the classroom learning environment.

Laboratory-based experiences allow students to inquire, explore, and observe things in the natural world that are brought into the classroom specifically to facilitate student investigations. The TEKS require teachers at all grade levels to provide a wide range of materials and instruments to facilitate student investigations. Safety must be an essential part of the planning process for all science teachers, whether the learning experiences occur in the classroom, in the field, or in the laboratory.

LABORATORY EXPERIENCES IN KINDERGARTEN-GRADE 2

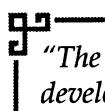
Laboratory-based experiences begin in the earlier grades by students asking questions, planning and constructing simple descriptive investigations, extending their senses using tools, conducting reasonable explanations, and communicating their findings.

Science experiences in these grades allow students to inquire, explore, and observe things that are brought into the classroom specifically to stimulate simple student investigations.

Teachers know that students in Kindergarten-Grade 2 are better inquirers when they are allowed to generate their own questions and design ways to find answers to these questions on their own by actively doing science.

Students are to participate in classroom and field investigations by following home and school safety procedures. They are to demonstrate safe practices while learning to use and conserve resources and materials.

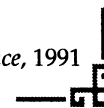
The Texas Essential Knowledge and Skills require that teachers of Kindergarten-Grade 2 be provided with a range of materials and instruments to facilitate student inquiry.



“The elementary science program must provide opportunities for children to develop understandings and skills necessary to function productively as problem-solvers in a scientific and technological world.

Elementary school children learn science best when they are involved in first-hand exploration and investigation and inquiry/process skills are nurtured.”

NSTA: *Elementary Science*, 1991



LABORATORY EXPERIENCES IN GRADES 3-5

Laboratory-based experiences that began in the earlier grades, require the students to plan and implement descriptive investigations by asking well-defined questions, formulating hypotheses, and selecting the right equipment and materials to conduct the investigations.

Students in Grades 3-5 can generate their own questions and design ways to find answers to questions on their own. They are to collect information through observations and taking measurements, as well as, analyzing and interpreting that information to develop reasonable explanations about the results. Students are to communicate valid conclusions and when possible, incorporating graphs, tables, maps, and charts to organize and evaluate information.

The Texas Essential Knowledge and Skills require that teachers in these grade levels be provided a wide range of materials and instruments to facilitate student inquiry, many of which require special precautions in order to assure the safety of students in the laboratory.

When conducting field and laboratory investigations, students are to follow home and school safety procedures and environmentally appropriate and ethical practices. Students must demonstrate safety practices during the field and laboratory investigations and make wise choices in the use and conservation of resources.

LABORATORY EXPERIENCES IN GRADES 6-8

Laboratory-based experiences that began in the earlier grades allowed students to inquire, explore, and observe things that are brought into the classroom specifically to stimulate student investigations.

Middle-grade students will become better inquirers when they are allowed even more freedom to generate their own questions and design ways to find answers to these questions on their own. Students in Grades 6-8 are to have the freedom to select and then use equipment and technology to implement investigative procedures. The Texas Essential Knowledge and Skills therefore, require teachers in Grades 6-8 to be provided a wide range of materials and

instruments to support student investigations, many of which require special precautions in order to assure the safety of students in the laboratory.

By Grade 8, students are expected to plan and implement descriptive and experimental investigative procedures, collect data, organize, analyze, evaluate, make inferences, and predict trends in evidence. They are expected to communicate valid conclusions effectively and use tools to construct graphs, tables, maps, and charts.

Students are to demonstrate safe practices that are environmentally appropriate, and ethical as they conduct laboratory investigations and do fieldwork.

LABORATORY EXPERIENCES IN GRADES 9-12

High school teachers are to expect students be better science learners when they are allowed the freedom to generate their own questions and design ways to find answers to these questions on their own. Students in ninth grade science should already have had numerous field- and laboratory-based science experiences from Kindergarten-Grade 8, and they will have used a wide range of science materials and instruments.

By Grade 9, the Texas Essential Knowledge and Skills emphasizes that the students are to demonstrate many of the new science concepts they are learning; and be able to plan and implement descriptive and experimental investigative procedures in which they select equipment and technology to facilitate their investigations. Specialized equipment and procedures facilitate students' conceptual understanding of complex concepts, many of which require special precautions in order to assure the safety of students in the laboratory.

LABORATORY MANAGEMENT TECHNIQUES

Classroom management techniques maximize and reinforce proper behavior and safety in the science laboratory.

Essential knowledge, concept mastery, and process skill development have high priority. Therefore, concern exists for effective and efficient strategies for maximum learning. Fortunately, the techniques for maximum learning also promote safety. The following is a list of these techniques.

1. Maintain fair and consistent classroom discipline. Classroom discipline can become a factor during a laboratory investigation or doing fieldwork, therefore, unsafe conditions may be created.
2. Establish routine procedures for conducting a laboratory investigation that maintains an orderly and safe environment. Cooperative learning techniques can be used so that different students in each laboratory group are assigned to:
 - * obtain materials from a supply area,
 - * return materials at the completion of a laboratory, and
 - * record data if class data are needed.
3. Explain and post the expectations for orderly conduct in the classroom, laboratory, and field. Teachers should always model appropriate classroom, laboratory, and field procedures.
4. Explain and post safety rules for the classroom, laboratory, and field. Students and parents must complete and return a signed safety contract before students begin investigations.
5. Explain the consequences that will be enforced for unsafe behavior.
6. Review safety rules for using equipment and the laboratory facilities before each laboratory investigation.
7. Arrange for proper disposal of wastes prior to the investigation.
8. Keep up with current information on safety and class procedures—practice them consistently.
9. Examine laboratory investigations and equipment for appropriateness and safety.
10. Review procedures for using the laboratory with the students. Safety rules and precautions should be discussed before an investigation has begun.
11. Promote a positive attitude. Students should not fear doing experiments, using reagents, or equipment, but should have a positive attitude toward safe laboratory procedures that avoid hazards.
12. Adjust procedures for students with emotional, physical or educational problems to capitalize on the contributions they are able to make.
13. Create an alternate lesson plan that does not involve laboratory work if a substitute teacher is in charge.
14. Monitor continuously for maximum learning and safe conditions.
15. Plan post-lab activities after the laboratory work has been completed.
16. Clean the work areas thoroughly and regularly.
17. Develop an approved plan for procedures to be followed in case of an accident.
18. Establish procedures for students who need to be removed from the laboratory because of unacceptable behavior.

Paraphrased from *Secondary Science Safety*, by J.G. Gerlovich, T.F. Gerard, B. Shriver, G.E. Downs, and L.C. Flinn, Jr. and from *Science Laboratory Techniques*, by R.B. Bartholomew and F.E. Crawley.

GUIDELINES FOR EVALUATING SAFETY IN EXPERIMENTS

- * Do not assume that investigations in laboratory manuals or journals published, printed or acquired from other teachers are safe.
- * Always read and check new investigations carefully.
- * Appropriate safety symbols should be present in the investigation to alert students of a hazardous precaution.
- * The investigation should inquire into, investigate, illustrate, or analyze a scientific concept or principle in a safe manner or method.
- * Check the equipment to be used, or the setup, and the glassware for proper assembly, and cracks.
- * Check the electrical equipment for proper grounding, frayed wires, and safe connections.
- * Know all actions and reactions that should occur between chemicals used and investigate unexpected reactions that might occur.
- * The hazards of all substances used in the activity must be known. Material Safety Data Sheet (MSDS) and other safety references must be consulted.
- * The hazards of predicted products and other possible products should also be known.
- * The correct amounts of substances and concentrations of solutions should be clearly stated in the directions.
- * Substances that have a high hazard rating should not be used in science labs. Substitute safer compounds for the hazardous substance.
- * All precautions must be thoroughly discussed in the pre-lab session with the students.
- * The students should be aware of what to do with the products that are formed and any remaining materials.
- * The students must understand exactly what to do and how they are to carry out the activity. The investigation must be clearly written.

*Science Laboratory Safety and Waste Disposal
for Texas Science Teachers, 1990*

RESPONDING TO AN ACCIDENT IN THE LABORATORY

Being prepared for accidents will help decrease the possibility of the accident becoming more severe or injuries occurring. The purpose of any action taken is to minimize the effect of the accident. Action must be taken quickly. Teachers should receive training on Cardio-Pulmonary Resuscitation (CPR), first aid, Heimlich maneuver, and other emergency procedures.

Planning for an emergency must include the entire organization within your school: administrators, maintenance staff, custodial staff, office staff, nurse, teachers, students, and parents. Every area and event should be included in the planning: the school building, grounds, field trips, etc.

COMMON EMERGENCIES

Possible emergencies that teachers may respond to include...

- * small to moderate fires.
- * chemical reactions that result in an explosion.
- * serious burns resulting from exothermic reactions.
- * serious chemical burns.
- * ingestion of hazardous chemicals.
- * electrical shocks from equipment.
- * chemical spills resulting from broken containers.
- * minor to serious cuts.

IF AN ACCIDENT OCCURS...

1. The immediate concern should be for the person injured.
2. First aid should be administered in the room to...
 - * stop the flow of blood in the case of a cut.
 - * wash off any caustic chemicals on the body or in the eyes.

Special Note: Precautions should be exercised anytime a teacher could come in contact with human blood. Wear protective gloves before handling victims who are bleeding.

3. If the injury is a cut or an abrasion...
 - * wash the injured area thoroughly.
 - * place a compress on the wound to stop the flow of blood.

- * replace the compress with a sterile bandage if the injury is minor.
- * accompany the student to the nurse's office if it is a moderate to severe injury.
- * follow proper procedures to clean up blood.

4. If the injury is the result of chemicals...

- * rush the injured person to the safety shower (safety showers should be within 10 seconds of any student).
- * immediately drench the entire area with continuous flow of water.
- * send a student to alert the school's nurse or to get another teacher.
- * use a spill kit to contain and remove the chemicals.

5. If foreign materials or chemicals have entered the eye...

- * rush the student to the dual eyewash station (eye washes should be within 10 seconds of any student).
- * remember, the student will have difficulty seeing, guide them.
- * rinse the open eyes with a continuous stream of tepid water (60-90°F) for 15 minutes.
- * send a student to alert the school's nurse or another teacher.

6. If the person has ingested hazardous material...

- * rush the person to the nurse's office.
- * the nurse should contact the Poison Control Center.
- * if a chemical was ingested, consult the MSDS in your department.

- * If the person's injury is severe, always accompany them to the nurse's office.
7. The nurse should assume responsibility for providing help at this point and...
 - * administer additional first aid.
 - * contact the parents.
 - * pursue additional treatment (information on emergency health cards).
 8. If the nurse is not available, the teacher is obligated to follow through with accident procedures to protect the student from further injury.
 - * The parents should be called and advised of the severity of the accident and their permission granted to proceed with treatment as needed.
 - * If the parents cannot be contacted, the teacher must act in accordance with the situation. The student's emergency health card gives permission for emergency care to be administered. A physician should be called and, upon the physician's advice, seek treatment for the injured student.
 9. After the injured person has been cared for and any chemical spill contained, the teacher needs to fill out an accident report for their own protection even if it is not required by the school district. See Appendix D: *Sample Forms*.
 10. If the injury is the result of electrical shock...
 - * Separate the person from the electrical source carefully. Use the master control switch.
 - * Call for emergency medical aid immediately.
 - * Check for breathing and pulse immediately.
 - * Start CPR if necessary.
 - * Check for entrance and exit burns. Treat burns like you would for a thermal burn.
 - * There may be two burns present—one where the power entered the body and the other where it exited. Some burns are large and below the skin.
 - * Keep the injured warm, quiet, and laying down.
 - * The injured person may stop breathing with high-frequency electrical currents or when struck by lightning.
 - * The injured person may be unconscious or dazed, weak, confused, with irregular pulse.

CAUSES FOR LABORATORY ACCIDENTS

To prevent accidents, it is necessary to identify causes of accidents. The school's, teacher's, and student's actions or lack of action, can contribute to many laboratory accidents.

WHEN THE SCHOOL OR THE TEACHER IS AT FAULT

1. Failure to thoroughly plan and conduct a safe activity.
 - * Failure to incorporate safety into the activity.
 - * Use of unnecessary hazardous chemicals.
 - * Following unsafe procedures and methods.
 - * Failure to plan for disposal of waste or hazardous chemicals.
 - * Inexperienced teachers without safety training.
 - * Failure to use and maintain discipline
 - * Failure to enforce safety rules.
2. Failure of the teacher to give adequate, clear instructions or perform thorough inspections of equipment.
 - * Failure to give thorough, or clear instructions.
 - * Incorrect instructions given to students or students did not understand the instructions before beginning.
 - * Failure to inspect equipment.
 - * Failure to monitor students during the activity.
3. Unsafe design of the activity, unsafe chemicals or equipment used.
 - * Unsafe or improper planning of the activity.
 - * Improper or poorly designed equipment.
 - * Failure to check if chemicals were suitable or safe to use.

4. Failure to provide safe laboratory work areas.
 - * Inadequate facilities: poor lighting and ventilation.
 - * Inadequate or inappropriate work space.
 - * One exit in laboratory (two required)
 - * Improper storage area.
 - * Inadequate maintenance and poor housekeeping.
5. Proper safety equipment not provided or maintained.
 - * Failure to provide fire extinguishers.
 - * Failure to maintain safety equipment
 - * Failure to provide safe equipment and materials.
 - * Lack of safety equipment: goggles, lab aprons, fume hoods, showers, eyewashes.

WHEN THE STUDENT IS AT FAULT

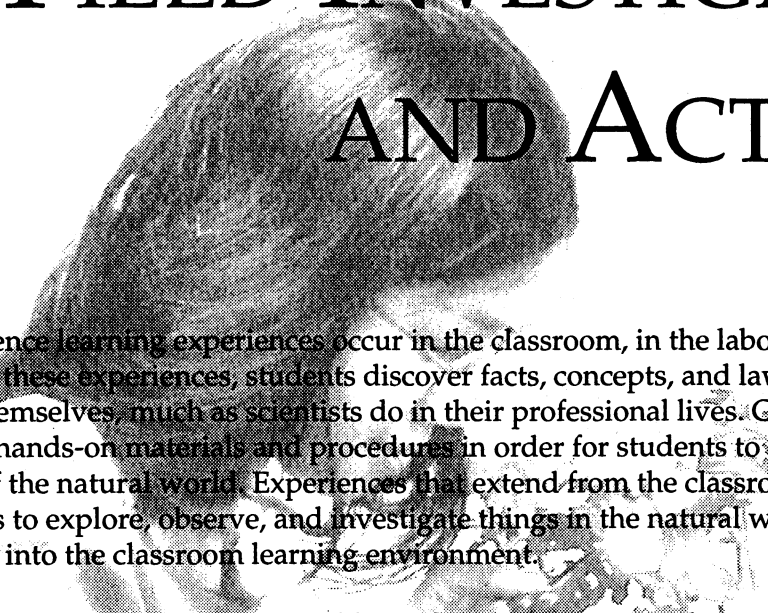
1. Failure to follow instructions and use safe practices.
 - * Safety rules not followed.
 - * Precautions and procedures not followed.
 - * Failure to understand what is to be done.
 - * Lack of knowledge of the hazards.
 - * Doing unauthorized experiments.
 - * Working without approval.
 - * Being disorderly.
 - * Failure to have equipment approved by the teacher.
 - * Failure to follow teacher's instructions.
2. Failure to use personal protective equipment.
 - * Failure to wear eye protection.
 - * Improper clothing and shoes.
 - * Failure to use fume hoods.
 - * Improper use of protective equipment.
3. Improper use of equipment or chemicals.
 - * Failure to follow precautions.
 - * Incorrect use of chemicals.
4. Physical condition of the student.
 - * Student was ill.
 - * Student was fatigued—not attentive or alert.
 - * Student was under the influence of alcohol or other drugs.
 - * Student had poor manual dexterity or skills.
5. Mental attitude and knowledge.
 - * Did not understand the experiment.
 - * Lack of knowledge needed to do the experiment.
 - * Lack of good judgement.
 - * Too rushed—resulted in clumsy work habits.
 - * Tried to use a shortcut that was hazardous.
 - * Inability to work cooperatively with other students.
 - * Tried procedures that were not safe.
 - * Uncontrolled anger or impulsive actions.
 - * Failure to remain calm and in control.

OTHER FACTORS

1. Equipment or materials with unknown defects.
 - * Chemicals contaminated.
 - * Chemical mislabeled.
 - * Equipment with unknown defect.
 - * Unknown tampering with equipment before use.
2. Other influences.
 - * Weather—electrical surges or other weather damage.
 - * Failure of local power plants.
 - * Vandalism of equipment.

Science Laboratory Safety and Chemical Waste Disposal for Texas Science Teachers, 1990

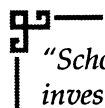
FIELD INVESTIGATIONS AND ACTIVITIES



Science learning experiences occur in the classroom, in the laboratory, and in the field. In these experiences, students discover facts, concepts, and laws of science for themselves, much as scientists do in their professional lives. Classroom experiences require hands-on materials and procedures in order for students to experience various facets of the natural world. Experiences that extend from the classroom into the field allow students to explore, observe, and investigate things in the natural world that cannot be brought into the classroom learning environment.

Laboratory-based experiences enable students to inquire, explore, and observe things in the natural world that are brought into the classroom to facilitate student investigations. The Texas Essential Knowledge and Skills for Science require teachers at all grade levels to be provided with a wide range of materials and instruments for facilitating student investigations (Appendix H: *Materials and Safety Equipment*). They also require that students, at every grade level and in every high school course, have field experience and do field work.

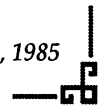
Field work, field trips, or field investigations provide first hand experience to a well-designed inquiry-based science program for students. Direct observations in a field setting provide a more stimulating and rewarding experience for the students and the teacher. Safety guidelines must be maintained to ensure a productive experience for all participants.



"School districts should develop and implement safety procedures for laboratory investigations and field trips.

Teachers should learn safe procedures for laboratory activities and field trips and follow them as a matter of policy."

NSTA: Field and Laboratory Liability, 1985



WHAT IS A FIELD INVESTIGATION?

The Texas Essential Knowledge and Skills for Science require students in Kindergarten-Grade 2 to conduct science investigations in the classroom and in the field. At the grade levels of Kindergarten-Grade 2, "the field" means science investigations of natural phenomenon that occur on the school grounds or in informal science settings such as arboretums, zoos, wildlife habitats, parks, and museums.

Students in Grades 3-8 are to conduct science investigations in the field and in a laboratory. At these grade levels, "the field" means science investigations of natural phenomenon that occur on the school grounds or in informal science settings such as arboretums, zoos, wildlife habitats, parks, and museums.

Texas Administrative Code 19, Section 74.3(b)(2)(C) requires that a minimum of 40% of the instructional time in secondary science (Grades 9-12) be devoted to laboratory and field activities. At Grades 9-12, "the field" means science investigations of natural phenomenon that occur anywhere

in which students can ask questions and find answers on their own about things occurring in the natural world. Informal science settings such as arboretums, zoos, wildlife habitats, parks, and museums are appropriate sites for student inquiry.

WHAT SHOULD BE PLANNED BEFORE A FIELD TRIP?

Safety must be emphasized on any field excursion. The following recommendations for teachers and administrators should be considered prior to students participating in fieldwork. The following list was adapted from *Science Safety: A Kindergarten to Senior 4 Resource Manual for Teachers, Schools, and School Divisions*, April 1997.

Why are you planning this field trip?

- * Does the science activity support what the students are learning in the Texas Essential Knowledge and Skills for Science?
- * Are the activities connected to learning experiences?

When do you plan on taking this field trip?

- * Is there adequate time to plan this trip?
- * Will relevant information be provided to students before the field trip occurs?
- * Is there adequate time after the field trip to do a wrap-up or analysis?
- * Are there any potential conflicts with the selected date?
- * Does the selected date indicate the need for special clothing or supplies?
- * Is there a contingency plan for inclement weather conditions?

What learning do you expect your students to gain or apply from this experience?

- * Have objectives for this field trip been established?
- * Have appropriate activities and instructional approaches been selected?
- * Have you and your students completed background research?
- * Will students be required to complete a project on the trip?
- * Are expectations about student behavior on the trip clear and realistic to the students and parents?

How are you going to get to the site?

- * Will transportation be required?
- * Is appropriate transportation both available and affordable?
- * Can the students actively engage in learning during the trip to the site?

Where do you plan to go with your class?

- * Is the site accessible to all students?
- * Is permission of landowners or officials required in order to visit this site?
- * Is there an admission fee?
- * Does the site have facilities such as bathrooms, lunch areas, shelters, meeting space?
- * Are there appropriate emergency facilities nearby?
- * Is it possible for the teacher to visit the site before the field trip?

What safety precautions are required?

- * Do you have adequate first aid kits readily available?
- * Do you have fire prevention equipment?
- * Will students be given additional safety training before the trip?
- * Is a cellular phone available for making emergency calls?
- * Are copies of the permission and medical forms with the teacher?

How long will this trip take?

- * Can time be used efficiently?
- * Is there too much to do in the time available?
- * Is time provide for some relaxation by the students?

What is the effect on the rest of the school?

- * Will someone have to cover your other classes?
- * Will a substitute be required?
- * Will others have to change their planned activities?
- * Will students on the field trip miss other important events or activities?

Who is helping supervise the students with you on the field trip?

- * Have group supervisors been identified?
- * Has the class been divided into teams or working groups?
- * Are there sufficient supervisors for the number of students and the activities?
- * Have the parents been contacted for their expertise?

Have parental consents been received for each student?

- * What forms are necessary for parents to give consent and provide emergency information?

Has the trip been approved by the appropriate administrators?

- * Do you know the district's procedure for getting approval for field trips?
- * Have the appropriate administrators given their approval?
- * Is additional insurance needed?

Are there special health concerns of students that need to be checked?

- * Have you talked with the school nurse to determine if there are specific health concerns?
- * Are there any students who may need to take medication while on the trip?

Have you discussed safety precautions with the students?

- * Wearing proper clothing and shoes
- * Using insect repellent
- * Identifying poisonous plants
- * Preventing overexposure to the sun
- * Drinking water and dehydration
- * Reporting and responding to accidents
- * Using a buddy system

Have you made plans to evaluate the field trip?

- * Will sponsors give feedback about the successes of the trip?
- * Will students have an opportunity to evaluate the field trip?

Have you included these items in a parental consent letter?



- | | | |
|---|-------------------------------------|--------------------------------------|
| √ Which students are going and how many | √ Types of activities planned | √ Anticipated costs, payments due |
| √ Purpose of the field trip | √ Names of teachers and supervisors | √ Risks involved |
| √ The educational opportunities | √ Special skills of supervisors | √ Description of contingency plan |
| √ Destination of the trip | √ Clothing requirements | √ Permission forms due date |
| √ Method of transportation | √ Lunch plans, meal arrangements | √ Medical Information forms due date |
| √ Time and date of departure | √ Required materials and supplies | √ Time, place for parent's meeting |
| √ Time and date of return | | |

Additional information concerning preparations for field trips can be found in Appendix E: *A Checklist for Science Field Investigations*.

WHAT SHOULD BE DONE UPON ARRIVAL AT THE SITE?

Once you have arrived, students need to be given specific information concerning safety before any work begins.

Do the students understand what is expected of them?

- * Have students been given clear objectives and expectations?
- * Do they know timelines for projects?
- * Do they know who will be in their group and who the supervisor is?
- * Does everyone have a buddy and periodic checks established?

What are students to do if an accident occurs?

- * Do students understand procedures for reporting accidents?

- * Do students know where the teachers and supervisors will be located?
- * Is everyone aware of where the first aid kit is located and who will use it?

Has the use of safety equipment been reviewed?

- * Has the safe use of equipment been reviewed with the students and supervisors?
- * Do students know where personal safety equipment is located such as safety goggles?

Are students aware of any on-site hazards?

- * Have poisonous plants been identified?
- * Have precautions against insect bites been made?

WHAT AWAITS THE STUDENTS AT THE SITE?

Poisonous plants are a common hazard that students may encounter when on a field trip in a natural area. Three different problems may be experienced by students and supervisors who come in contact with poisonous plants: allergic reactions, dermatitis reactions, and ingestion reactions.

Some of the most common poisonous plants that you might come into contact with are poison ivy (*Toxicodendron radicans*), poison oak (*Toxicodendron quercifolium*), and poison sumac (*Toxicodendron vernix*). See Appendix E: *Poisonous Plant Guide* for a listing of more poisonous plants. Each of these plants can cause severe dermatitis—itching and oozing sores, swelling of the throat and mouth, weakness, and fever. The degree of plant poisoning can range from minor skin irritation to long lasting inflammation or blisters depending on the person's sensitivity to the poison.

To help reduce the chance of infection, students should always wash with soap and water immediately, removing the plant oils after contact with the plants or after their

return from the field experience. Taking a change of clothing for students that are sensitive to these plants will also reduce the probability of reaction

Allergies are a result of an individual's sensitivity to air-borne materials such as algae, fungus spores, and pollen grains. It is probably impossible to protect students from allergies. Hay fever, asthma and other allergy related respiratory diseases can cause serious complications and students who suffer from these reactions should be identified prior to the field trip. Medications sent by parents should be carried with the teacher so that an immediate response to an allergic reaction can be made.

Many plants are highly toxic when ingested. Poisoning may be the result from ingesting seeds, fruits, stems, leaves, flowers, etc. from the plant. The state of the plant growth, size, and physical condition of the individual person and the time of year also can be factors in the seriousness of the poisoning.

The National Science Teachers Association publication *Safety in the Secondary Science Classroom* provides a valuable set of standards when working with plants in the laboratory or encountering unknown plants in the field.

1. *Never eat unknown berries, seeds, fruits, or other plant parts.*
2. *Never rub any sap or fruit juices on the skin or open wound.*
3. *Never inhale or expose your skin or eyes to the smoke of any burning plant.*
4. *Never pick any strange wildflowers or cultivate plants unknown to you.*
5. *Never eat food after handling plants without scrubbing your hands with soap and water.*

In the event a student ingests a plant and becomes ill, using the following procedure may prevent a more serious condition from occurring.

Call the physician listed on the student's emergency information form or a local doctor.

Be prepared to provide the doctor with the following information:

- * Name of the plant (if unknown, collect samples)
- * A complete description of the plant
- * When the student ate the plant
- * Age, weight, height of student
- * What symptoms the student is exhibiting
- * What part of the plant and how much was ingested

Be prepared to transport the student to the nearest hospital.

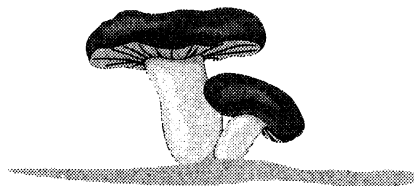
Plants that are known to be poisonous when ingested and should be avoided are blue-green algae that "bloom" or become very prominent in polluted water. Many species of "toadstools" or mushrooms are poisonous. It is very difficult to distinguish the edible varieties from the poisonous ones in nature. Some of the more common poisonous mushrooms include the *Amanita*, *Clitocybe*, *Lactarius*, *Lepiota* and *Russula*.

When ingested, these poisonous varieties can cause extreme abdominal pain and vomiting, loss of muscular coordination, and hallucinations. It is extremely important that an accurate identification of the ingested species be made so that proper treatment can be administered.

Besides plants and fungi, students may encounter a variety of animals—insects, snakes, and mammals—that may be hazardous to some of the students. Teachers need to be aware of students who react to insect bites and be prepared to take immediate action. Long sleeve shirts and blouses may reduce the chance of insect bites and stings from mosquitoes, ticks, mites, and chiggers. Additional precautions such as using insect repellents may further reduce the probability of insect bites.

The threat of injury to students from venomous snakes is a serious problem in some areas of the state. In Texas, the venomous snakes include rattlesnakes, copperheads, cottonmouths, and coral snakes. Handling of any snake should be discouraged and students should never attempt to handle venomous snakes.

Studying natural phenomenon in the field is an important part of science instruction. It helps students to make the connection between what is being studied in the classroom to what occurs in the natural world. Direct observations and investigations can motivate students to go beyond classroom instruction and the knowledge acquired in this way may never be forgotten.



SEVERE WEATHER SAFETY GUIDELINES

Severe weather can occur quickly and without warning. It is important that teachers follow recommended guidelines if severe weather threatens the safety of students while on field trips. The National Oceanographic and Atmospheric Administration (NOAA) has developed a *Severe Weather Safety Guide*. The following recommendations have been adapted from NOAA's guidelines.

TORNADO SAFETY

Tornadoes are the most violent atmospheric phenomenon on the planet. Winds of 200-300 m.p.h. can occur with the most violent tornadoes. The following are instructions on what to do when a tornado warning has been issued for your area or whenever a tornado threatens.



If you are on a field trip and...

IN SMALL BUILDINGS

Go to the basement (if available) or to an interior room on the lowest floor, such as a closet or bathroom. Wrap yourself in overcoats or blankets to protect yourself from flying debris.

IN SCHOOLS, HOSPITALS, OR FACTORIES

Go to interior rooms and halls on the lowest floor. Stay away from glass enclosed places or areas with wide-span roofs such as auditoriums and warehouses. Crouch down and cover your head with your hands.

IN HIGH-RISE BUILDINGS

Go to interior small rooms or halls. Stay away from exterior walls or glassy areas.

IN CARS OR SCHOOL BUSES

ABANDON THEM IMMEDIATELY!! Most deaths occur in cars. If you are in either of those vehicles, leave them and go to a substantial structure or designated shelter.

IF NO SUITABLE STRUCTURE IS NEARBY

Lie flat in the nearest ditch or depression and use your hands to cover your head.

FLASH FLOOD SAFETY

Flash floods and floods are the #1 weather-related killer with around 140 deaths recorded in the U.S each year. These can occur quickly and be extremely dangerous when on field trips.

WHEN INSIDE

If ordered to evacuate or if rising water is threatening, leave immediately and get to higher ground.

IF OUTDOORS

- * Go to higher ground immediately! Avoid small rivers or streams, low spots, canyons, dry riverbeds, etc.
- * Do not try to walk through flowing water more than ankle deep.
- * Do not allow students to play in streams, drainage ditches or viaducts, storm drains, or other flooded areas.

IN A VEHICLE

DO NOT DRIVE THROUGH FLOODED AREAS!

Even if it looks shallow enough to cross. The large majority of deaths due to flash flooding are due to people driving through flooded areas. Water only one foot deep can displace 1500 pounds. Two feet of water can **EASILY** carry most automobiles. Roadways concealed by floodwaters may not be intact.



LIGHTNING SAFETY

Do you know what to do if you are caught in the open during a thunderstorm or you feel tingling or your hair standing on end?



Lightning causes around 100 deaths in the U.S annually (more than hurricanes and tornadoes combined). Even if no rain is falling, lightning can strike up to several miles away from a thunderstorm.

IF OUTDOORS

When on a field trip go to a safe shelter immediately such as inside a sturdy building. A hard top automobile or school bus with the windows up can also offer fair protection.

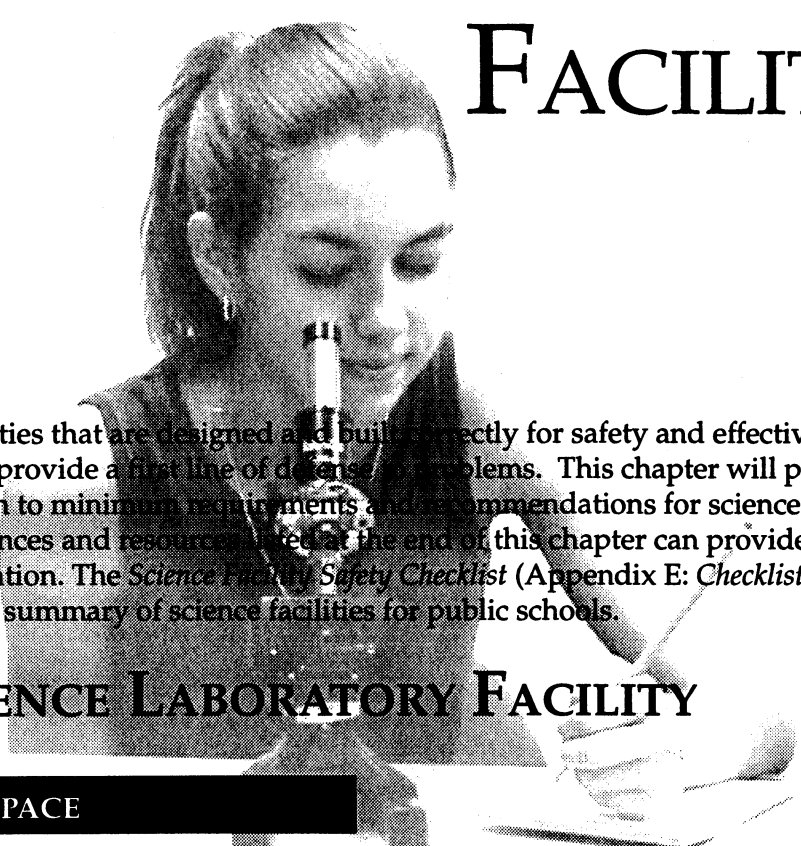
If you are in a boat or swimming, get out of the water immediately and move to a safe shelter away from the water.

If you are in a wooded area, seek shelter under a thick growth of relatively small trees.

If you feel your hair standing on end, squat with your head between your knees. Do not lie flat.

Avoid isolated trees or other tall objects, bodies of water, sheds, fences, convertible automobiles, tractors, and motorcycles.

FACILITIES



Science facilities that are designed and built correctly for safety and effective science instruction provide a first line of defense against problems. This chapter will provide an introduction to minimum requirements and recommendations for science facilities in Texas. The references and resources listed at the end of this chapter can provide more extensive information. The *Science Facility Safety Checklist* (Appendix E: *Checklists and Guides*) provides a useful summary of science facilities for public schools.

THE SCIENCE LABORATORY FACILITY

ADEQUATE SPACE

One of the most important requirements for science facilities is sufficient space provided either in new, or renovated science areas. Studies have shown that insufficient space results in higher accident rates. A significant increase in accidents occurs when the floor space per student in a pure laboratory is less than 41 square feet. As a result of the research and best practice recommendations, the National Science Teachers Association recommends 60 square feet per student. Additionally, the use of technology and the requirement to meet the needs of handicapped students and teachers indicates the need of additional space. In industrial laboratories, the recommendation is 200 square feet per researcher.

In existing facilities where additional physical space is not an option, the recommended way to have a safer learning environment is to decrease the size of the classes so that each student has at least 50 square feet of working space. No class should exceed 24 students, assuming the laboratory is at least 1,200 square feet.

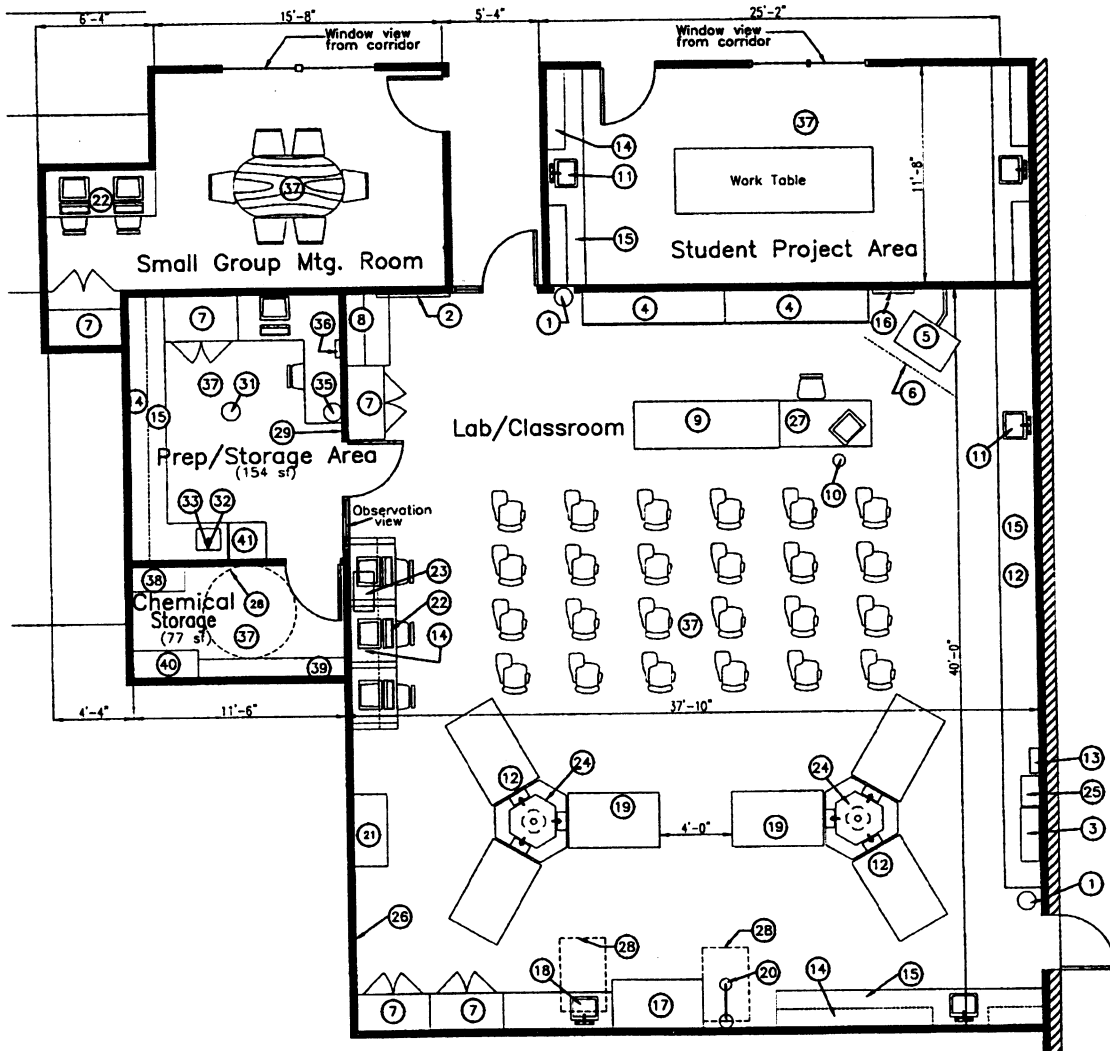
In renovated or new facilities, TAC §61.1033 *School Facilities Standards* has

requirements for elementary, middle school, and high school combination lecture/laboratory science facilities. (See Appendix A for full text.) The square foot/pupil requirement is defined as the net interior space of a room divided by the maximum number of pupils to be housed in that room during a single class period. The square foot/room measurement is the net square footage of a room that will house 22 students at the elementary level and 25 students at the middle and high school level. The net square footage of room includes exposed storage space, but does not include hallway space or storage space, such as preparation offices. The school district is required to provide the instructional space called for in the district's educational specifications. The school district may satisfy the requirements by using the minimum square foot per pupil or the square foot per room measurement, as appropriate.

Space is needed for technology and to meet the needs of handicapped students. It is estimated that approximately an additional 15 square feet per computer station and 12 square feet per monitor/VCR/videodisc player, and 20 square feet per handicapped student station is needed.

AN EXAMPLE OF A COMBINATION LABORATORY/CLASSROOM

1440 Square Feet (36'x60'sf /student)



Design Layout
by
Sandra S. West, Ph.D.
Department of Biology
Southwest Texas State University
and
Martha Pena Weiss
Pfluger Associates P.L.L.C.
Architects/Planning Consultants

LEGEND

COMBINATION LABORATORY/CLASSROOM

CLASSROOM LEGEND

1. **ABC Fire Extinguisher** (recessed in wall)
2. Tack Board (4')
3. **Fire Blanket Storage**
4. Sliding Marker Board Assembly
(with storage accommodations)
5. T.V. Monitor
6. Projection Screen
7. Tall Storage Cabinet
8. Open Adjustable Shelves (12" deep)
9. Mobile Demonstration Center
10. LCD Projector (mounted from ceiling)
11. Moveable Demo. Table (24" x 54")
12. **Utility Connections (Electricity, Gas, Data) Note: GFCI in all electrical outlets**
13. **First Aid Cabinet**
14. Upper Cabinets
15. Base Cabinets
16. **Emergency Utility Cutoff Panel**
17. **Demonstration Fume Hood**
18. **Sink (ADA compliant)**
19. Moveable Tables (36" x 54")
20. **Shower and Eye Wash Station**
21. Tote Cabinet
22. Computer Station (moveable cart)
23. Computer Printer
24. Tri-facial Utility Center with sinks
25. **Safety Goggle Cabinet**
26. **Lab Apron Storage**
27. Teacher's Desk
28. **ADA clear floor space**

PREPARATION STORAGE LEGEND

29. **Mater Utility cutoff switch**
30. not used
31. **Emergency Lighting**
32. **Eye/Face Wash and Drench Station**
33. Large Sink (hot and cold water)
34. not used
35. **BC Fire Extinguisher** (recessed in wall)
36. **Phone**
37. **Smoke Detector**
38. **Flammable Storage Cabinet**
39. **Non-metal adjustable shelves**
40. **Vented Acid Cabinet**
41. Portable Skeleton Cabinet

CHEMICAL STORAGE AREA LEGEND

(Note: Ventilation System is to be isolated from the rest of the building.)

38. **Flammable Storage Cabinet**
(43" wide x 18" deep)
39. **Open Shelves adjustable non-metal**
40. **Acid Cabinet (43" wide x 18" deep)**
Vented, Non-metal, (separate compartment for nitric acid)

SECURITY OF EQUIPMENT

The combination lecture/laboratory (“combo”) science room is one that meets the definition by either instructional use or by furniture type/instructional use. Therefore, a “combo” room is one that has either a combination of science laboratory and traditional science classroom instruction occurring or where the room is furnished with science laboratory furniture and where traditional science activities also occur.

Some of the most serious injuries occur when students remove chemicals from unsecured science classrooms or preparation/equipment storerooms. The answer is simple. Don’t store chemicals, including poisons, anywhere else except in a locked, dedicated storeroom.

There are other materials or equipment that should also be in secured storage. They include items such as balances, microscopes, sharp objects (syringes, scissors, scalpels, razors, etc.), lasers, and teacher’s portable Direct Current (DC) unit.

FIRE SAFETY

The National Fire Protection Association (NFPA) Life Safety Code 101 was developed “... to establish minimum requirements that will provide a reasonable degree of safety from fire in buildings and structures.” The aspects of Life Safety Code 101 that pertain to science rooms include egress, fire extinguishers, smoke alarms, and water sprinkler systems.

There should be two clearly marked emergency exits in each science room and preparation/equipment storage room. NFPA 45 is the Standard on Fire Protection for Laboratories. Public school science classrooms, including the support rooms, are in the Class C hazard lab group that is required to have a second exit for any laboratory 1,000 square feet or larger. One of the exits can be a window if the room is on the ground level and the window is large enough that an adult can escape.

All exits must be unobstructed. The laboratory and preparation rooms should be unlocked when in use, but should remain locked when not in use.

Fire extinguishers should be placed in a visible location at every exit. The laboratory should have an ABC extinguisher and the preparation/equipment storage room. A fireproof fire blanket should be located near the fire extinguisher. It should be located in a visible, eye-level location that is clearly marked and that can be easily and quickly accessed.

If there is no outside window, an emergency light should be available in both the lab and the preparatory rooms. If night classes occur in the room, then an emergency light is needed even if there are windows in the room.

A functioning general fire alarm system throughout the building is required and fire drill procedures must be posted and practiced.

ELECTRICAL SAFETY

Compliance with the National Electrical Code NFPA 70 is the best means of elimination potential electrical fires. Electrical fires are one of the most frequent types of fires and typically result from the overuse of electrical circuits or the use of extension cords. Sufficient electrical outlets should be provided, including computer use, so that the use of extension cords and loose electrical cords can be avoided. Generally, two duplex outlets per lab station plus a minimum of two duplex outlets per non-lab station wall are recommended.

Science equipment, such as a hot plate, requires a separate outlet per item so it is important to provide sufficient electrical outlets so that circuits are not overloaded and do not constantly short-circuit. Since the computer requirements vary, the only general guideline is that the educational goals that require an expanding use of computers and other technology must be considered to determine the electrical needs

in the science class. All outlets should be tested to determine if the wiring is correct.

All utilities should have emergency and master utility shut-off controls for each science classroom. The controls should be easily accessible to the teacher, preferable near the teacher's station, but not too easily accessible to students. Laboratory utility shut-off controls should be clearly labeled with the type of utility and the room number to which the control is connected.

Ground-fault interrupters (GFCI) should be installed on all outlets in a science room to protect against major shock and electrical fires by preventing short-circuits.

Additionally, outlets should be grounded and located away from sinks or other water sources.

No DC lines are needed since the hazard is greater than the educational gain. Instead, small, dry cells are used in today's science curriculum.

PREPARATION ROOM AND EQUIPMENT STORAGE FACILITY

ADEQUATE SPACE

Just as space is important in the design of the science classroom, space is also an important safety consideration in the design of storage for equipment, materials, and chemicals. Today's science curriculum requires the use of many and diverse types of technology, equipment, and materials. Therefore, the facilities should provide for sufficient storage space and diverse sizes and shapes of storage areas.

Additionally, when different types of science courses (physical, chemical, biological, earth/space science) are taught, the quantity and diverse types of equipment and materials that are used therefore, require additional storage. Consideration should be given to storage of odd-shaped items such as skeletons, carts, aprons, charts, distilling units, chromatographs, centrifuges, water baths, ice maker, microwave, and air tracks.

If, in a rare case where the chemical inventory includes flammables that need to be refrigerated, the refrigerator must be spark-free. A traditional home refrigerator does not have the thermostat housed in a spark-proof casing to decrease the possibility of a thermostat arc becoming a source for ignition of the stored flammable.

CHEMICAL STORAGE

Chemicals should be stored in a separate dedicated room different from the preparation/equipment storeroom. The room should have continuous ventilation that exhausts the air at a rate of six air changes per hour to the outside, not recirculated back into the general system. The shelves should be made entirely of wood, including the shelf supports that are plastic or other corrosion-resistant material.

If the room is to store corrosives, any metal item will corrode. No electrical outlets or breaker boxes should be in the room. The acid cabinet must be either nonmetal or corrosion-resistant coated metal.

The wooden shelves should be a maximum of 12 inches deep and tightly anchored to the wall. Containers should not be stored more than two deep. Sufficient space should be provided so that chemicals arranged in compatible families have approximately two to three inches of space between them. In a room of approximately 50 square feet, at least 36 linear feet of storage is needed in addition to the separate acid and flammable storage cabinets.

There is some disagreement about the need for lips on the shelves. Lips prevent containers from rolling off and spilling the contents. On the other hand, lips can catch

the bottom of a container being removed causing the contents to be spilled or dropped.

The acid cabinet should be vented to the outside to prevent a buildup of toxic fumes. Any venting of chemical fumes must be to the outside away from any intake duct. A separate nitric acid compartment or cabinet must be provided to separate nitric acid from the other inorganic acids or readily oxidized substances.

An approved flammables cabinet in the room is needed for volatile chemicals such as alcohol. The flammables cabinet **should not be vented** unless there are significant problems with the fumes. An approved cabinet is designed to protect the flammables from an outside heat or fire source so that there is no danger to fire fighters. Poisons should be kept locked in a cabinet.

Countertops should be chemical resistant. It is not recommended to have countertops that are not chemical resistant because of warping, dents, and holes that will appear on the surface. They do not resist the daily wear and may become unsightly with stains after a brief period of usage.

GAS CYLINDERS

Although gas cylinders are rarely found in science classes today, they present a particularly hazardous dilemma. They are extremely heavy metal items and must be well secured to the wall, preferably to a support stud. They can cause serious injury or even death if they fall on a child. An additional hazard occurs if the valve becomes defective and the cylinder literally becomes a missile that can penetrate walls. These cylinders are more frequently used by vocational students, booster clubs, and little league volunteers.

VENTILATION

Ventilation should be carefully designed in four areas: science classroom, preparation/equipment storeroom, chemical storeroom, and the fume hood.

The science classroom should be vented to the outside away from the intake vents and not recirculated in the building's general system. The air should be ventilated at a rate of four air changes per hour. Emergency exhaust ventilation with a manual switch should be available for acute buildup of fumes during certain lab activities in the science classroom. If the fan is wall-mounted, then fan guards are recommended.

The preparation/equipment storeroom should be ventilated using the same criteria as the classroom. No chemicals should be stored in the classroom or the preparation/equipment storeroom because of three problems: security, corrosion to metal, and toxic impact on human health.

There should be a separate room dedicated to the storage of chemicals. It must be ventilated at the greater rate of six air changes per hour minimum (OSHA). As mentioned, the air should be vented to the outside of the building at sufficient distance from the air intakes to prevent recirculation. If the ventilation unit is a wall mounted type, then it should be equipped with a fan guard.

Fume hood ventilation should follow the same guidelines and be vented to the outside away from intake vents. A fume hood should be available for use in every chemistry classroom and any high school science classroom where the students use hazardous chemicals. A fume hood should also be located in every secondary preparation/equipment storeroom for teacher use. Advanced Placement Chemistry needs two fume hoods or an island type that provides two or more individual workstations.

Fume hoods should be placed at least 10 feet from doors, windows, or vents because of interference with the proper function of the fume hood. They should not be placed on a main traffic aisle nor used as a chemical storage area. Most importantly, the ventilation system must be adequately engineered. If two hoods are used, there should be at least two feet between them for adequate workspace for safe use and the

vents must be adequately engineered for that purpose so that there is no interference with the draw of the ducts. The sash level should be marked for a draw of 80 to 120 linear feet per minute of air movement with the date of measurement. (ASHRAE 110 testing standard and ANSI Z9.5 standard)

SAFETY SYMBOLS

There is no approved or official set of safety symbols. There are many familiar ones. (See Appendix G: *Safety Symbols*) The important idea is to use the safety symbols so that chemicals, equipment, and materials are more safely used in science classrooms, preparation/equipment storerooms and chemical storerooms by students and adults. The symbols can be found in various sources such as commercially purchased safety posters, web sites, and science supplies and equipment company catalogs. Large signs with the safety symbols tend to be more noticeable and easier to remember during an emergency.

The symbols should be used judiciously and in a well thought out discriminating manner. All fire hazard equipment (extinguisher, blanket) should be placed near the exit and should be clearly labeled.

Similarly, the first aid equipment (ADA eyewash and shower kit) should be located together in one area and clearly labeled. This is particularly needed at the secondary level Grades 9-12.

It should be separate from the Preparation/Equipment Storeroom for three reasons:

- (1) human health,
- (2) security to prevent students from stealing chemicals, and
- (3) corrosion of metal equipment such as balances, microscopes, etc., emergency utility cutoff, and electrical panels that are frequently found in preparation rooms.

RENOVATING EXISTING SCIENCE FACILITIES

If the renovation of existing science facilities is more than cosmetic, and is greater than 50%, then the Texas School Facilities Standards apply just as they apply to building new facilities. However, any amount of renovation should incorporate the requirements and the recommendations because they are based on research that provides abundant evidence that facilities are the critical foundation for providing a safe and effective science learning environment for students.

PREPARATION AND STORAGE

The total Preparation and Storage area needs 15 square feet/student or 360 square feet to support instruction for 24 students. Of the 15 square feet, approximately 1 square foot should be dedicated to separate, secure storage. However, to meet Texas Accessibility Standards requirements a room of approximately 6x8 feet is needed to provide the 5 foot wheelchair turn radius.

The preparation and storage room needs...

- * an ADA eye/face wash & drench
- * large deep sink with hot water
- * fume hood for Grades 6-12
- * BC type fire extinguisher
- * labeled master utility cutoff
- * storage for utility carts
- * space for equipment and materials to be safely stored out of the aisles
- * refrigerator (spark proof) for chemicals and lab specimens
- * an MSDS book

FACILITIES CHECKLIST

A convenient checklist has been prepared for teachers and administrators to determine if their science facilities are providing safe learning environments for the students and a safe working conditions for the faculty. The checklist is based on laws, rules, and regulations of state and federal legislation and regulatory agencies. To determine if your science facilities are safe, use Appendix F: *Science Facilities Safety Checklist* to assess your facility's condition.

SAFETY EQUIPMENT AND SUPPLIES

Equipment and supplies are necessary to teach science. The purpose of this chapter is to provide information on the safety equipment and supplies needed for science instruction. Refer to Appendix H for a list of the minimum equipment and supplies needed to teach science in Kindergarten-Grade 12.

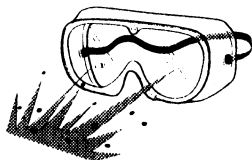
PERSONAL PROTECTION

The use of personal protection equipment is required when "hazards" cannot be adequately controlled. Personal protection equipment includes eyewear, laboratory aprons, laboratory coats and protective gloves. Eyewear should meet the ANSI Standard Z87.1-*Practice for Occupational and Educational Eye and Face Protection*. Eyewear meeting this standard will bear markings such as "Z87.1" on the frames and the lens will be marked with the manufacturer's trademark.

EYE PROTECTION DEVICES

Safety goggles are required for science laboratory and field activities involving ANY hazardous chemical, which could damage the eye if the chemical splashed into the eye or if the eye was rubbed with fingers that had the chemical on them. Goggles provide eye protection from fine dusts, liquids, splashes, mists, and sprays. They also prevent splashes and sprays from body fluids or dangerous chemicals. Reusable goggles should always be disinfected before being used by another student.

Safety goggles should be large enough to protect and form a seal around the eyes. If not able to seal, goggles should contain side shields to prevent contamination to the eyes.



Sanitizing is required for any piece of safety equipment that is shared with another person. There are several ways for sanitizing goggles. The effectiveness of goggle cabinets using ultraviolet lamps seems to be related to the amount of time the goggles are under the ultraviolet lamp rays. Other methods of sanitizing may be found in Appendix A: §295.146 of the Texas Department of Health, *Face and Eye Protection Standards*, to maintain and disinfect eye protectors.

Eye protection may also be provided by safety glasses. Safety glasses with sideshields will NOT provide adequate protection for chemical splashes. These are designed primarily to protect the eyes from flying objects.

Face shields can provide additional face protection and, if coupled with safety goggles, increased protection to the entire facial area. It must be remembered that plastic type lenses or devices may be severely affected by certain chemicals and, in some cases, easily scratched.

PROTECTIVE GLOVES

Gloves protect hands from heat, absorb perspiration, and provide a shield from corrosive chemicals, body fluids, and prevent the transmission of microorganisms from being spread from one person.

Certain gloves can dissolve when they are in contact with solvent. The correct glove should match the nature of the job. Always check your gloves to be sure that there are no tears, punctures, and/or holes, especially latex gloves.

When removing gloves, peel the gloves off your hand, starting at the wrists and working toward the fingers. Keep the working surface of the gloves from contact with the skin during removal.

PROTECTIVE GLOVES AND THEIR FUNCTION

GLOVE TYPE	FUNCTION
Plastic	Protects against light corrosives and irritants
Latex	<ul style="list-style-type: none"> Provides protection against biological materials Should be changed as soon as they are soiled Note: Some people may have an allergic reaction to latex, which can lead to a serious medical condition.
Natural Rubber	Protects against electric shock and light corrosive material
Neoprene	Great when working with solvents, oils, or light corrosive material
Cotton	<ul style="list-style-type: none"> Absorbs perspiration Great for wearing under latex gloves
Asbestos	<ul style="list-style-type: none"> Insulates against heat Note: Asbestos gloves are labeled with a warning sign about the danger of cancer. Asbestos is a known carcinogen.

LABORATORY APRONS AND COATS

Laboratory aprons and coats are designed to protect clothing and skin from splashed and spilled chemicals and biological materials. They should fit the wearer properly to provide maximum protection. A laboratory coat or an apron should be worn at all times in the laboratory.

There are no ANSI Standards for the manufacture of aprons. Therefore, selection of the appropriate apron must be based on the hazard. Materials for aprons may vary widely. These may be single or multiple layered material. Multiple layers would decrease the "permeation" rate. They are usually made of plastic or rubber to protect against corrosive materials and irritating chemicals.

Aprons are usually listed as "bib type," which are suitable for laboratory use. Aprons should be worn over clothing that covers the arms and body.

Laboratory coats are usually fire retardant and made of cotton or paper. They are good for protection against flying objects, sharp or rough edges, splashes and spills, and fire.

FIRE PROTECTION

Fire is one of the most frequent mishaps in the science laboratory. The first line of defense from a fire is fire prevention. Effective fire prevention centers on thorough understanding of combustion and the required ingredients. As long as air is present, oxygen will be available for combustion to take place. The areas where preventive measures are best exercised are the fuel and ignition sources.

Fires are classified by the chemical properties of the fuel.

The basic classifications are grouped as follows:

- * Class A – Ordinary combustibles (i.e., paper, wood, etc.)
- * Class B – Organic solvents (i.e., acetone, alcohols, ethers)
- * Class C – Electrical wiring or static charges
- * Class D – Active metals (i.e., sodium, potassium, magnesium)

These symbols are accepted for the different classifications of fire. They are applied to fire extinguishers and extinguisher locations to indicate their suitability in extinguishing the different types of fires (See Appendix G: *Safety Symbols*).

The following precautions should be taken to prevent fires from occurring in the science classroom, laboratory, storage and preparation area.

- * Be aware of ignition sources in your laboratory area (open flames, heat, and electrical equipment).
- * Purchase and store flammable reagents in the smallest quantities possible.
- * Do not store flammable liquids in standard refrigerators (an explosion-proof refrigerator should be used).
- * Store flammable liquids in appropriate safety cabinets and/or safety cans.
- * Do not store incompatible reagents together (e.g., acids with flammables). A list of incompatible reagents can be found in Appendix F.
- * Do not store ethers for extended periods of time as explosive peroxides could form.
- * Make sure that all electrical cords are in good condition. All electrical outlets should be grounded and should accommodate a 3-pronged plug.

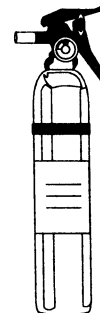
Each science classroom, laboratory, storage and preparation area should have a fire blanket and an appropriate fire extinguisher.

Remember...

- R** Rescue anyone in immediate danger
- A** Turn in an Alarm, call 911
- C** Confine fire, close doors and windows
- E** Extinguish the fire

FIRE EXTINGUISHERS

In most school environments, hand-held, portable fire extinguishers are the first fire-extinguishing agent used. Therefore, a multipurpose ABC fire extinguisher must be located in each science classroom, laboratory, storage room, and preparation area. Extinguishers must be:



- * located to be easily seen and the area around them kept clear.
- * inspected on a regular basis.
- * used by well-trained teachers and students.

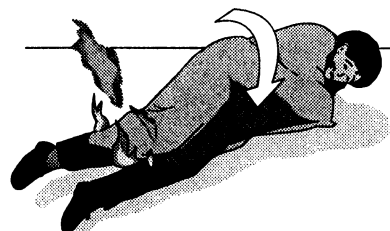
Fire extinguishers are labeled in accordance with NFPA standards.

After practicing first safety and prevention, a fire may still occur in a science classroom laboratory, storage room or preparation area.

FIRE BLANKETS

Actual fire control revolves around proper types of control devices such as a fire blanket. Fire blankets are made of specially treated fabric and should be located at strategic areas for all science laboratories where hazardous chemicals are stored and used. Fire blankets can be used if one is unable to reach the safety shower.

To use a fire blanket, follow the recommended technique of wrapping the victim in it to extinguish the fire.



FUME HOODS

Proper use of laboratory hoods should be developed for students taking Chemistry, Integrated Physics and Chemistry, or any other course where chemicals are used.

Written instructions on the use of fume hoods should be posted, and these instructions should be included in the laboratory safety training that each student is to receive.

GENERAL USE OF FUME HOODS

Each laboratory facility and preparation room where chemicals are used in experiments and preparation room should be equipped with a fume hood. No open face fume hood with a low face velocity can provide complete safety against events that take place in the hood. However, a properly designed hood in a properly ventilated room can provide adequate protection. To provide proper protection, follow these recommended guidelines.

- * Keep the interior light on so that the working area is properly illuminated.
- * Check the exhaust system—air movement is inward and upward in the hood.
- * The exhaust should be vented to the outside above the roof and away from air vents.
- * Conduct all portions of the experiment that cause contaminants to form inside the hood.
- * Large objects should not be placed directly on the hood's working surface. Use blocks under the large object to allow proper airflow under the object.
- * The fume hood should be placed in an area of low traffic flow.
- * Move the vertical sash to the lowest position that allows access so that manipulation is possible. The sash should protect the head and upper body in case of an explosion. (Safety goggles are required).
- * Do not place your head in the hood when contaminants are being generated.
- * Do not use the fume hood as a waste disposal unit except for very small amounts of volatile chemicals.
- * Do not store chemicals or apparatuses in the working area of the hood.
- * Keep the slots in the hood baffle (air intake) free from obstructions.
- * Keep the laboratory door closed unless indicated from the manufacturer.
- * Do not place electrical receptacles or other sources that may produce a spark in the fume hood when using flammable chemicals or when gases may be present.
- * The hood's sash should be marked for appropriate closure point when it is necessary to partially close the sash during an operation.
- * The sash should be closed when the hood's exhaust system is not operating.
- * Provide regular maintenance on the hood's exhaust system. Use static pressure gauges on the hood throat and across filters in the exhaust system to ensure proper exhaust flow.

Science Laboratory and Chemical Waste Disposal for Texas Teachers, 1990

"A fume hood is required for every chemistry, physical science, or other science laboratory where hazardous or vaporous chemicals are used. Most middle schools need a fume hood in the preparatory rooms"

NSTA Guide to School Science Facilities, 1999

EYE/FACE WASHES

The first response prior to medical treatment, for a student or teacher who has hazardous material in the eye or on the face, is flushing with water to dilute chemicals, wash off debris, or irrigate the eyes. It is very important that the eyelids are held open and the eyeballs rolled so that water can flow on all surfaces of the eyeball and in the folds surrounding the eyeballs.

An eye/face wash that can wash both eyes simultaneously is required in every science laboratory, classroom, and preparation room where hazardous materials are used.

Squeeze bottle type eyewashes are NOT sufficient and should NOT be used as eyeface washes in any science laboratory.

There are several different designs for eye/face washes. To ensure that the eye/face wash stations in your science facilities will meet safety requirements, they should...

- * be located no more than 10 seconds from a student work station.
- * be located no farther than 25 feet from any student work station.
- * comply (one eye/face wash) with ADA regulations on accessibility.
- * be provided with sufficient water pressure to operate correctly (0.4 gpm).
- * wash both eyes simultaneously and the face with tepid water (60-90°F).
- * supply an instantaneous flow of tempered (recirculated) water for at least 15 minutes.
- * have a water control valve that remains on, allowing the user to use both hands.
- * be clearly marked and unobstructed for immediate use.
- * **Eye/face washes should be flushed for 5 minutes once a week to remove any harmful contaminant that may form or grow in the eyewash.**

"For the first time ever, a student had to use one of our eye washes. The eye washes, as in many schools, only have cold water going to them. As a result, the 15 minutes of eye irrigation became quite painful to the student. Fortunately, the student suffered no eye damage from either the material that got into her eye or from the cold water. The cold water diminished the student's willingness to continually irrigate her eyes. I wonder how many schools have thought to ensure that the water is at an appropriate (60-90°F) temperature?"

David Hoyler, Director
Middle and Upper Schools
Locust Valley, NY

The “Hand-Held Drench” hoses are listed in the American National Standards Institute (ANSI) Standards (ANSI Z 358.1), but carry instructions that they are *not intended to replace emergency shower or eyewash units*.

For more information, see the American National Standards Institute (ANSI) standards for eyewash equipment.

SAFETY SHOWERS

A safety shower is required in chemistry and integrated physics and chemistry as well as in any laboratory where hazardous chemicals are used. Safety showers...

- * must meet the standards for height, spray pattern, tepid water temperature (60-90°F), and water flow of 20 gallons per minutes at 30 PSI.
- * have a control valve that can remain on (15 minutes) without requiring the use of the operator’s hands.
- * be located no more than 50 feet from any student work station or no more than 10 seconds away.
- * are marked with a highly visible sign for each safety shower.
- * should be large enough to accommodate the injured person and a teacher assisting with the emergency.
- * should have a fixed valve handle or a chain with a large ring that can be pulled to start the flow of water.
- * must have sufficient water flow and pressure to function properly for immediate use.
- * should be ADA compliant.
- * be flushed once a week to eliminate contamination and check for proper working conditions.

Tepid water should not exceed the temperature of a person’s eyeball (60-90°F) on combination units eyewash/shower systems.

For additional information see the ANSI *Standards for Shower and Eyewash Equipment* (Z358.1).

VENTILATION

A well-maintained ventilation system is an important contributor to a healthy environment in science classrooms and laboratories. According to the *NSTA Guide to School Science Facilities*:

“Forced ventilation at a minimum rate of four changes of air per hour should be provided for science laboratories, and continuous ventilation at six changes per hour for chemical storage rooms. Assuming that there is a fume hood in each preparation room, four air changes per hour is adequate. All exhausts should be vented to the outside of the building, not recirculated in the building’s ventilation system.

Chemical storage rooms need systems that vent directly outside, usually to the roof, and away from fresh-air intake pipes. Stage cabinets for flammables should not be ventilated to the outside.

Every science room should be equipped with exhaust fans designed for the rapid venting of smoke or bad odors created by an investigation.”

Additional information on ventilation can be found in the American National Standards Institute (ANSI) for laboratory ventilation (Z9.5-1992).

UTILITY CARTS

Chemicals should be transported from the preparatory room to the classroom or laboratory by using heavy-duty utility carts with raised sides to contain spills. Carts composed of noncorrosive materials (plastic or stainless steel) are recommended to reduce rusting and deterioration. Heavy-duty wheels or casters approximately 5” in diameter are suggested for smooth transportation of chemicals.

Each laboratory and preparatory room should have at least one utility cart for transporting chemicals and other materials.

ELECTRICAL PROTECTION

Electrical safety needs must be considered for all new, old, and renovated science classrooms, laboratories, storage rooms, and preparation areas. The emphasis of electrical safety should be on prevention.

Minimum considerations for electrical safety include:

- * Ground-fault interrupters (GFCI) should be installed to protect against major shock and electrical fires by preventing short circuits.
- * All outlets must be grounded to prevent electrical accidents. Sufficient outlets should be provided to eliminate the need for extension cords. If floor boxes are used, they should not be located near water sources or areas where water is used.
- * Surge protectors should be used to protect computers and other electronic devices from power surges.
- * Emergency shut-off controls (electricity, gas and water) should be located in an area that is not easily accessible to students.
- * Circuits should not be overloaded.
- * Use only spark-free refrigeration in laboratories, storage rooms, and preparation areas for storage of flammable chemicals.
- * Avoid the use of extension cords.

In developing the school's safety program, include provisions for handling electrical emergencies. All teachers of science should know where the master electrical cutoff switch and the control box are located, and how to operate both of these.

Before an activity is conducted that requires the use of an electrical device, the teacher and students must be familiar with its operation and safety features.

As a safety precaution, examine the wiring for frayed or bare wires and look at the electrical plugs for secure wiring. If a problem occurs...

1. Remember to remain calm and consider the evidence.

- * Was a pop or a spark made when attempting to operate the equipment?
- * Were you able to see where it happened?
- * Is there an explanation for this situation?

2. Consider if any action is warranted.

- * Will this action be safe?
- * Could there be too many electrical devices on one circuit?
- * Use the master electrical utility cutoff and check the devices. Are they still warm?
- * Do they smell of burning electrical insulation?
- * Are the wires to the equipment warm or hot?

3. Direct students not to touch anything.

- * All electrical hazards are not directly due to an electrical situation.
- * Special attention must also be given to the proper use and handling of laboratory equipment.

Manual of Safety and Health Hazards in the School Science Laboratory, 1984

CHEMICAL SAFETY

Material Safety Data Sheets (MSDS) are important in keeping current with §502.006(b) of the Hazard Communications Act. It requires that an employer shall maintain a legible copy of a current MSDS for each hazardous chemical purchased. Material Safety Data Sheets shall be readily available, on request, for review by employees at each workplace.

Every chemical manufacturer is required by law to supply a recent MSDS with each chemical it produces. These should be sent with each chemical that is purchased by a school or school district. If MSDS are not available, request them from the chemical manufacturer. Every teacher needs to know and understand the information on an MSDS.

MATERIAL SAFETY DATA SHEETS

Each manufacturer may develop a unique format and style for listing the information required by the Hazard Communications Act. The following information identifies what information should be listed on MSDS forms for science teachers.

PRODUCT IDENTIFICATION

This section provides the name, address, and telephone number of the manufacturer if additional information is needed concerning a chemical. This section also lists an emergency phone number to reach the manufacturer in case of an emergency.

HAZARDOUS COMPONENTS

Information about the hazardous chemical is listed in this section. It is important that the user know the exact ingredients of the substance, if it is an element or a compound, if the substance is pure, and what percentage of the substance is hazardous. Pure substances will have a Chemical Abstract Service (CAS) number that identifies the substance. The American Chemical Society's CAS assigns a different number to each compound and element.

The common name is given and sometimes other common names for example, a trade name may appear. Specific hazardous

information such as a chemical's Threshold Limit Value (TLV) and the Time Weighted Average (TWA) is also provided.

The normal time interval for TWA is a 40-hour week. Thus the values given are based on how much a person can be exposed to each day, assuming the person works an 8-hour day and 5 days a week. Compounds with low exposure limits are very toxic.

PHYSICAL DATA

The physical characteristics of a hazardous substance are concerned with a change of the physical state of the material. The boiling point is given for a standard (one atmosphere) pressure and the temperature at which the vapor pressure of the liquid equals the external pressure of one atmosphere. Compounds with low boiling points vaporize very easily. If the material is a solid at normal temperatures then its melting point will be given. Specific gravity indicates how dense the substance is compared to water.

Vapor pressures and vapor densities are important factors concerning liquids. When the vapor pressure and vapor density are high and the substance is combustible, a flammability hazard will be indicated. Other physical properties that may be listed in this section include evaporation rate, solubility

in water, the appearance, color and odor. Some compounds have distinct odors and can be identified by them such as ammonia or hydrogen sulfide.

FIRE AND EXPLOSION HAZARDS

The flash point is the minimum temperature, when there are sufficient vapors, to support combustion. Liquids with flash points below 20° C are very hazardous flammable liquids. Liquids that have a low flash point and wide flammability limits are very dangerous.



Many react so rapidly that an explosion occurs along the burning process. Most of these liquids will have a 4 on the NFPS rating such as gasoline, diethyl ether and carbon disulfide.

This section may also contain information related to the type of fire extinguisher should be used to fight a fire when this substance is burning. Information about precautions that must be followed when handling these dangerous materials is also available. Flammables need specific storage requirements and transportation precautions.

HEALTH HAZARDS

There are several ways a chemical can create health problems. Is the substance poisonous? This is generally the first concern a person has about a hazardous substance. It is important to know what the critical concentrations are that chemicals will cause injury to a person.

Almost every chemical will be toxic to humans at some concentration. In a medical sense, lethal dose (LD) indicates the dosage or concentration of a substance when it is more than the body can tolerate. For example, LD₅₀ means that 50% of the population receiving that concentration will experience death.

Corrosiveness or problems with skin contact are terms that mean the chemical seriously destroys skin tissue and can cause a chemical burn. Strong alkaline substances such as calcium oxide, potassium hydroxide, or sodium phosphate can cause chemical burns. Some corrosive chemicals can cause a rapid dehydrating of the body tissues like glacial acetic acid and anhydrous aluminum chloride. While others like hydrofluoric acid cause rapid decomposition of skin, bones, and other body tissues.

Another health hazard that may be listed in this section are chemicals that are carcinogens, causing cancer. Some carcinogens are organic compounds like benzene and carbon tetrachloride. Some chemicals are suspected of being carcinogens like formaldehyde and polychlorinated biphenyls.

FIRE AND EXPLOSION DATA

The stability of the substance should be stated in this section. High reactivity is commonly associated with unstable compounds. This section is concerned with compounds that are very reactive. Many are explosives like picric acid and ammonium perchlorate. Strong oxidants are color coded yellow.

The compounds that are highly reactive with water will appear in this section even though they occupy a different quadrant on the NFPA diamond. Compounds such as sodium hydride react with water to release hydrogen gas. An important feature of this section is the listing of incompatibility of certain chemicals with other chemicals. This assists with the storage of chemicals in compatible families.

SPILL AND DISPOSAL PROCEDURES

This provides valuable information that is difficult to find in other resources—how to handle a chemical spill and how to dispose of chemicals properly. Many of the MSDS forms will list information on the Environmental Protection Agency (EPA) hazardous waste number for disposal purposes.

It may just state that the chemical must be disposed of in accordance with local, state, and federal environmental regulations.

PROTECTIVE EQUIPMENT

Personal protective equipment that must be used or worn will be included in this section. If an MSDS lists protective equipment for a chemical being used in an experiment, the students and teacher must wear the protective equipment.

STORAGE AND HANDLING PROCEDURES

This section gives the user information about proper storage for a particular chemical. Statements such as "Storage Code: RED—flammable substance, store in cool, well-ventilated areas," will be found in this section or combined in other sections on the MSDS. If special handling procedures are required, the teacher will find them given in this section.

TRANSPORTATION DATA AND ADDITIONAL INFORMATION

This is optional information, on MSDS forms, that lists the Department of Transportation (DOT) class required if the material is to be shipped.

CHEMICAL LABELING

There are no regulations on what a chemical label must look like. However, the Hazard Communications Act does require that all manufacturer's labels must include the...

- * name of the chemical
- * physical and health hazards including the organs it would affect
- * manufacturer's name and address

The sample label of Ethyl Ether lists the required information in addition to the NFPA Hazard Code, chemical formula, and the CAS number.

Other items that may be identified on the chemical label include the ...

- * CAS number that was assigned by the Chemical Abstract Service.
- * chemical formula.
- * molecular weight for compounds, the atomic weight for elements.
- * common name of the chemical.
- * purity of the substance.
- * lot numbers.
- * supplier's name and address.


If the chemical is removed and placed in a new container or the original label was destroyed, the label of the new container must include the...

- * identify the chemical name and formula.
- * physical and health hazards.

CHEMICAL STORAGE

Safe chemical storage is based on the chemical properties of the substances that are to be stored. The hazards of the chemicals are closely associated with their chemical and physical properties. Proper storage of chemicals should follow these guidelines.

1. The chemicals must be properly labeled with the identity of the contents, hazards, and manufacturer's name and address.
2. The chemicals must be stored in compatible families.

ETHYL ETHER	
$C_2H_5OC_2H_5$	GENERIC CHEMICALS
Education Grade	1717 Toxic Row
	Ether, USA 10059
1000mL	HIGHLY VOLATILE
	EXTREMELY FLAMMABLE
CAS 60-29-7	MAY FORM EXPLOSIVE PEROXIDES
	HARMFUL IF SWALLOWED OR INHALED
	MAY CAUSE INJURY TO EYES
	EFFECTS MAY BE DELAYED
	STORE AT 77°F (SAMPLE LABEL)

3. The location of the chemical storage room should be located so that people in the building or damage to the building will be minimal if an explosion or fire was to occur.
4. The chemical storeroom must have two exits and doors that lock.
5. The doors should be labeled "Authorized Personnel Only" or "Hazardous Materials."
6. The storage room must have continuous forced air ventilation that is vented to the outside away from air intakes.
7. Storage cabinets and shelves must be resistant to corrosion.
8. Chemicals must be stored in upright position and no more than two containers deep.
9. Shelves may be equipped with a lip to prevent chemicals from being jarred off the shelf.
10. Corrosives (acids and bases) should be stored in an approved corrosive cabinet.
11. Flammables should be stored in an approved flammable cabinet.
12. Chemicals should not be stored above eye-level and never stored on the floor.
13. Water-reactive chemicals (metals) should be stored where they will remain dry.
14. Proper safety equipment must be clearly marked inside the storeroom.
 - * ABC fire extinguisher
 - * Safety goggles
 - * Fire blanket
 - * Spill kit
 - * First aid kit
15. The room must be adequately lighted.
16. Smoke detectors should be present.
17. An on-going chemical inventory should be maintained.

CHEMICAL DISPOSAL

There are several important steps that should be taken prior to proceeding with chemical disposal. Determine how many chemicals are designated for disposal.

Remove...

- * out-of-date or contaminated chemicals.
- * chemicals without legible labels.
- * chemicals that are too hazardous for student use.

OPTIONS FOR PROPER CHEMICAL DISPOSAL

Contact commercial chemical disposal companies in your area. Many waste disposal companies recycle chemicals and resell them. Other options may be available by contacting...

- * other schools in your area and combine quantities for disposal.
- * industries in the area for assistance in disposal.
- * institutions of higher education; they may allow you to use their system of disposal.
- * the Texas Natural Resources Conservation Commission.

Chemicals can be properly disposed by chemical disposal companies using the following methods.

1. Incineration
2. Detonation
3. Open burning
4. Neutralization of acids and bases (final pH range of 5-9)
5. Carbon absorption
6. Oxidation/reduction
7. Precipitation and clarification
8. Biological treatment
9. Land disposal

Do not flush chemicals down sinks as a means to dispose of them. This may adversely affect the water treatment plants in your area by destroying microorganisms essential to the process of water purification.

*Science Laboratory Safety and Chemical Waste Disposal
for Texas Science Teachers, 1990*

Discussing microscale science techniques may appear out of place in a laboratory safety manual. Quite the contrary, microscale techniques offer a pedagogically sound approach to science laboratory investigations and provide simple solutions to many safety issues.

Major concepts emphasized in laboratory instruction have shifted from a simple reduction in amounts of chemicals used to a reeducation approach.

The primary construct put forth by advocates of microscale chemistry is to instill in educators and students "If you don't need that much, then don't use it." The purpose is to move away from a "throwaway mentality. One aspect of microscale chemistry is that it reduces the amount of materials being "wasted."

Hazardous waste management is a problem confronting all education institutions. Schools are finding it increasingly difficult to fund the disposal of hazardous waste while attempting to maintain a hands-on chemical learning environment. Microscale experiments make it possible to promote critical thinking skills while addressing major safety issues for a safe learning environment. Advantages of incorporating microscale/small scale chemistry into the learning environment include the...

- * reduction in the cost of chemicals.
- * reduction of possible fire and explosion danger.
- * reduction of chemical waste disposal costs.
- * introduction of experiments where chemicals once thought to be too expensive or hazardous can be made available with the reduced amounts.
- * recycling of products for future experiments (plan ahead and use it again).
- * introduction of less expensive glassware.
- * reduction of exposure to toxic materials.

SAFETY ADVANTAGES

Using the microscale technique means that...

- * dispensing liquids from plastic dropper bottles greatly reduces many spills.
- * accidental glass container breakage is eliminated.
- * air quality is improved by smaller amounts of vapor escaping.
- * fire hazards are virtually eliminated.

Although some of the liquid is lost due to vaporization during both processes, the microscale technique reduces hazardous organic chemicals that must be recovered and disposed of properly. In addition, this technique represents a responsible step in reducing environmental pollutants.

In the science storeroom, chemicals in smaller containers (approximately 10% of the size used in macroscale) reduce the need for storage space. Packaging and handling represents the greatest cost in purchasing chemicals.

Consider health and fire hazards, storage cost and disposal cost when buying more chemicals than is needed because the cost per milliliter or gram appears to be less in larger quantities.

Byron E. Howell, *Microscale Chemistry Center*

CHEMICAL SPILLS

If a chemical spill occurs in the laboratory or preparatory room or in the classroom quick action by the teacher can reduce the possibility of injury to a student or themselves. A chemical spill such as a liter bottle of hydrochloric acid breaking in the chemistry laboratory is considered a major spill. The teacher should...

- * immediately evacuate all students through the exits farthest from the spill. Fumes from a chemical spill can cause severe damage to the body.
- * immediately assist any person splashed with the chemical to the safety shower.

- * turn on emergency exhaust fan.
- * contain the spill wearing proper protective clothing. Do not allow the spill to trap you.
- * call for help. The school safety plan should contain agencies or departments in your community that will assist in containment and removal of the chemical.

SPILL CONTROL MATERIALS

There are many types of commercial materials that have been developed for containment and removal of chemical spills. They range from absorbent pads that quickly absorb chemicals in a liquid state, porous bags filled with an amorphous silicate, to materials that neutralize an acid or a caustic spill.

What is typically found in public schools is a plastic 5-gallon bucket filled with dry sand, vermiculite, or dry clay materials. These do nothing to neutralize a chemical like an acid or base, but absorb the liquid or contain it in a smaller area. The disadvantage of using sand is that it is heavy and difficult to transport.

Once the chemical has been contained and neutralized, use clean up equipment that is made of plastic or polypropylene so that the equipment doesn't react with any of the chemical that remains. The contaminated material is to be placed in plastic bags or containers and marked appropriately. The custodial staff should be informed of the material so that it can be disposed of properly.

HEALTH CONCERNS

Dangerous situations can happen very quickly and a teacher must know what to do almost instantly. There is no time to form a plan of action. The plan must be worked out in advance and quickly recalled when an emergency arises. *Most laboratory accidents can be prevented if a safe activity is used, good laboratory management techniques are followed, and safe practices observed during the investigation.*

WHAT KINDS OF HEALTH CONCERNS?

ALLERGIES

An allergy is hypersensitivity to foreign substances that are normally harmless but produce a violent reaction in a person. Allergies are the body's effort to eliminate something it considers harmful. In some people the histamine that the body produces in response to an allergen can cause muscle cramps, disorientation, unconsciousness, and death from shock or suffocation.

Teachers should be aware of the allergies of their students as well as being concerned with their own allergies. These should always be reviewed before beginning an experiment, whether performed indoors or outdoors.

It is a good practice to inform the parents of the live and preserved plants and animals, chemicals, outdoor activities, and foods that may be tasted or used in your classroom. Express a concern about students' possible allergic reactions to the materials. Parents should respond by listing allergic reactions that their children may have if exposed to the materials listed. This may prevent student from having a severe allergic reaction in your classroom.

BURN HAZARDS

One of the common accidents that can occur in the science laboratory or classroom involves burns from heat or chemicals.

Careful planning, using classroom management techniques, and providing safety training for the students can prevent burns. A primary focus of safety in the laboratory is to avoid all burns. Accidents may happen so minimizing the seriousness of the burn to a first-degree burn is a desirable secondary target in laboratory safety.

The following information is adapted from the U.S. Department of Health and Human Services, *Manual of Safety and Health Hazards in the School Science Laboratory*.

CHEMICAL BURNS

Handling hazardous chemicals with extreme care can prevent chemical burns. Hold the chemical at arm length toward the back of the working area on the laboratory table. Do not place hazardous chemicals in unstable containers or in an apparatus that is not properly secured.

If a student receives a chemical burn, remove clothing and place the student in the safety shower for at least 15 minutes. Call the nurse and 911. Cover burns with clean dressing.

A chemical burn to the eyes should be continuously washed from at least 15 minutes at the eyewash station. Call the nurse and 911. Remove contact lenses. Cover both eyes with clean dressing.

USE GLOVES AND WASH YOUR HANDS BEFORE AND AFTER GIVING FIRST AID TO PREVENT THE SPREAD OF PATHOGENS! GLOVES ARE NOT 100% PROTECTION FROM INFECTION.

HEAT BURNS

If the student receives a burn, perform the procedures listed on the table.

DEGREE OF BURN	INJURY TO BODY	FIRST AID PROCEDURE
First Degree Burns	<ul style="list-style-type: none"> • affect the outer layer of the epidermis • characterized by redness and heat • itching, burning, and pain common 	<ul style="list-style-type: none"> • hold under cool water on burn for 5 minutes • cover with clean dressing
Second Degree Burns	<ul style="list-style-type: none"> • affect deeper layers of the epidermis • characterized by mottled red skin and blisters • considerable pain and body fluid loss through blisters • infection is possible and hospitalization may result 	<ul style="list-style-type: none"> • Call 911 • Call the school nurse • DO NOT remove burnt clothing • DO NOT cover burns with dressing
Third Degree Burns	<ul style="list-style-type: none"> • affect skin and deeper tissue • burns are white or charred in appearance • little pain due to nerve ends burned • internal loss of body fluids • danger of infection is high • extensive hospitalization required 	<ul style="list-style-type: none"> • Call 911 • Call the school nurse • DO NOT remove burnt clothing • DO NOT cover burns with dressing

PREVENTION

Most burns result from accidental contact with heated objects and liquids. Heated objects should be constantly attended by the student conducting the investigation or placed where it is shielded from accidental contact.

Hot plates are one of the more dangerous pieces of equipment because they retain heat for a long period after they have been switched off. A hot plate sitting on the edge of a laboratory table looks innocent—until a student leans an elbow on it while conducting an investigation. Hot plates should be placed out of reach to avoid accidental contact.

Students should never have to reach across a hot apparatus to perform an experiment. The apparatus should be placed so that if hot liquids are spilled, they will fall on the laboratory table, not the student.

Remember...

- * Open ends of glassware used for heating should be pointed away from all other students.
- * Use a hot plate, rather than a Bunsen burner, when evaporating liquids.
- * Hot plate thermostats should be set at the correct temperature for the experiment, not set on the maximum temperature.
- * Bunsen burners should be operated at a sensibly low level.
- * Objects should not be held for an excessive period of time in a Bunsen burner flame.
- * Hot water baths should not be boiled unless absolutely necessary.
- * Light bulbs used in experiments should be the lowest wattage possible.
- * Heat-generating chemicals should be mixed slowly.

- * Dilute solutions of chemicals should be used when possible.

Ingestion or inhalation of chemicals will require a call to the nurse, 911, and the Poison Control Center in your area. If you need to perform CPR, it is recommended that a mouth-to-mask resuscitator be used so that you do not succumb to the chemical as well.

GLASSWARE HAZARDS

Most laboratory accidents with injuries involve glassware failure that is caused by improper use. Glassware is fragile. Glassware used in science laboratories should be made of Pyrex or Kimax. This type of glassware offers the best resistance to chemicals, being heated, and accidental breakage. Remember...


- * Never use glassware that is scratched or chipped—breakage and injury may result. Dispose of glassware in an appropriate container.
- * Always lubricate glass tubing, thermometers, or rods when inserting them in rubber stoppers.
- * Always protect the hands with several layers of cloth when inserting glass in rubber stoppers.
- * Do not try to cut through glass with a file. To properly cut glass with a file, make a scratch on the glass tubing or rod with a sharp triangular file using a quick motion. Snap the tubing or rod at the scratch and fire polish the cut ends.
- * Wrap or strip glassware with masking tape if it is to be used under vacuum or pressure. This will prevent flying pieces of glass in the event of an implosion or explosion.
- * Never heat pipettes, volumetric flasks, or burettes—they can change volume as a result of expansion.
- * Do not heat bottles, graduated cylinders, or volumetric glassware, funnels, jars, droppers, watchglasses, desiccators, and glass plates.
- * Manipulate heated glass with caution to avoid burns. Glass cools slowly.
- * When bending glass tubing or fire polishing cut glass tubing, never hand the tubing to anyone until it has cooled.
- * If a student receives a minor cut or scratch, wash your hands, put on protective gloves and then clean the area with soap and water. Place a clean dressing over the wound and send the student to the school nurse.
- * If a student receives a wound that causes severe bleeding, send for the nurse and call 911. Put on protective gloves and apply pressure to the wound until help arrives. If the student has been impaled with object in the wound, DO NOT remove the object.

Many injuries occur when cleaning glassware. In addition to the possibility of injury from broken glass, there is the threat of injury from the cleaning solutions used.

Most glassware can be cleaned with detergents and brushes. When stronger cleaning solutions are needed, trisodium phosphate, dichromate-acid, and alcoholic potassium hydroxide are used. All of these cleaning solutions are hazardous chemicals. These cleaning solutions are dangerous and should be handled carefully.

BIOHAZARDS

A biohazard is defined as any biological material (living or dead) that is a pathogen (disease carrying organism).

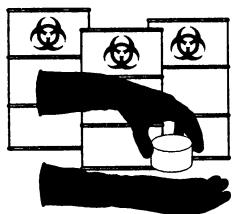
The biohazard symbol  is universal and should be used on all potential pathogenic material.

BIOLOGICAL SPILLS

Biological spills that occur in a science laboratory or classroom can generate aerosols that can be dispersed in the air throughout the room. These spills can be very dangerous if they involve microorganisms that may be infectious.

If a spill occurs...

- * remove any contaminated clothing.
- * vigorously wash exposed area with soap and water for one minute.
- * wear disposable gloves and soak up the contents of the spill with paper towels.
- * place contaminated paper towels in a plastic bag for disposal.
- * go over the spill area with a disinfectant.
- * consult the MSDS and a physician if necessary.



BLOOD SPILLS

Cleaning of blood spills should be limited to persons who are trained for the task. If an untrained person encounters a blood spill, they should limit access to the area and call for assistance immediately. Follow these steps for proper removal of blood spills:

- * wear disposable gloves.
- * if they develop holes, remove them and wash hands immediately, then use new gloves.

- * remove contaminated gloves by grasping the glove at the wrist and pulling it off turning the glove inside out.
- * double bag gloves and contaminated materials.
- * use disposable towels only.
- * if the spill involved broken glassware, NEVER pick up the glass directly with the hands.
- * use a brush and dustpan to collect broken glassware.
- * biological spills of ANY type should be cleaned up with a 1:10 solution of bleach. (One part bleach to nine parts water) Leave on contaminated area for 15 minutes. This dilution will destroy most viruses and bacteria.

STANDARD PRECAUTIONS

Standard precautions have been created to minimize the risk of infection all types of sources and apply to all people. All blood, body fluids and body substances are to be considered potentially infectious. Standard precautions should be followed to establish a procedure for infection control. For example:

- * Wash hands with soap.
- * Wear disposable gloves and wash hands after removing the gloves.
- * Wear mask and eye protection or face shield.
- * Wear lab aprons or coats.
- * Place contaminated waste (gloves, paper towels, bandages, etc.) in plastic bag.
- * Notify custodial staff for proper disposal of waste.
- * Custodial staff are to place the material in a red plastic biohazard bag and follow proper disposal procedures.

USE PROPER BODY MECHANICS

Teachers must know how to properly apply the principles of body mechanics to minimize personal and student injury. The following list will assist in correctly moving heavy objects.

THINK BEFORE LIFTING

- * Assess the size of the load and get help if needed.
- * When possible, use assisting devices or try pushing or pulling the object first.
- * When lifting an injured student, explain the process so that the student can help, if possible.
- * Make sure the path is clear and unobstructed before lifting.

WHILE LIFTING

- * Bend at knees, keep the back straight, and hold the object close to your body.
- * Spread the feet about one foot apart and use your leg muscles.
- * Never twist your body—move your feet first, then allow the leg muscles to turn the body.
- * Never jerk the load—lift in a smooth motion, and don't twist the body.
- * If it is too heavy to lift alone, GET HELP!
- * Use same technique to set down the load as you used to pick up the load.

HAVE FIRST AID KITS READY



First aid kits should be kept in a conspicuous place in science laboratories and preparation rooms preferably by a sink. The place where the kits should be marked clearly and students made aware of the location and procedures for using the kits.

ITEMS RECOMMENDED FOR FIRST AID KITS

- * box of disposable gloves (latex or plastic)
- * antiseptic and disinfectant
- * bottle of bleach—prepare solution at time needed (dilute 1 part bleach to 10 parts water)
- * disposable towels
- * sterile gauze for covering large wounds
- * medical tape
- * scissors
- * Bandage strips for covering small wounds
- * plastic bags for holding contaminated waste

ITEMS NOT RECOMMENDED FOR FIRST AID KITS

- * iodine (can cause tissue damage)
- * ice pack compress (swelling of soft tissues should be examined by a physician)
- * ammonia inhalants (if student is unconscious, get help)
- * tourniquet (use pressure until medical assistance is available)

LIVE ANIMALS IN THE CLASSROOM

Classroom experiences that involve non-human animals range from observation to dissection. National Association of Biology Teachers (NABT) supports these experiences so long as they are conducted within the long established guidelines of proper care and use of animals, as developed by the scientific and educational communities.



“As with any instructional activity, the use of non-human animals in the biology classroom must have sound educational objectives. Any use of animals, whether for observation or dissection, must convey substantive knowledge of biology.”

NSTA: *Guidelines for Responsible Use of Animals in the Classroom*



GUIDELINES FOR USING LIVE ANIMALS

Teachers and students must be aware of the responsibilities involved in having live animals in the classroom. These guidelines are to assist when live animals are introduced in the classroom or laboratory. See Appendix B: *Professional Organization Position Statements*.

- * Investigations should not be performed on any animal that might cause suffering, pain, or be a possible health hazard to the teacher or student.
- * Animals brought to the classroom should be observed carefully by a science instructor. The health and safety of the animal and the students should be a priority during this classroom activity.
- * Animals that “live” in the classroom should be treated with care and respect while sharing the living space with students.
- * Be aware of any allergies students may have toward animals.
- * Wear personal protective equipment when caring for animals especially animals that are not domesticated. Some wild (non-domesticated) animals may carry infectious diseases or organisms that transmit to humans.
- * Students should notify the teacher prior to bringing an animal to the classroom. Potentially dangerous situations can be eliminated before they occur.

HANDLING LIVE ANIMALS

Precautions should be used if live animals are kept in the classroom. Teachers should be aware that diseases such as salmonellosis, can be transmitted to students who handle classroom animals. The small painted turtle, that frequents elementary school classrooms, has been found to carry the salmonella

bacteria. Keeping the cages clean of fecal remains will reduce the presence of bacteria that may cause an illness.

Always insist that students *wash their hands* before feeding the animals, after they have handled the animals, or touch materials from the animal’s cage.

SAFETY TRAINING

This chapter will assist school district personnel and administrators with guidelines on what must be presented in a professional development program and who should receive it. There are several ways that a school district's safety program can be presented. A well-designed professional development safety program should include information on safety equipment, safety facilities, safety procedures, and first aid. Additional requirements may need to be added according to local school district policy and local safety codes.

In addition to professional development on general safety components, teachers and other district employees must receive instruction on the Texas Hazard Communications Act.

TEXAS HAZARD COMMUNICATIONS ACT (HAZCOM)

The Hazard Communications Act of 1985 was passed during the 69th Legislative Session and became law effective January 1, 1986. The law was later revised during the 73rd Legislative Session and became law effective September 1, 1993. Under section 502.009(b) of the Texas Hazard Communications Act, public schools are to develop, implement, and maintain a written hazard communication program.

WHO IS TO RECEIVE PROFESSIONAL DEVELOPMENT TRAINING?

Section 502.004 of the Hazard Communications Act defines an "employee" as a person who may be or may have been exposed to hazardous chemicals in the person's workplace under normal operating conditions or foreseeable emergencies. This includes persons working for this state (school district personnel).

The law requires that all teachers of Prekindergarten through high school and other district personnel must receive training on the Hazards Communications Act prior to working in the area or with the

hazardous materials. Teachers new to the profession must receive safety training before they work with or in the area containing the hazardous chemicals however, district personnel changing assignments only require training on hazardous materials not covered in their initial training and updates. For example, a teacher changing assignments from earth science to chemistry and previously trained on the Hazard Communications Act will require additional training on the hazardous chemicals related to the new teaching assignment.

"Students are not 'employees' for the purpose of the Texas Hazard Communications Act, Texas Health and Safety "Code, Sections 502.001-016. Therefore, the Texas Hazard Communications Act is not applicable to students in their capacity as students except for the requirements of Section 502.004(e)(5)(B) that requires that materials safety data sheets must be maintained by the laboratory and made accessible to students."

July 21, 1993 Texas Attorney General ruling, Opinion Number DM-239

1. A professional development program must include, as appropriate:
 - a. understanding and interpreting labels on hazardous chemicals and Material Safety Data Sheets (MSDS) and the relationship between those two methods of hazard communications;
 - b. safe handling of hazardous chemicals known to be present in the school district personnel's work area and to which the employee may be exposed;
 - c. the proper use of protective equipment and first aid treatment to be used with respect to the hazardous chemicals to which teacher may be exposed;
 - d. general safety instructions on the handling, cleanup procedures, and disposal of hazardous chemicals.
2. Training on hazardous chemicals may be conducted by the categories of the chemicals. The protective equipment and first aid treatment may be accomplished by categories of hazardous chemicals as well.
3. Teachers and other school district personnel must receive additional training when the potential for exposure to hazardous chemicals in the work area increases significantly or when the school district receives new and significant information concerning the hazards of a chemical in the employee's work area.
4. The school district shall provide training to a new or newly assigned teacher, administrator, or other school district personnel before the individual works with or in an area containing a hazardous chemical.
5. The school district shall keep a written hazard communications program and a record of each training session given to school district personnel, including the date, a roster of the employees who attended, the subjects covered in the training session, and the names of the instructors. Those records shall be maintained for at least 5 years by the school district. The Texas Department of Health will have access to those records and may interview teachers during compliance inspections.

HAZCOM GUIDELINES FOR SCHOOL DISTRICTS

The Texas Department of Health recommends the following steps as a guide for the development of a district-wide safety-training program.

1. Create a list of all district personnel that require safety training.
2. Determine the appropriate level of training for different job classifications based on the number and type of chemicals, chemical categories used, and the duration and frequency of use.
3. Designate a person(s) responsible for conducting the safety training.
4. Determine the format of the safety program to include visuals, classroom instruction, hands-on instruction, materials required.
5. Elements of the training program should include but should not be limited to:
 - * Texas Hazard Communications Act—purpose and application,
 - * use, location, and interpretation of Materials Safety Data Sheets (MSDS),
 - * location, health effects, and safe handling of hazardous chemicals present in the work area,
 - * proper use of protective equipment—safety goggles, lab aprons, safety gloves, etc.,
 - * first aid treatment with respect to hazardous chemical exposure,

- * safety instructions on the labeling, handling, cleanup, and disposal of hazardous chemicals,
 - * the employee rights under the Texas Hazard Communications Act.
6. Describe the procedures for training new or newly assigned employees where hazardous chemicals may be found.
 7. Describe the procedures for providing periodic update safety training.
 8. Describe the school district's procedures for responding to responding to an emergency situation involving hazardous chemicals.
 9. Establish a procedure for maintaining records of training sessions that include:
 - * dates of the training sessions
 - * a list of district personnel trained
 - * topics covered in the safety session
 - * name of the instructor(s)
 - * retention of this information for at least 5 years

The school district has the responsibility to obtain an MSDS for each hazardous chemical used in the schools. Copies of the MSDS are to be maintained on each campus readily available to teachers and other district personnel upon request. Generic MSDS that comply with OSHA standards are acceptable in lieu of the manufacturer's MSDS.

For further information on the requirements of a HAZCOM training program, contact:

Texas Department of Health
Hazard Communications Branch
1100 West 49th Street
Austin, Texas 78756
(512) 834-6603

SAFETY TRAINING FOR STUDENTS

The science laboratory is a place of discovery and investigation. One of the first things students discover is that learning in a laboratory is an exciting experience. The laboratory can also be a dangerous place to work if proper safety rules are not established and followed. To prepare students for a successful year in science, the teachers should develop safety rules that incorporate the following safety information.

PERSONAL PROTECTIVE EQUIPMENT

1. Many materials in the laboratory cause eye injury. Protect yourself from possible injury by wearing the splash-proof safety goggles provided in the laboratory. In Texas schools it is a state law that safety goggles must be worn in all situations where the possibility of injury to the eye is present. This includes working with chemicals, heating materials, and using certain kinds of equipment.
2. Laboratory aprons or coats should also be worn when working with chemicals or heated substances.
3. Protective gloves should be worn when handling hazardous chemicals and materials.



PROPER DRESS

1. Wear long sleeve blouses and shirts. Regular length slacks or denim jeans provide good protection for your legs. Shorts will not protect the legs and are not appropriate when working in a laboratory.

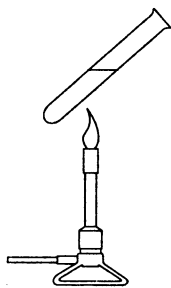
2. Long hair should be tied back to prevent it from coming into contact with chemicals or an open flame.
3. Wear shoes without open ends. Sandals will not protect the feet from spills or other injuries and should never be worn in a laboratory.
4. Any article of clothing or jewelry that can hang down from the body and may come into contact with chemicals or open flames should be removed or tied back before working in the laboratory.
10. Turn off all burners before leaving lab.
11. Know the location and use of all safety equipment (fire extinguishers, eyewash station, safety shower, fire blankets, chemical spill kits)
12. Never work in the laboratory alone or without permission.
13. Do not enter supply or storage rooms without a teacher present or with the teacher's permission.

GENERAL LABORATORY SAFETY RULES

1. Read all directions for doing a laboratory investigation before beginning. Be alert in the laboratory and listen for the teacher's directions. Ask questions if you do not understand any part of the investigation.
 2. Never perform activities that are not authorized by the teacher.
 3. Do not handle equipment without specific permission.
 4. Take extra precautions when handling chemicals. Never pour chemicals or other substances into the sink or trash container. If a chemical spill occurs, notify the teacher immediately.
 5. Never eat or drink in the laboratory. Never drink from a beaker or other container used in the laboratory.
 6. There should never be loud talking or playing in the laboratory.
 7. Handle cutting instruments carefully. Never cut materials toward you—use a cutting motion away from yourself.
 8. When you have completed the investigation, clean up your work area and return equipment and supplies to their proper place.
 9. Wash your hands with soap and warm water after every investigation.
1. Report all accidents to your teacher immediately.
 2. Learn what to do in case of an accident such as an acid spilling on the body, materials in the eye, and cut or burns.
 - * For chemicals splashed on the body—rush to the safety shower and pull the handle, remain in the shower for at least 15 minutes.
 - * For materials entering your eye—rush to the eye wash station and flush the eyes with a continuous stream of water for at least 15 minutes. Hold your eyelids open with your fingers or get assistance from your teacher.
 - * Minor cuts or burns are to be reported to the teacher and first aid given in the laboratory.
 - * For cuts or burns that are more severe, general first aid should be given and then examined by the school nurse.
 3. Be aware of the location of the first aid kit, but allow the teacher to administer first aid to an injured student.

FIRE SAFELY

1. Do not use an open flame without first putting on safety goggles.
2. Know how to light and regulate the flame on a burner.
3. Never leave an open flame unattended. When the burner is not being used, turn it off.
4. Keep your area clean and free from clutter.
5. Do not reach across an open flame.
6. Always point the open end of a test tube away from others when heating liquids. Some chemicals can boil out of the test tube violently and unexpectedly when being heated.
7. Never heat chemicals in a closed container such as a corked test tube. The expanding gas inside will cause the test tube to explode or turn the stopper into a projectile with considerable force.
8. Do not pick up a container that has been heated or hand a container to someone. Hold the back of your hand near the container and check for heat. If you can feel heat, use a mitten or tongs to pick up the container.

**CHEMICALS SAFELY**

1. Never touch, taste, or smell any chemical that you do not know is harmless. Many chemicals are toxic. If you are instructed to smell fumes during an investigation, do so by gently waving your hand over the container so that the fumes are brought to you. Do not bring the container to your nose. Do not inhale the fumes directly from the container, they may be too concentrated and cause you injury.
2. Only use chemicals that are listed in the investigation and do not substitute other chemicals for the ones listed.
3. Notify the teacher immediately if chemicals have been spilled.
4. Dispose of the chemicals properly as directed by the teacher. Do not pour them in the sink or trash container.
5. Use extra precautions with acids and bases. Always pour acid into water. Do not pour water into acids.
6. Remember to wash any acid or base immediately from your skin and notify the teacher.
7. Use a pipette bulb. Never pipette liquids using your mouth.
8. Read the labels twice before using the chemical.
9. Do not pour extra chemicals back into the original container. This causes contamination of the chemical and may cause incorrect results to occur in future investigations.
10. Never use the same spatula to remove chemicals from two different containers. Each container should have its own spatula.
11. When removing a stopper from a bottle, do not lay it down on the lab table, but place the stopper between two fingers and hold the bottle so that the label is in the palm of your hand. Both the bottle and the stopper will be held in one hand.
12. Replace all stoppers and caps on the correct bottle after you have finished using it.

USE GLASSWARE SAFELY

- * Glass tubing should never be forced into a rubber stopper. Use a lubricant and a turning motion on the glass tubing when inserting it into a rubber stopper or rubber tubing.
- * When heating glassware, use a wire or ceramic screen to protect the glassware from the flame.
- * After cutting glass tubing, always fire polish the ends to remove any sharp edges.
- * Never use broken or chipped glassware. If glassware breaks, notify your teacher and properly dispose of it in a broken glassware container.
- * Never eat or drink from laboratory glassware.
- * Clean glassware thoroughly before returning it to storage.

USE ELECTRICAL EQUIPMENT SAFELY

1. Be careful not to shock yourself or intentionally shock another person.
2. Turn off all power sources when setting up circuits or repairing equipment.
3. Do not use metal articles such as rulers, metal pencils or writing pens; do not wear rings, metal watchbands, or bracelets when working with electrical equipment.
4. When disconnecting electrical equipment, pull from the plug and not the wire.
5. Use caution when handling electrical equipment that has been in use. The equipment may be warm or hot from being used.
6. Never connect, disconnect, or operate a piece of electrical equipment with wet hands or standing on a wet floor.

OTHER PRECAUTIONS

1. Do not use hair spray, hair mousse, or other flammable hair products during or just before doing laboratory work where an open flame is used. These products may contain highly flammable chemicals and ignite easily.
2. Synthetic fingernails are also highly flammable and should not be worn in lab.

PROFESSIONAL DEVELOPMENT SAFETY PROGRAM

Equipment

Telephone

- emergency numbers
- locations

Fire Extinguishers

- types and uses
- location

Public Address System

- location
- emergency use

Eye Protection Devices

- law requirements
- types of protection
- purpose
- sanitation and storage

Fire Blankets

- purpose
- location

Spill Control Kit

- types
- purpose
- proper use
- location

Facilities

Corrosive Cabinet

- purpose
- location
- chemical storage
- ventilation

Broken Glass Containers

- purpose
- location
- proper disposal

Electrical Safety

- circuit breaker box
- electrical outlets
- extension cords
- location of outlets
- hazards

Emergency Showers

- law requirements
- location
- proper use
- purpose
- routine tests

Eye Wash Stations

- law requirements
- water temperature
- water pressure
- types and purpose

Flammables Cabinet

- purpose
- location
- chemical storage

Master Utility Controls

- purpose
- types of controls
- location
- maintenance
- security

Emergency Exits

- law requirements

Chemical Storage

- types of chemicals
- ventilation
- shelving

Forced Air Ventilation

- law requirements
- purpose
- uses
- locations

Safety Signs

- types
- purpose
- locations

Compressed Gas Cylinders

- types
- pressure hazards
- transporting
- security

Fume Hoods

- requirements
- location
- purpose and use

Emergency Exhaust Fan

- purpose and use

Procedures

Fire Drill Procedures

- fire drill rules
- posting evacuation routes

Safety Contract

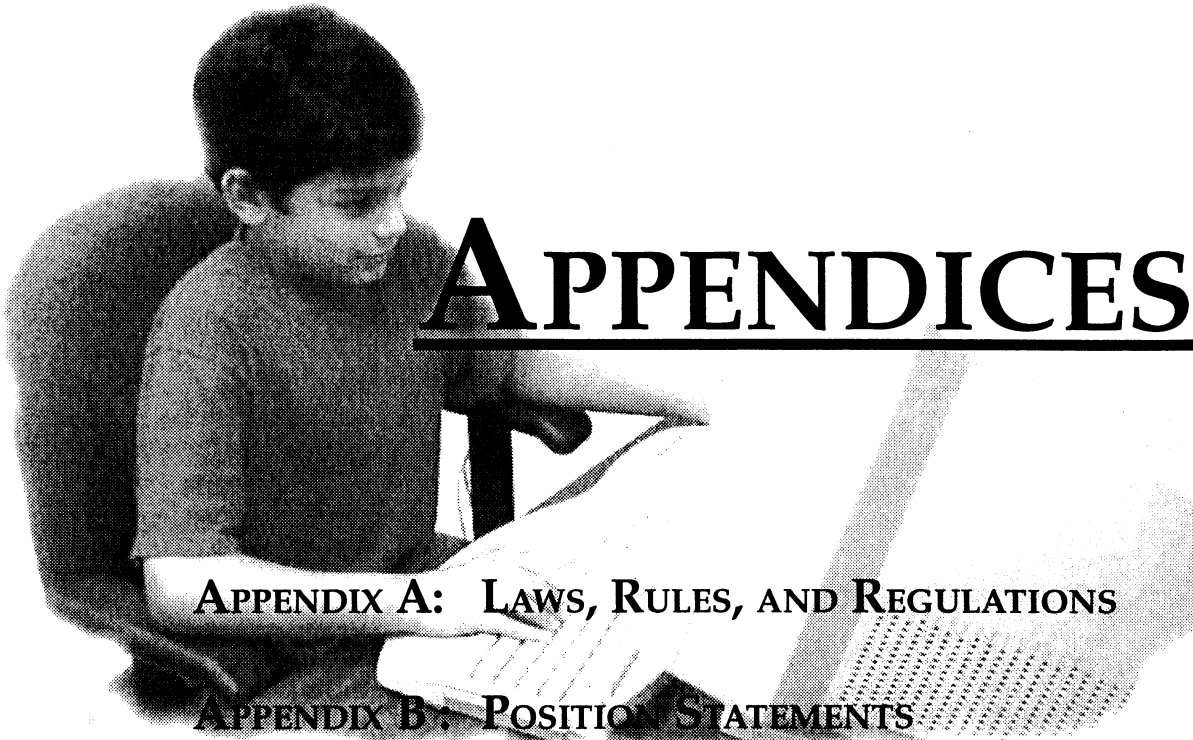
- student contract
- purpose and use

Emergency Procedures

- developing procedures
- what to do in an emergency
- when and how to call for assistance

First Aid Procedures

- handling cuts, burns and minor injuries
- reporting and keeping records
- when to call for assistance
- who to call for assistance
- CPR training
- Heimlich maneuver



APPENDIX A: LAWS, RULES, AND REGULATIONS

APPENDIX B: POSITION STATEMENTS

APPENDIX C: AGENCIES AND ASSOCIATIONS

APPENDIX D: SAFETY FORMS

APPENDIX E: CHECKLISTS AND GUIDES

APPENDIX F: HAZARDOUS CHEMICAL LISTS

APPENDIX G: SAFETY SYMBOLS

APPENDIX H: MATERIALS AND SAFETY EQUIPMENT

APPENDIX I: BIBLIOGRAPHY

APPENDIX A

LAWS, RULES, REGULATIONS

Federal Law

Public Law 105-17 Least Restrictive Environment

Texas Education Code (STATE LAW)

Chapter 1 Equal Educational Services or Opportunities
Chapter 21 Code of Ethics
Chapter 28 Required Curriculum (40% Laboratory Instruction)
Chapter 37 Safe Schools
Chapter 38 Protective Eye Devices in Public Schools
Chapter 46 Instructional Facilities Allotment

Texas Administrative Code, Title 19, Part II (TEXAS EDUCATION AGENCY RULES)

Chapter 61 School Facilities Standards
Chapter 74 Required Curriculum (40% Laboratory Instruction)
Chapter 247 Educator's Code of Ethics

Texas Administrative Code, Title 25 (TEXAS DEPARTMENT OF HEALTH RULES)

Chapter 295 Standards for Face and Eye Protection
Chapter 501 Hazardous Substances
Chapter 502 Hazard Communications Act

Civil Practice and Remedies Code, Title 5 (STATE LAW)

Chapter 101 Tort Claims

Public Law 105-17
“Least Restrictive Environment”

Title I—Individuals with Disabilities Education Act
Sec. 101. AMENDMENTS TO THE INDIVIDUALS WITH DISABILITIES EDUCATION ACT.
Part A—GENERAL PROVISIONS

Section 612(a)(5) LEAST RESTRICTIVE ENVIRONMENT

IN GENERAL—To the maximum extent appropriate, children with disabilities, including children in public or private institutions or other care facilities, are educated with children who are not disabled, and special education classes, separate schooling, or other removal of children with disabilities from the regular educational environment occurs only when the nature or severity of the disability of a child is such that education in regular classes with the use of supplementary aids and services cannot be achieved satisfactorily.



Texas Education Code
“Equal Educational Services or Opportunities”

TITLE 1. GENERAL PROVISIONS
CHAPTER 1. GENERAL PROVISIONS
Sec. 1.001. Applicability.

Sec. 1.002. Equal Educational Services or Opportunities.

(b) An educational institution may not deny services to any individual eligible to participate in a school district’s special education program as provided by Section 29.003, but the educational institution shall provide individuals with disabilities special educational services as authorized by law or, where expressly authorized, assist in and contribute toward the provision of appropriate special educational services in cooperation with other educational institutions and other appropriate agencies, institutions, or departments.

Added by Acts 1995, 74th Legislature, chapter. 260, Sec. 1, effective. May 30, 1995.

Texas Education Code
“Code of Ethics”

SUBTITLE D. EDUCATORS AND SCHOOL DISTRICT EMPLOYEES AND VOLUNTEERS
CHAPTER 21. EDUCATORS
SUBCHAPTER A. GENERAL PROVISIONS

Sec. 21.041. Rules; Fees.

(b) The board shall propose rules that:
(8) provide for the adoption, amendment, and enforcement of an educator’s code of ethics.

Added by Acts 1995, 74th Legislature, chapter. 260, Sec. 1, effective. May 30, 1995.

Texas Education Code
“Required Curriculum”

SUBTITLE F. CURRICULUM, PROGRAMS, AND SERVICES
CHAPTER 28. COURSES OF STUDY; ADVANCEMENT
SUBCHAPTER A. ESSENTIAL KNOWLEDGE AND SKILLS; CURRICULUM

Sec. 28.001. Purpose.

It is the intent of the legislature that the essential knowledge and skills developed by the State Board of Education under this subchapter shall require all students to demonstrate the knowledge and skills necessary to read, write, compute, problem solve, think critically, apply technology, and communicate across all subject areas. The essential knowledge and skills shall also prepare and enable all students to continue to learn in postsecondary educational, training, or employment settings.

Added by Acts 1995, 74th Legislature, chapter. 260, Sec. 1, effective. May 30, 1995.

Sec. 28.002. Required Curriculum.

- (a) Each school district that offers kindergarten through grade 12 shall offer, as a required curriculum:
- (1) a foundation curriculum that includes:
 - (A) English language arts;
 - (B) mathematics;
 - (C) science; and
 - (D) social studies, consisting of Texas, United States, and world history, government, and geography; and
 - (2) an enrichment curriculum that includes:
 - (A) to the extent possible, languages other than English;
 - (B) health;
 - (C) physical education;
 - (D) fine arts;
 - (E) economics, with emphasis on the free enterprise system and its benefits;
 - (F) career and technology education; and
 - (G) technology applications.
- (j) The State Board of Education by rule may require laboratory instruction in secondary science courses and may require a specific amount or percentage of time in a secondary science course that must be laboratory instruction.

**Texas Education Code
"Removal of Disruptive Student"**

**SUBTITLE G. SAFE SCHOOLS
CHAPTER 37. DISCIPLINE; LAW AND ORDER
SUBCHAPTER A. ALTERNATIVE SETTINGS FOR BEHAVIOR MANAGEMENT**

Sec. 37.002. Removal by Teacher.

- (a) A teacher may send a student to the principal's office to maintain effective discipline in the classroom. The principal shall respond by employing appropriate discipline management techniques consistent with the student code of conduct adopted under Section 37.001.
- (b) A teacher may remove from class a student:
 - (1) who has been documented by the teacher to repeatedly interfere with the teacher's ability to communicate effectively with the students in the class or with the ability of the student's classmates to learn; or
 - (2) whose behavior the teacher determines is so unruly, disruptive, or abusive that it seriously interferes with the teacher's ability to communicate effectively with the students in the class or with the ability of the student's classmates to learn.

Sec. 37.006. Removal for Certain Conduct.

- (d) In addition to Subsection (a), a student may be removed from class and placed in an alternative education program under Section 37.008 based on conduct occurring off campus and while the student is not in attendance at a school-sponsored or school-related activity if:
 - (1) the superintendent or the superintendent's designee has a reasonable belief that the student has engaged in conduct defined as a felony offense other than those defined in Title 5, Penal Code; and
 - (2) the continued presence of the student in the regular classroom threatens the safety of other students or teachers or will be detrimental to the educational process.

**TEXAS EDUCATION CODE
"PROTECTIVE EYE DEVICES"**

CHAPTER 38. HEALTH AND SAFETY

Sec. 38.005. Protective Eye Devices in Public Schools.

Each teacher and student must wear industrial-quality eye-protective devices in appropriate situations as determined by school district policy.

Added by Acts 1995, 74th Legislature, chapter. 260, Section 1, effective. May 30, 1995.

TEXAS EDUCATION CODE
"STANDARDS FOR SCHOOL FACILITIES"

CHAPTER 46. INSTRUCTIONAL FACILITIES ALLOTMENT

Sec. 46.008. Standards.

The commissioner shall establish standards for adequacy of school facilities. The standards must include requirements related to space, educational adequacy, and construction quality. All new facilities constructed after September 1, 1998, must meet the standards to be eligible to be financed with state or local tax funds.

Added by Acts 1997, 75th Legislature, chapter 592, Sec. 1.04, effective September 1, 1997



TEXAS ADMINISTRATIVE CODE
"School Facilities Standards"

The State Board of Education (SBOE) is assigned specific rulemaking authority under the Texas Education Code. SBOE rules are codified under the Texas Administrative Code (TAC). The TAC is the official compilation of all final state agency rules published in the Texas Register. Following its effective date, a SBOE rule is entered into the TAC under Title 19, Part II. Title 19 is Education, and Part II is the Texas Education Agency.

Texas Administrative Code, Title 19, Part II

Chapter 61. School Districts

Subchapter CC. Commissioner's Rules Concerning School Facilities

Statutory Authority: The provisions of this Subchapter CC issued under the Texas Education Code, §42.004, unless otherwise noted.

§61.1033. School Facilities Standards.

- (a) Definitions and procedures. The following words, terms, and procedures, when used in this section, shall have the following meanings, unless the context clearly indicates otherwise.
- (5) Major space renovations - At least 50% of the gross area of the facility's instructional space is within the limits of the work. Other renovations associated with repair or replacement of architectural interior or exterior finishes; fixtures; equipment; and electrical, plumbing, and mechanical systems are not subject to the requirements of subsections (d) and (e) of this section, but shall comply with applicable building codes as required by subsection (f) of this section.
 - (6) Square feet per pupil - The net interior space of a room divided by the maximum number of pupils to be housed in that room during a single class period.
 - (7) Square feet per room measurements - The net square footage of a room that will house 22 students at the elementary level and 25 students at the middle or high school level. The net square footage of a room includes exposed storage space, such as cabinets or shelving, but does not include hallway space or storage space, such as closets or preparation offices.

- (b) Effective date. The requirements for school facility standards shall apply to projects for new construction or major space renovations approved by a school district board of trustees after September 1, 1998.
- (c) Certification of design and construction.
- (1) In this section, the word “certify” indicates that the architect or engineer has reviewed the standards contained in this chapter and used the best professional judgment and reasonable care consistent with the practice of architecture or engineering in the State of Texas in executing the construction documents. The architect or engineer also certifies that these documents conform to the provisions of this section, except as indicated on the certification.
 - (2) The school district shall notify and obligate the architect or engineer to provide the required certification. The architect’s or engineer’s signature and seal on the construction documents shall certify compliance.
 - (3) To ensure that facilities have been designed and constructed according to the provisions of this section, each of the involved parties shall execute responsibilities as follows.
 - (A) The school district shall provide the architect or engineer the long-range school facility plan and/or educational specifications approved by the board of trustees as required by this subchapter, and building code specifications for the facility.
 - (B) The architect or engineer shall perform a building code search under applicable regulations that may influence the project, and shall certify that the design has been researched before it is final.
 - (C) The architect or engineer shall also certify that the facility has been designed according to the provisions of this section, based on the long-range school facility plan and/or educational specifications, building code specifications, and all documented changes to the construction documents provided by the district.
 - (D) The building contractor or construction manager shall certify that the facility has been constructed in general accordance with the construction documents specified in subparagraph of this paragraph.
 - (E) When construction is completed, the school district shall certify that the facility conforms to the design requirements specified in subparagraph (A) of this paragraph.
- (d) Space, minimum square foot requirements.
- (1) A school district shall provide instructional space if required by the district educational specifications described in subsection (e) of this section.
 - (2) For each type of instructional space, a district may satisfy the requirements of this section by using, as appropriate, either the standard for the minimum square feet per pupil or for square feet per room specified in paragraphs (1)-(3) of this subsection. Room size requirements are based on rooms that will house 22 students at the elementary level and 25 students at the middle or high school level.
 - (A) General classrooms.
 - (i) Classrooms for prekindergarten-Grade 1 shall have a minimum of 36 square feet per pupil or 800 square feet per room.
 - (ii) Classrooms at the elementary school level shall have a minimum of 30 square feet per pupil or 700 square feet per room.

- (iii) Classrooms at the secondary school level shall have a minimum of 28 square feet per pupil or 700 square feet per room.
- (B) Specialized classrooms.
- (i) Computer laboratories shall have a minimum of 41 square feet per pupil or 900 square feet per room at the elementary school level; and 36 square feet per pupil or 900 square feet per room at the secondary school level.
 - (ii) Science lecture/lab shall have a minimum of 41 square feet per pupil or 900 square feet per room at the elementary school level; 50 square feet per pupil or 1,000 square feet per room at the middle school level; and 50 square feet per pupil or 1,200 square feet per room at the high school level.
- (e) Educational adequacy. A proposed new school facility or major space renovation of an existing school facility meets the conditions of educational adequacy if the design of the proposed project is based on the requirements of the school district's educational program and the student population that it serves.
- (f) Construction quality.
- (1) Districts with existing building codes. A school district located in an area that has adopted local building codes shall comply with those codes (including fire and mechanical, electrical, and plumbing codes). The school district is not required to seek additional plan review of school facilities projects other than what is required by the local building authority.
 - (2) Districts without existing building codes. A school district located in an area that has not adopted local building codes shall adopt and use the latest edition of either the Uniform Building Code or Standard (Southern) Building Code (and related fire, mechanical, and plumbing codes); and the National Electric Code. A qualified, independent third party, not employed by the design architect or engineer, shall review the plans and specifications for compliance with the requirements of the adopted building code. The plan review shall examine compliance conditions for emergency egress, fire protection, structural integrity, life safety, plumbing, and mechanical and electrical design. The review shall be conducted before bidding and must be conducted by a certified building code consultant. Associated fees shall be the responsibility of the school district. The reviewer shall prepare a summary list of any conditions not in conformance with the provisions of the adopted building code and is required to send a copy to the school district, design architect, or engineer. The design architect or engineer shall revise the plans and specifications as necessary and certify code compliance to the district. Any disputes shall be a matter for contract resolution.
 - (3) Other provisions. School districts shall comply with the provisions of the Americans with Disabilities Act of 1990 (Title I and Title II) and other local, state, and federal requirements as applicable.

Statutory Authority: The provisions of this §61.1033 issued under the Texas Education Code, §46.008, as added by House Bill 4, 75th Texas Legislature, 1997.

Source: The provisions of this §61.1033 adopted to be effective September 1, 1998, 23 TexReg 7221.

Texas Administrative Code
“Required Curriculum”

Texas Administrative Code, Title 19, Part II
Chapter 74. Curriculum Requirements
Subchapter A. Required Curriculum

Statutory Authority: The provisions of this Subchapter A issued under the Texas Education Code, §§7.102, 28.002, 28.023, 28.025, 28.054, and 38.003, unless otherwise noted.

§74.1. Essential Knowledge and Skills.

- (a) A school district that offers Kindergarten through Grade 12 must offer the following as a required curriculum:
- (1) a foundation curriculum that includes:
 - (A) English language arts;
 - (B) mathematics;
 - (C) science; and
 - (D) social studies, consisting of Texas, United States and world history, government, and geography; and
 - (2) an enrichment curriculum that includes:
 - (A) to the extent possible, languages other than English;
 - (B) health;
 - (C) physical education;
 - (D) fine arts;
 - (E) economics, with emphasis on the free enterprise system and its benefits;
 - (F) career and technology education; and
 - (G) technology applications.
- (b) A school district must provide instruction in the essential knowledge and skills of the appropriate grade levels in the foundation curriculum as specified in Chapter 110 of this title (relating to Texas Essential Knowledge and Skills for English Language Arts and Reading); Chapter 111 of this title (relating to Texas Essential Knowledge and Skills for Mathematics); Chapter 112 of this title (relating to Texas Essential Knowledge and Skills for Science); Chapter 113 of this title (relating to Texas Essential Knowledge and Skills for Social Studies); and Chapter 128 of this title (relating to Texas Essential Knowledge and Skills for Spanish Language Arts and English as a Second Language). A school district may add elements at its discretion but must not delete or omit instruction in the foundation curriculum specified in subsection (a) of this section.

Source: The provisions of this §74.1 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective September 1, 1998, 23 TexReg 5675.

§74.2. Description of a Required Elementary Curriculum.

A school district that offers kindergarten through Grade 5 must provide instruction in the required curriculum as specified in §74.1 of this title (relating to Essential Knowledge and Skills). The district must ensure that sufficient time is provided for teachers to teach and for students to learn English language arts, mathematics, science, social studies, fine arts, health, physical education, technology applications, and to the extent possible, languages other than English. The school district may provide instruction in a variety of arrangements and settings, including mixed-age programs designed to permit flexible learning arrangements for developmentally appropriate instruction for all student populations to support student attainment of course and grade level standards.

Source: The provisions of this §74.2 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective September 1, 1998, 23 TexReg 5675.

§74.3. Description of a Required Secondary Curriculum.

(a) Middle Grades 6-8. A school district that offers Grades 6-8 must provide instruction in the required curriculum as specified in §74.1 of this title (relating to Essential Knowledge and Skills). The district must ensure that sufficient time is provided for teachers to teach and for students to learn English language arts, mathematics, science, social studies, fine arts, health, physical education, technology applications, and to the extent possible, languages other than English. The school district may provide instruction in a variety of arrangements and settings, including mixed-age programs designed to permit flexible learning arrangements for developmentally appropriate instruction for all student populations to support student attainment of course and grade level standards.

(b) Secondary Grades 9-12.

(1) A school district that offers Grades 9-12 must provide instruction in the required curriculum as specified in §74.1 of this title (relating to Essential Knowledge and Skills). The district must ensure that sufficient time is provided for teachers to teach and for students to learn the subjects in the required curriculum. The school district may provide instruction in a variety of arrangements and settings, including mixed-age programs designed to permit flexible learning arrangements for developmentally appropriate instruction for all student populations to support student attainment of course and grade level standards.

(2) The school district must offer the courses listed in this paragraph and maintain evidence that students have the opportunity to take these courses:

(C) science - Integrated Physics and Chemistry, Biology, Chemistry, and Physics. Science courses shall include at least 40% hands-on laboratory investigations and field work using appropriate scientific inquiry;

Source: The provisions of this §74.3 adopted to be effective September 1, 1996, 21 TexReg 4311; amended to be effective October 13, 1997, 22 TexReg 10129; amended to be effective September 1, 1998, 23 TexReg 5675.

Texas Administrative Code "Code of Ethics"

Texas Administrative Code, Title 19, EDUCATION Part 7, State Board for Educator Certification Chapter 247. Educators' Code of Ethics

Statutory Authority: The provisions of this Chapter 247 are authorized under Texas Education Code, §21.041(b)(8), which requires the State Board for Educator Certification (SBEC) to propose rules providing for the adoption, enforcement, and amendment of an educators' code of ethics, and Section 63(i) of the conforming amendments to Senate Bill 1 (74th Legislature, 1995), which provides for a code of ethics proposed by the SBEC and adopted by the State Board of Education.

§247.1. Purpose and Scope.

In compliance with the Texas Education Code, § 21.041(b)(8), the State Board for Educator Certification (the board) adopts an educators' code of ethics as set forth in §247.2 of this title (relating to Code of Ethics and Standards Practices for Texas Educators). The board may amend the ethics code in the same manner as any other formal rule. The board is solely responsible for enforcing the ethics code for purposes related to certification disciplinary proceedings.

§247.2. Code of Ethics and Standard Practices for Texas Educators.

(a) Professional responsibility. The Texas educator should strive to create an atmosphere that will nurture to fulfillment the potential of each student. The educator shall comply with standard practices and ethical conduct toward students, professional colleagues, school officials, parents, and members of the community. In conscientiously conducting his or her affairs, the educator shall exemplify the highest standards of professional commitment.

(c) Principle II: Professional practices and performance. The Texas educator, after qualifying in a manner established by law or regulation, shall assume responsibilities for professional administrative or teaching practices and professional performance and shall demonstrate competence.

(5) Standard 5. The educator shall comply with written local school board policies, state regulations, and other applicable state and federal laws.

(e) Principle IV: Ethical conduct toward students. The Texas educator, in accepting a position of public trust, should measure success by progress of each student toward realization of his or her potential as an effective citizen.

(1) Standard 1. The educator shall deal considerately and justly with each student and shall seek to resolve problems including discipline according to law and school board policy.

(2) Standard 2. The educator shall not intentionally expose the student to disparagement.

(3) Standard 3. The educator shall not reveal confidential information concerning students unless disclosure serves lawful professional purposes or is required by law.

(4) Standard 4. The educator shall make reasonable effort to protect the student from conditions detrimental to learning, physical health, mental health, or safety.

(5) Standard 5. The educator shall not deliberately distort facts.

(6) Standard 6. The educator shall not unfairly exclude a student from participation in a program, deny benefits to a student, or grant an advantage to a student on the basis of race, color, sex, disability, national origin, religion, or family status.

(7) Standard 7. The educator shall not unreasonably restrain the student from independent action in the pursuit of learning or deny the student access to varying points of view.

(f) Principle V: Ethical conduct toward parents and community. The Texas educator, in fulfilling citizenship responsibilities in the community, should cooperate with parents and others to improve the public schools of the community.

(1) Standard 1. The educator shall make reasonable effort to communicate to parents information that lawfully should be revealed in the interest of the student.

Source: The provisions of this Chapter adopted to be effective March 1, 1998, 23 TexReg 1023.



Texas Department of Health
“Face and Eye Protection Standards”

Title 25. HEALTH SERVICES

Part I. TEXAS DEPARTMENT OF HEALTH

Chapter 295. OCCUPATIONAL HEALTH

Subchapter F. STANDARDS FOR FACE AND EYE PROTECTION IN PUBLIC SCHOOLS

§295.141 Purpose and Scope

(a) Purpose. The purpose of these sections of this undesignated head is to provide governing boards and administrators of Texas school districts reasonable and adequate means, ways, and methods for the proper selection and safe use of eye protective equipment.

(b) Scope. These sections shall apply to all teachers and pupils within Texas public schools participating in certain vocational, industrial arts, and chemical-physical courses or laboratories where potentially hazardous operations exist. These sections were extracted from American Standards Association Bulletin Z2.1-1959, which is to be used as a further reference for material not contained within these sections.

Source: The provisions of this §295.141 adopted to be effective February 22, 1993, 18 TexReg 848.

§295.143 Definitions

(a) General information.

(1) The word “approved” refers to approval by the Texas Department of Health, i.e., the agency having jurisdiction over the specific requirement.

(2) The use of the word “shall” indicates a mandatory requirement. The word “should” indicates a recommendation.

(b) Specific definitions.

(1) Bridge size—The distance between lenses on the nose side of each eye, expressed in millimeters.

(2) Contaminant—A harmful material that is foreign to the normal atmosphere.

(4) Dust—Finely divided solid particles generated by processing (including handling, crushing, grinding, or pulverizing) materials such as rock, metal, wood, and grain.

(6) Eye size—A measurement expressed in millimeters and denoting the size of the lens-holding section of an eye frame.

(10) Goggles—A device, with contour-shaped eyecups or facial contact with glass or plastic lenses, worn over the eyes and held in place by a headband for the protection of the eyes and eye sockets.

(11) Hand shield—A device, usually held in the hand or supported on the wearer’s chest, designed to protect the eyes and face during welding operations.

(13) Lens—The transparent glass or plastic device through which the wearer of the protective goggles or spectacles sees, and which provides protection to the eyes against flying objects, glare, or injurious radiation, or a combination of these hazards.

(14) Lens, corrective—A lens ground to the wearer's individual corrective prescription.

(15) Mist—Suspended liquid droplets generated by breaking up a liquid into a dispersed state.

(16) Particulate matter—Matter occurring in the form of minute separate particles, such as dust, fume, mist, and fog; a dispersoid.

(19) Spectacle—A device patterned after conventional-type spectacle eyewear but of more substantial construction, either with or without side shields, and with clear, impact-resistant filter or corrective lenses of glass or plastic.

Source: The provisions of this §295.143 adopted to be effective February 22, 1993, 18 TexReg 848.

§295.144 General Requirements

(a) Eye protection shall be required where there is a reasonable probability of injury to the body that can be prevented by such protection.

(b) In such cases, governing boards and administrators of Texas school districts shall furnish protectors of a type suitable for the work to be performed, and participating teachers and pupils shall use such protectors.

(c) No person shall be subjected, without protection, to a hazardous environmental condition.

(d) Protectors shall meet the following minimum requirements. Protectors shall:

(1) provide adequate protection against the particular hazards for which they are designed;

(2) be reasonably comfortable when worn under the designated conditions;

(3) fit snugly and shall not unduly interfere with the movements of the wearer;

(4) be durable;

(5) be capable of being disinfected; and

(6) be easily cleanable.

(e) Protectors should be kept clean and in good repair.

(f) Eye protector shall be provided where machines or operations present the hazard of flying particles, pieces, or substances.

(g) Workers whose vision requires the use of corrective lenses in spectacles and who are required by this standard to wear protective goggles shall be provided with goggles of one of the following types:

(2) goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles; and

(h) Only protectors which bear the label of or meet the standards set forth in American Standards Association Bulletin Z2.1-1959 shall be used.

Source: The provisions of this § 295.144 adopted to be effective February 22, 1993, 18 TexReg 848.

§295.145 Eye Protectors

(a) Face shields.

(1) Function. The devices described in this subsection are designed to provide protection to the face (i.e., the front part of the head including forehead, eyes, cheeks, nose, mouth, chin) and neck, where required, from flying particles and sprays of hazardous liquids and, in addition, to provide antiglare protection where required.

(2) Intended uses. Some typical uses for face shields include the following:

(C) buffing, polishing, wire brushing, and grinding operations where flying particles or objects may strike the face;

(E) handling hot or corrosive materials.

(c) Goggles, eyecup models. The three basic types of eyecup goggles shall be subdivided into the following classes.

(1) Chippers' models providing protection against flying objects. Eyecups shall be ventilated in a manner to permit circulation of air. Ventilation openings shall be such as to exclude a spherical particle 0.04 inch in diameter.

(2) Dust and splash models providing protection against relatively fine dust particles or liquid splashes. Eyecups shall be ventilated in a manner to permit circulation of air. The ventilation openings shall be baffled or screened to prevent the direct passage of dust or liquids into the interior of the eyecups.

(3) Welders' and cutters' models providing protection against glare and injurious radiations. The basic designs may be modified to provide more protection against special hazards, but the modified equipment shall meet the same requirements as the basic design. Eyecups shall be ventilated in a manner to permit circulation of air. The ventilation openings shall be baffled to prevent the passage of light rays into the interior of the eyecups.

(d) Spectacles, metal or plastic frame.

(1) Protection. Spectacles shall provide protection to the eye from flying objects and, where required, from glare and injurious radiations. Spectacles without side shields are intended to provide frontal eye protection only. Where side as well as frontal eye protection is required, the spectacles shall be provided with side shields. The edge of the side shield shall have a smooth finish or shall be padded.

(2) Materials and methods of test. General materials used shall be capable of withstanding the disinfection, corrosion resistance, water absorption, and inflammability tests outlined in §295.146 of this title (relating to Materials and Methods of Test of Protections).

(e) Goggles, flexible fitting.

(1) Description. Goggles shall consist of a frame (composed of a flexible, chemical-resistant, nontoxic, nonirritating, and slow-burning material, forming a lens holder), lenses, and a positive means of support on the face such as an adjustable headband of suitable material to retain the frame comfortably and snugly in place in front of the eyes. The lens holder shall be such that the lenses are held firmly and tightly and may be removed or replaced without the use of tools. The goggles may be ventilated or not, as required by their intended use. Where chemical goggles are ventilated, the openings shall be such as to render the goggles splashproof.

(2) Protection. Goggles shall provide eye protection from fine dusts, fumes, liquids, splashes, mists, and spray.

(3) Application. Specific application for use of flexible fitting goggles will be found in Table 1 of § 295.147 of this title (relating to Selection of Eye and Face Protective Devices).

(4) Materials and methods of test. Plastic lenses used in flexible fitting goggles shall be not less than 0.050 inch in thickness. Materials used shall be capable of withstanding the disinfection, corrosion resistance, water absorption, and flammability tests outlined in § 295.146 of this title (relating to Materials and Methods of Test of Protections).

(f) Goggles, plastic eyeshield.

(1) Description. The goggles shall consist of a frame of plastic material, lens or lenses, and a means of support such as an adjustable headband to retain the goggles in front of the eyes. The frame and lens need not be of the same material. The lens need not be an integral part of the goggles. The frame may be translucent, clear, or opaque, and may be ventilated or not, as required by its intended use. The edge of the frame which bears against the face shall have a smooth surface free from roughness or irregularities which might cause discomfort to the wearer.

(2) Protection. The goggles shall provide protection against flying objects and, where required, from glare and injurious radiations. Where the goggles are used for protection against injurious light radiation, the lenses and frames shall meet the requirements of § 295.148(b) of this title (relating to Appendix for § 295.146) and the frames shall prevent the passage of injurious light rays.

(3) Application. Specific application for use of plastic eyeshield goggles will be found in Table of § 295.147 of this title (relating to Selection of Eye and Face Protective Devices).

(4) Materials and methods of test. Where plastic lenses are used in plastic eyeshield goggles, they shall be not less than 0.050 inch in thickness. If glass lenses are used, they shall be not less than 3.0 millimeters nor more than 3.8 millimeters in thickness. Materials used shall be capable of withstanding the disinfection, corrosion, resistance, water absorption, and flammability tests outlined in § 295.146 of this title (relating to Materials and Methods of Test of Protections).

(g) Spectacles, plastic eyeshield.

(1) Description. Spectacles shall consist of a frame of metal, fiber, or plastic material, plastic lens or lenses, and temples or other suitable means of support to retain the frame before the eyes. The lens or lenses need not be an integral part of the frame. The spectacles shall have side shields, if required by their intended use.

(2) Protection. Spectacles shall provide protection to the eye from flying objects and, where required, from glare and injurious radiation. Spectacles without side shields provide frontal eye protection only. Where side as well as frontal eye protection is required, the spectacles shall be provided with side shields.

(3) Application. Specific application for use of plastic eyeshield spectacles will be found in Table 1 of §295.147 of this title (relating to Selection of Eye and Face Protective Devices).

(4) Materials and methods of test. Plastic lenses used in plastic eyeshield spectacles shall not be less than 0.050 inch in thickness. Materials used shall be capable of meeting the applicable requirements and withstanding the tests outlined in §295.146

of this title (relating to Materials and Methods of Test of Protections).

§295.146 Materials and Methods of Test of Protections

(a) Materials. Materials used in the manufacture of eye protectors shall combine mechanical strength and lightness of weight to a high degree, shall be nonirritating to the skin when subjected to perspiration, and shall withstand frequent disinfection by the methods prescribed in this section. Where metals are used, they shall be inherently corrosion resistant.

(b) Disinfection. All materials shall be such as to withstand, without visible deterioration or discoloration, washing in detergents and warm water, rinsing to remove all traces of detergent, and disinfection by the following methods:

(1) immersion for 10 minutes in a solution of formalin made by placing one part of 40% formaldehyde solution in nine parts of water at a room temperature of 68 degrees Fahrenheit;

(2) subjection to a moist atmosphere of formaldehyde for a period of 10 minutes at a room temperature of 68 degrees Fahrenheit; or

(3) immersion for 10 minutes in a solution of modified phenolics, hypochlorite, or quaternary ammonium compounds in strength specified by the manufacturer at a room temperature of 68 degrees Fahrenheit.

(c) Corrosion resistance. Metal parts shall be tested for corrosion resistance by placing them in a boiling aqueous 10% (by weight) solution of sodium chloride for a period of 15 minutes. The parts upon being removed from this solution shall be immediately immersed in a 10% (by weight) aqueous solution of sodium chloride at a room temperature of 68 degrees Fahrenheit. They shall then be removed from this solution and, without wiping off the adhering liquid, allowed to dry for 24 hours at room temperature. The metal parts shall then be rinsed in lukewarm water and allowed to dry. On visual inspection, the metal parts shall show no signs of roughening of the surface resulting from corrosion.

(d) Water absorption. Plastic parts shall be tested for water absorption and the results calculated in accordance with Test Method Number 7031 of Federal Specification L-P-406 (see §295.148(a) of this title (relating to Appendix for §295.146)). The amount of the water absorbed shall not exceed 5.0%.

(e) Flammability.

(1) Eyecup goggles. Eyecup goggles shall be tested for flammability by use of a 5/8-inch high diameter Bunsen burner, adjusted for a 3/4-inch high non-luminous flame of commercial natural gas (1,000-1,200 British thermal units). The temple side of the specimen shall be held at the tip of this flame in a draft-free room and the time (in seconds) required to ignite the material so that it will remain burning after the flame is removed shall be determined. The time required to ignite the specimen in the manner described shall be not less than four seconds.

(2) All other types. Where plastic materials are used, such materials shall be slow burning. Cellulose nitrate, or materials having flammability characteristics approximating those of cellulose nitrate, shall not be used. Flammability of the materials shall be no greater than that exhibited by cellulose acetate or acetate butyrate.

Source: The provisions of this § 295.146 adopted to be effective February 22, 1993, 18 TexReg 848.

§295.147 Selection of Eye and Face Protective Devices

Source: The provisions of this §295.147 adopted to be effective February 22, 1993, 18 TexReg 848.

(c) Maintenance and disinfection of eye protectors.

(1) Maintenance.

(A) It is essential that the lenses of eye protectors be kept clean. Continuous vision through dirty lenses can cause eye strain, which could possibly result in substandard production by the operator. Daily cleaning of the eye protector with soap and hot water is recommended.

(C) Replace headbands. Slack, worn-out, sweat-soaked, or twisted headbands do not hold the eye protector in proper position. Visual inspection can determine when the elasticity is reduced to a point beyond proper function.

(D) Keep goggles in case when not in use. Spectacles, in particular, should be given the same care as one's own glasses, since the frame, nose pads, and temples can be damaged by rough usage.

(2) Disinfection. Personal protective equipment which has been previously used shall be disinfected before being issued to another employee. Even when each employee is assigned protective equipment for extended periods, it is recommended that this equipment be cleaned and disinfected regularly. Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles or spectacles and thoroughly clean all parts with soap and hot water. Carefully rinse all traces of soap and replace defective parts with new ones. Swab thoroughly or completely immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide. Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air. Do not rinse after removing parts from solution because this will remove the germicidal residue which retains its effectiveness indefinitely. The dry parts or items should be placed in clean, dust-proof containers, such as a box, bag, or plastic envelope to protect them until reissue.

(d) Fitting of goggles and spectacles.

(1) Cup goggles.

(A) The first step in fitting cup goggles is to adjust the nose bridge. Both the ball and link-chain bridges of goggles are adjustable to accommodate the individual wearer. Both types of bridges usually have some means for shortening or lengthening. In either case, to shorten or lengthen the bridge, the instructions of the manufacturer should be followed. Chain not needed after adjustment should be cut off. The chain should be insulated to protect the nose of the wearer.

(B) The proper procedure for adjusting headbands is to keep the band loose enough to slip two fingers under it, palm side down, without stretching. Headbands should be worn low and flat and approximately at the base of the skull in order to hold goggles in a comfortable position. Most cup goggles are thinner and slanted away at the lower nasal sides, which makes for comfort as well as easy identification in getting them right side up.

(2) Spectacles.

(A) The first step in fitting spectacles is to determine the proper eye and bridge sizes. This is done best by using fitting samples and placing the sample spectacles on the nose to arrive at the proper size. The adjustable rocker pads should fit flush against the sides of the nose without allowing the metal bridge of the spectacle to rest on the nose bridge of the wearer. The small metal arms, to which the pearl pads are attached, can be readily

adjusted by round nose pliers which are especially designed for this purpose.

(B) To fit the temples comfortably over the ears, hold the spectacle firmly in one hand and shape the bow of the temple gradually by drawing it slowly between thumb and forefinger of other hand. Temples should be angled down from frame to ear so that lenses will be perpendicular to the line of vision. Prescription safety spectacles should be fitted only by qualified optical personnel.

Source: The provisions of this §295.148 adopted to be effective February 22, 1993, 18 TexReg 848.



Texas Department of Health "Hazardous Substances"

Health and Safety Code

TITLE 5. SANITATION AND ENVIRONMENTAL QUALITY
SUBTITLE D. HAZARDOUS SUBSTANCES
CHAPTER 501 HAZARDOUS SUBSTANCES
SUBCHAPTER A. GENERAL PROVISIONS

Sec.502.002. Hazardous Substance Described.

- (A) A hazardous substance is:
- (1) a substance or mixture of substances that is toxic, corrosive, flammable, an irritant, or a strong sensitizer, or that generates pressure through decomposition, heat, or other means, if the substance or mixture of substances may cause substantial personal injury or substantial illness during or as a proximate result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children;
 - (2) a toy or other article, other than clothing, that is intended for use by a child and that presents an electrical, mechanical, or thermal hazard; or
 - (3) a radioactive substance designated as a hazardous substance under Section 501.003.
- (B) A substance is corrosive if, when in contact with living tissue, it causes destruction of that tissue by chemical action. A chemical action on an inanimate surface is not corrosive for the purpose of this section.
- (C) An article is an electrical hazard if, in normal use or when subjected to reasonably foreseeable damage or abuse, it may cause, because of its design or manufacture, personal injury or illness by electric shock.
- (D) A substance is flammable if it has a flash point of 80 degrees Fahrenheit or less, as determined by the Tagliabue Open Cup Tester or other method as provided by Section 501.021.
- (E) A substance is an irritant if it is noncorrosive and if, on immediate, prolonged, or repeated contact with normal living tissue, it induces a local inflammatory reaction.

- (F) An article is a mechanical hazard if, in normal use or when subjected to reasonably foreseeable damage or abuse, it presents, because of its design or manufacture, an unreasonable risk of personal injury or illness:
- (1) from fracture, fragmentation, or disassembly of the article;
 - (2) from propulsion of the article or a part or accessory of the article;
 - (3) from points or other protrusions, surfaces, edges, openings, or closures;
 - (4) from moving parts;
 - (5) from lack or insufficiency of controls to reduce or stop motion;
 - (6) as a result of self-adhering characteristics of the article;
 - (7) because the article or a part or accessory of the article may be aspirated or ingested;
 - (8) because of instability; or
 - (9) because of any other aspect of the article's design or manufacture
- (G) A substance is radioactive if it emits ionizing radiation.
- (H) A substance is a strong sensitizer if, when on normal living tissue, it causes, through an allergic or photodynamic process, a hypersensitivity that becomes evident on reapplication of the same substance.
- (I) An article is a thermal hazard if, in normal use or when subject to reasonable foreseeable damage or abuse, it present, because of its design or manufacture, an unreasonable risk of personal injury or illness because of heat, including heat from heated parts, substances, or surfaces.
- (J) A substance is toxic if it is capable of producing personal injury or illness to any person through ingestion, inhalation, or absorption through any body surface and it is not radioactive.

**Texas Department of Health
"Hazard Communications Act"**

Health and Safety Code

TITLE 5. SANITATION AND ENVIRONMENTAL QUALITY
SUBTITLE D. HAZARDOUS SUBSTANCES
CHAPTER 502 HAZARD COMMUNICATIONS ACT
SUBCHAPTER A. GENERAL PROVISIONS

Sec. 502.001. Short Title.

This chapter may be cited as the Hazard Communications Act.

Sec. 502.003 Definitions.

(1)-(3) Intentionally omitted

(4) "Chemical name" means:

(A) the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature;

- (B) A name that clearly identifies the chemical for the purpose of conducting a hazard evaluation.
- (5) "Common name" means a designation of identification, such as a code name, code number, trade name, brand name, or generic name, used to identify a chemical other than by its chemical name.
- (6)-(9) Intentionally omitted
- (10) "Employee" means a person who may be or may have been exposed to hazardous chemicals in the person's workplace under normal operating conditions or foreseeable emergencies, and includes a person working for this state, a person working for a political subdivision of this state, or member of a volunteer emergency service organization or, if the applicable OSHA standard or MSHA standard is not in effect, a person working for a private employer. Workers such as office workers or accountants who encounter hazardous chemicals only in nonroutine, isolated instances are not employees for purposes of this chapter.
- (11) "Employer" means a person engaged in private business who is regulated by the federal Occupational Safety and Health Act of 1970 (Pub. L. No. 91-596), the Federal Coal Mine Health and Safety Act of 1969 (Pub. L. No. 91-173), or the Federal Mine Safety and Health Amendments Act of 1977 (Pub. L. No. 95-164) on the effective date of this Act, or the state or a political subdivision of the state, including a state, county, or municipal agency, a public school, a college or university, a river authority or publicly owned utility, a volunteer emergency service organization, and other similar employers. The term does not include any person to whom the federal Occupational Safety and Health Act of 1970 (Pub. L. No. 91-596), the Federal Coal Mine Health and Safety Act of 1969 (Pub. L. No. 91-173), or the Federal Mine Safety and Health Amendments Act of 1977 (Pub. L. No. 95-164) is applicable if that employer is covered by the OSHA standard or the other two federal laws.
- (12) "Expose" or "exposure" means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry, including inhalation, ingestion, skin contact, or absorption. The term includes potential, possible, or accidental exposure under normal conditions of use or in a reasonably foreseeable emergency.
- (13) "Hazardous chemical" or "chemical" means an element, compound, or mixture of elements or compounds that is a physical hazard or health hazard as defined by the OSHA standard in 29 CFR Section 1910 (c), or a hazardous substance as defined by the OSHA standard in 29 CFR Section 1910.1200 (d)(3), or by OSHA's written interpretations. A hazard determination may be made by employers who choose not to rely on the evaluations made by their suppliers if there are relevant qualitative or quantitative differences. A hazard determination shall involve the best professional judgement.
- (14)-(16) Intentionally omitted
- (17) "Material Safety Data Sheet" ("MSDS") means a document containing chemical hazard and safe handling information that is prepared in accordance with the requirements of the OSHA standard for that document.
- (18)-(19) Intentionally omitted
- (20) "Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive in terms defined in the OSHA standard.

(21) Intentionally omitted

(22) "Work area" means a room, a defined space, a utility structure, or an emergency response site in a workplace where hazardous chemicals are present, produced, or used and where employees are present.

(23) "Workplace" means an establishment, job site, or project, at one geographical location containing one or more work areas, with or without buildings, that is staffed 20 or more hours a week.

Sec. 502.004. Applicability of Chapter.

- (a) Except as provided by Subsection (b), this chapter applies to only employers who are not required to comply with the OSHA standard, the Federal Coal Mine Health and Safety Act of 1969 (Pub. L. No. 91-173), or the Federal Mine Safety and Health Amendments Act of 1977 (Pub. L. No. 95-164).

Sec. 502.006. Material Safety Data Sheet.

- (a) A chemical manufacturer or distributor shall provide appropriate material safety data sheets to employers who acquire hazardous chemicals in this state with each initial shipment and with the first shipment after an MSDS is updated. The MSDSs must conform to the most current requirements of the OSHA standard.
- (b) An employer shall maintain a legible copy of a current MSDS for each hazardous chemical purchased. If the employer does not have a current MSDS for a hazardous chemical when the chemical is received at the workplace, the employer shall request an MSDS in writing from the manufacturer or distributor in a timely manner or shall otherwise obtain a current MSDS. The manufacturer or distributor shall respond with an appropriate MSDS in a timely manner.
- (c) Material safety data sheets shall be readily available, on request, or review by employees or designated representatives at each workplace.

Sec. 502.007. Label.

- (a) A label on an existing container of a hazardous chemical may not be removed or defaced unless it is illegible, inaccurate, or does not conform to the OSHA standard to other applicable labeling requirement. Primary containers must be relabeled with at least the identity appearing on the MSDS, the pertinent physical and health hazards, including the organs that would be affected, and the manufacturer's name and address. Except as provided by Subsection (b), secondary containers must be relabeled with at least the identity appearing on the MSDS and appropriate hazard warnings.
- (b) An employee may not be required to work with a hazardous chemical from an unlabeled container except for a portable container intended for the immediate use of the employee who performs the transfer.

Sec. 502.009. Employee Education Program.

- (a) An employer shall provide an education and training program for employees who use or handle hazardous chemicals.
- (b) An employer shall develop, implement, and maintain at the workplace a written hazard communication program for the workplace that describes how the criteria specified in this chapter will be met.
- (c) An education and training program must include, as appropriate:

- (1) information on interpreting labels and MSDSs and the relationship between those two methods of hazard communications;
 - (2) the location by work area, acute and chronic effects, and safe handling of hazardous chemicals known to be present in the employee's work area and to which the employees may be exposed;
 - (3) the proper use of protective equipment and first aid treatment to be used with respect to the hazardous chemicals to which employees may be exposed; and
 - (4) general safety instructions on the handling, cleanup procedures, and disposal of hazardous chemicals.
- (d) Training may be conducted by categories of chemicals. An employer must advise employees that information is available on the specific hazards of individual chemicals through the MSDSs. Protective equipment and first aid treatment may be by categories of hazardous chemicals.
- (e) An employer shall provide additional instruction to an employee when the potential for exposure to hazardous chemicals in the employee's work area increases significantly or when the employer receives new and significant information concerning the hazards of a chemical in the employee's work area. The addition of new chemicals alone does not necessarily require additional training.
- (f) An employer shall provide training to a new or newly assigned employee before the employee works with or in a work area containing a hazardous chemical.
- (g) An employer shall keep the written hazard communication program and a record of each training session given to employees, including the date, a roster of the employees who attended, the subjects covered in the training session, and the names of the instructors. Those records shall be maintained for at least five years by the employer. The department shall have access to those records and may interview employees during inspections.

Sec. 502.017. Employee Notice; Rights of Employees.

- (a) An employer shall post and maintain adequate notice, at locations where notices are normally posted, informing employees of their rights under this chapter. If the director does not prepare the notice under Section 502.008, the employer shall prepare the notice.
- (b) Employees who may be exposed to hazardous chemicals shall be informed of the exposure and shall have access to the workplace chemical list and MSDSs for the hazardous chemicals. Employees, on request, shall be provided a copy of a specific MSDS with any trade secret information deleted. In addition, employees shall receive training concerning the hazards of the chemicals and measures they can take to protect themselves from those hazards. Employees shall be provided with appropriate personal protective equipment. These rights are guaranteed.

Civil Practice and Remedies Code
"Tort Law"

TITLE 5. GOVERNMENTAL LIABILITY
CHAPTER 101. TORT CLAIMS
SUBCHAPTER A. GENERAL PROVISIONS

Sec. 101.001. Definitions

In this chapter:

(2) "Employee" means a person, including an officer or agent, who is in the paid service of a governmental unit by competent authority, but does not include an independent contractor, or a person who performs tasks the detail of which the government unit does not have the legal right to control.

(3) "Governmental Unit" means:

(B) a political subdivision of this state, including any city, county, school district, junior college district, levee improvement district, drainage district, irrigation district, water improvement district, water control and improvement district, water control and preservation district, freshwater supply district, navigation district, conservation and reclamation district, soil communication district, public health district, and river authority.

Sec. 101.021. Governmental Liability.

A governmental unit in the state is liable for:

(1) property damage, personal injury, and death proximately caused by the wrongful act or omission or the negligence of an employee acting within his scope of employment if:

- (A) the property damage, personal injury, or death arises from the operation or use of a motor-driven vehicle or motor-driven equipment; and
- (B) the employee would be personally liable to the claimant according to Texas law; and
- (C) personal injury and death so caused by a condition or use of tangible personal or real property if the governmental unit would, were it a private person, be liable to the claimant according to Texas law.

Acts 1985, 69th Legislature, chapter. 959, Sec. 1, effective September 1, 1985

NOTICE TO EMPLOYEES

The Texas Hazard Communications Act of 1985 (revised 1993), codified as Chapter 502 of the Texas Health and Safety Code

Requires Public Employers to provide employees with specific information on the hazards of chemicals to which employees maybe exposed in the workplace. As required by law, your employer must provide you with certain information and training. A summary of the law follows.

Workplace Chemical List. Employers must develop a list of hazardous chemicals used in the workplace in excess of 55 gallons or 500 pounds. This list shall be updated by the employer at least annually and made available for employees and their representatives on request.

Materials Safety Data Sheets. Employees who may be exposed to hazardous chemicals shall be informed of the exposure by the employer and shall have ready access to the most current material safety data sheets, which detail physical and health hazards and other pertinent information on those chemicals.

Labels. Employees shall not be required to work with hazardous chemicals form unlabeled containers, except portable containers for immediate use and the contents of which are known to the user.

Employee Education. Program Employees shall receive training by the employer on the hazards of the chemicals and on measures they can take to protect themselves from those hazards, and shall be provided with appropriate personal protective equipment. Training shall be provided to new employees prior to working in the area with hazardous chemicals.

Reporting Injuries or Fatalities. Employers must report to the Texas Department of Health within 48 hours of the occurrence of a chemical accident that results in one or more employee fatalities or results in the hospitalization of five or more employees.

Employee Rights. Employees may file complaints with the Texas Department of Health at the address or telephone number below and may not be discharged or discriminated against in any manner for the exercise of any rights provided by this act.

EMPLOYERS MAY BE SUBJECT TO ADMINISTRATIVE PENALTIES AND CIVIL OR CRIMINAL FINES
RANGING FROM \$50 TO \$100,000 FOR EACH VIOLATION OF THIS ACT.

Further information may be obtained from:
Texas Department of Health
Hazard Communications Branch
1100 West 49th Street
Austin, Texas 78756
(512) 834-6603

APPENDIX B

PROFESSIONAL ORGANIZATION POSITION STATEMENTS

American Academy of Ophthalmology

The Use of Contact Lenses in an Industrial Environment

Council of State Science Supervisors

Laboratory Safety

Science Education Safety: Key Issues in School Laboratory Safety

The Use of Human Body Fluids and Tissue Products in Biology

Teaching

National Biology Teachers Association

Role of Laboratory and Field Instruction in Biology Education

The Use of Animals in Biology Education

The Use of Human Fluids and Tissue Products in Teaching Biology

National Science Teachers Association

Guidelines for Responsible Use of Animals in the Classroom

Elementary School Science

Laboratory Science

Liability of Teachers for Laboratory Safety and Field Trips

These are position statements of national and state professional organizations. Local school districts should use the information based on evaluations of what is appropriate for their curriculum.

POLICY STATEMENT

THE USE OF CONTACT LENSES IN AN INDUSTRIAL ENVIRONMENT A Joint Statement of the American College of Occupational and Environmental Medicine and the American Academy of Ophthalmology

Policy:

Under the Americans with Disabilities Act of 1990, individuals cannot be disqualified from performing their essential functions in an industrial environment because they wear contact lenses unless it can be proven that they pose a direct threat to the health or safety of themselves or others in the work place. However, contact lenses do not fulfill the personal protective equipment requirements for ocular safety when worn by individuals performing certain tasks (e.g. welding and grinding) identified in the Code of Federal Regulations. As required by the Occupational Safety and Health Administration (OSHA), individuals who wear contact lenses in the work place must combine them with appropriate industrial safety eyewear.

Background:

Individuals who wear contact lenses (either for cosmetic or medical reasons) have sometimes been disqualified from industrial employment. However, some individuals must wear contact lenses for medical reasons to obtain their best visual performance or efficiency. Under 1990 ADA, the use of contact lenses may be considered an accommodation for the ocular disabled in cases such as monocular aphakia and keratoconus, and would therefore be permitted. Other individuals simply prefer to wear contact lenses instead of spectacles for correcting refractive errors.

Evaluation:

OSHA has codified the voluntary ANSI Z87.1 consensus standard, which makes compliance mandatory. The OSHA rule states, "The required industrial-safety eyewear for the specific hazard identified in ANSI Z87.1 must be worn over the contact lenses." Therefore, individuals who wear contact lenses are required to combine them with appropriate industrial safety eyewear (ANSI Z87.1) since contact lenses do not provide ocular protection from hazards such as particles, chemicals, and radiant energy. For example, medical personnel must wear eye-and-face-safety devices to protect themselves from HIV or laser radiation, and cosmetologists should wear such devices to protect themselves from aerosol spray.

Additionally, when a full-face respirator is used, both spectacles and contact lenses can pose safety problems in the industrial work place. Zelnick et al showed that when a respirator was worn even without spectacles there was a loss of visual field, which varied depending on the type of full-face respirator. Since the frames of the spectacles have been shown to be an obstruction of the full field of vision, the use of a respirator compounds the loss of visual field. Individuals who wear soft contact lenses in air-fed respirators have been shown to present with symptoms of "dry-eyes" due to dehydration of the contact lenses. Increasing the blinking rate and sometimes using artificial tears is necessary to minimize these symptoms.

Challenges to federal regulations and voluntary ANSI standards, which disallowed the use of contact lenses with a respirator, resulted in an OSHA-funded research project conducted by Lawrence Livermore National Laboratories (LLNL). The research concluded that the "prohibition against wearing contacts while using a full-facepiece respirator should be revoked or withdrawn. Wearers of corrective lenses should have the option of wearing either contacts or eyeglasses with their full-facepiece respirators." In consideration of LLNL's research and other articles that support contact lens use, the prohibition was considered unwarranted by OSHA. OSHA published an enforcement procedure authorizing the use of rigid gas-permeable and soft contact lenses in all workplaces and with all types of respirators.

Recommendations:

Medical personnel should determine, on an individual basis, the advisability of wearing contact lenses in the industrial work environment. Individuals should be instructed in the principles of contact lens wear, and the symptoms of problems, and they should be urged to seek immediate help if an injury occurs.

COUNCIL OF STATE SCIENCE SUPERVISORS (CSSS)

POSITION PAPERS

LABORATORY SAFETY

The Council supports the premise that science should be taught in a space specifically dedicated to science classes with provisions for laboratory activities. A safe and well-equipped preparation and workspace 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. An adequate budget for facilities, equipment, supplies, and proper waste management must be provided to support the laboratory experiences. They must be maintained and updated on a regular basis. Unique science supplies must be provided in sufficient quantity that students have a direct, hands-on experience.

The number of students assigned to each laboratory class should not exceed 24. Students must have immediate access to the teacher in order to provide a safe and effective learning environment.

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

SCIENCE EDUCATION SAFETY

KEY ISSUES IN SCHOOL LABORATORY SAFETY

Students and teachers must be aware of the potential for safety problems in the science classrooms and laboratories. Schools should review available safety resources and develop safety training for their teachers and students as well as safety rules for the classroom.

Teachers must choose safe labs that cover important concepts. Thought must be given to the chemicals purchased by schools. Which chemicals are the safest for the proposed labs, how much is needed, where will the chemicals be stored and in what arrangement? Are the storage areas locked and well ventilated?

Schools needing to dispose of unwanted or unknown (no label) chemicals should contact their state science education supervisor, state ecology agency or regional EPA office. Teachers or school officials should be prepared to give the name or description of the chemical, amount, type of container, nearest landfill and local sewage system.

Some state education agencies have worked with their state pollution control agencies and have used polluter fines to conduct statewide school chemical clean-ups in their states. Where this can not be done, local schools should band together to engage in regional chemical clean-ups to conserve costs.

Scientific equipment must be maintained. Written lab instructions must be clear and safety rules emphasized in these instructions.

Most states have regulations on fume hoods, whole-room ventilation, chemical storage, eyewash, safety showers, eyewear, aprons, and gloves, fire blankets, first aid kits, and fire extinguishers in science classrooms. Schools should check with their state science supervisor for regulations, laws, and liabilities.

GENERAL SCIENCE SAFETY CHECKLIST

The following is a suggested checklist of safety concerns in K-12 science laboratories.

1. Appropriate protective equipment for the science laboratory
2. Enforcement of safety procedures
3. All students and teachers know the local of all protective equipment
4. All students read and sign a lab safety contract
5. Sufficient, accessible lab stations per number of students in each laboratory
6. All students must wear proper safety goggles whenever chemicals, glassware, or heat is used
7. Equipment and chemical inventory maintained
8. Chemicals properly arranged by compatibility and securely stored
9. Restricted amounts of chemicals
10. Adequate labeling on equipment, chemicals and hazards
11. Material Safety Data Sheets
12. Unobstructed exits from laboratory
13. Uncluttered laboratories
14. Master shut-off switches for gas, water and electricity
15. Safety Rules and charts posted
16. Records kept on safety training and lab incidents
17. Emergency exit/escape plan posted
18. Live animals and students are protected from one another

GENERAL LAB SAFETY RECOMMENDATIONS

1. Always perform an experiment or demonstration prior to allowing students to replicate the activity. Look for possible hazards. Alert students to potential dangers.
2. Safety instructions should be given orally and be posted each time an experiment is begun.
3. Constant surveillance and supervision of student activities are essential.
4. Never eat or drink in the laboratory or from laboratory equipment. Keep personal items off the lab tables.
5. Never use mouth suction in filling pipettes with chemical reagents. Use a suction bulb.
6. Never force glass tubing into rubber stoppers.
7. A bucket of 90% sand and 10% vermiculite, or kitty litter (dried bentonite particles) should be kept in all rooms in which chemicals are either handled or stored. The bucket must be properly labeled and have a lid that prevents other debris from contaminating the contents.
8. Smoke, carbon monoxide, and heat detectors are recommended in every laboratory. Units should be placed in the laboratory and related areas (storerooms, preparation rooms, closets, and offices).
9. Use heat-safety items such as safety tongs, mittens, aprons, and rubber gloves for both cryogenic and very hot materials
10. A positive student attitude toward safety is imperative. Students should not fear doing experiments, using reagents, or equipment, but should respect them for potential hazards. Students should read the lab materials in advance noting all cautions (written and oral).
11. Teachers must set good safety examples when conducting demonstrations and experiments. They should model good lab safety techniques such as wearing aprons and goggles.
12. Rough play or mischief should not be permitted in science classrooms or labs.
13. Never assume that an experiment is free from safety hazards just because it is in print.
14. Closed-toed shoes are required for labs involving liquids, heated or heavy items that may injure the feet.
15. Confine long hair and loose clothing. Laboratory aprons should be worn.
16. Students should avoid transferring chemicals they have handled to their faces.
17. Never conduct experiments in the laboratory alone or perform unauthorized experiments.
18. Use safety shields or screens whenever there is potential danger that an explosion or implosion of an apparatus might occur.
19. All persons engaged in supervising, or observing science activities involving potential hazards to the eye must wear proper eye protection devices.
20. Make certain all hot plates and burners are turned off when leaving the laboratory.
21. School staff should conduct frequent inspection of the laboratory's electrical, gas, and water systems.

22. Install ground fault circuit interrupters at all electrical outlets in science laboratories
23. A single shut-off for gas, electricity, and water should be installed in the science laboratory. It is especially important that schools in the earthquake zones to have such a switch.
24. MSDS sheets must be maintained on all school chemicals. Schools should maintain an inventory of all science equipment.
25. Laboratories should contain safety equipment appropriate to their use such as emergency shower, eye-wash station (15 minutes of potable water that operates hands free), fume hood, protective aprons, fire blankets, fire extinguisher, and safety goggles for all students and teacher(s).
26. Protective (rubber or latex) gloves should be provided when students dissect laboratory specimens.
27. New laboratories should have two unobstructed exits. Consider adding another to old labs if only one exit exists.
28. There should be frequent laboratory inspections and school staff should conduct an annual, verified safety check of each laboratory.
29. Give consideration to the National Science Teachers Association's recommendation to limit science classes to 24 students or less for safety.
30. All work surfaces and equipment in the chemical or biological laboratory should be thoroughly cleaned after each use.
31. Students should properly note odors or fumes with a wafting motion of the hand.
32. Chemistry laboratories should be equipped with functional fume hoods. Fume hoods should be available for activities involving flammable and/or toxic substances.
33. The several chemical authorities believe that contact lenses do not pose additional hazards to the wearer and that contact lenses are allowed when appropriate eye and face protection are used. The wearing of contact lenses in the science laboratory has been a concern because of possibility of chemicals becoming trapped between the lenses and the eye in the event of a chemical splash. Check with your state science supervisor for your state's recommendation.
34. All laboratory animals should be protected and treated humanely.
35. Students should understand that many plants, both domestic and wild, have poisonous parts and should be handled with care.

Criteria for scheduling special needs students into laboratory classes should be established by a team of counselors, science teachers, special education teachers and school administrators. Aides or special equipment should be made available to the science teacher.

The Council of State Science Supervisors

NATIONAL BIOLOGY TEACHERS ASSOCIATION

POSITION STATEMENTS

ROLE OF LABORATORY AND FIELD INSTRUCTION IN BIOLOGY EDUCATION

Philosophy : The study of biology provides students with opportunities to develop an understanding of our living world. Biology is the study of life and its evolution; of organisms and their structures, functions, processes, and interactions with each other and with their environments.

Scientific inquiry is the primary process by which scientific knowledge is gained. It involves the basic skills of questioning, prediction, qualitative and quantitative observation, classification, inference, communication and, additionally, integrated skills such as identifying and controlling for variables, generating procedures, planning strategies for testing hypotheses and answering questions, and for collecting and interpreting appropriate data. The knowledge of biology includes scientific data, concepts, hypotheses, theories, methodology, use of instruments, and conceptual themes.

Biologists recognize that knowledge based upon experimental results and accurate observations is gained through a variety of experiences, including the pursuit of cause and effect relationships. Thus, the role of the laboratory and field learning becomes a key component in understanding biology. Laboratory activities and inquiry provide students with opportunities to observe, sample, experience, and experiment with scientific phenomena in their quest for knowledge of living things.

The most effective vehicle by which the process of inquiry can be learned appears to be a laboratory or field setting where the student experiences, firsthand, the inquiry process. Laboratory and field studies have also been demonstrated to be effective means for comprehension, understanding and application of biological knowledge. Thus, study in a laboratory and/or field setting is an integral and essential part of a biology course. The following are recommendations regarding teaching strategies, physical resources, and curriculum development that will enhance the study of biology and improve the quality of biology instruction in our schools.

A Definition of a Laboratory Environment

In a laboratory or field learning environment, students work individually or in small groups on a question, problem or hypothesis; they use the processes and materials of science to construct their own explanation of biological phenomena. They will often observe, collect data and interpret data of life processes, living organisms, and/or simulations of living phenomena. The distinction between laboratory or field learning and traditional classroom learning is that activities are student-centered, with students actively engaged in hands-on, minds-on activities using laboratory or field materials and techniques.

Teaching Strategies:

1. Direct experience. The laboratory and field components of biology instruction should provide experiences for direct student involvement which emphasize the above process skills and the tentative nature of science; knowledge is gained by observing cause and effect relationships among variables. It is essential for students to be provided opportunities for questioning, hypothesis formulation, experimental design, and data analysis. Also, students must be given opportunities to pursue procedural options rather than simply follow recipes. They must be provided opportunities to design and carry out their own experiments. While computer-assisted instruction and video materials contribute to biology learning, they should not be used to substitute for direct observation of living organisms or for experiments in which students learn cause and effect relationships between and among biological phenomena. School administrators need to recognize the expenses related to offering experiential, hands-on laboratory courses and provide adequate funding.

2. Instructional time. Biology courses need to have an integrated laboratory and field experience component in which students spend at least one-half of their total instructional time. Provisions for this amount of laboratory and fieldwork should be made in the curriculum of a biology course.

3. **Instruction.** While we respect the professional teacher's expertise in determining appropriate lessons and sequence of instruction, most of the student's biology education should begin with experiences in a laboratory or field setting. These experiences allow students to construct new knowledge for themselves and can provide the basis for the introduction of more abstract concepts presented in lectures, discussions or reading assignments.

4. **Quality of instruction.** Biology laboratory instruction should provide students with frequent opportunities to observe and experiment with living materials, as opposed to nonliving specimens or artifacts. Every student should have direct, hands-on experiences with the laboratory materials.

5. **Teacher education.** Teachers of secondary biology laboratory instruction are expected to have a major in the biological sciences and should have formal training in laboratory and field teaching strategies (see NABT Biology Teaching Standards). Instruction in biology laboratory and field study should be an integral part of pre-service and in-service teacher training. Ideally, pre-service teachers should do "lab and/or field science" under the guidance of a research scientist. One cannot truly teach or truly understand process science until he/she has science research experience. Educational institutions should encourage their life science teachers to grow professionally by attending summer institutes and professional meetings, as well as taking graduate courses in biology and biology education. Administrators should seek educational funding from available sources to support and compensate teachers in their efforts to update their current knowledge and to network with colleagues from different schools.

Facilities, Classroom Environment and Teacher Load:

1. **Laboratory space.** Adequate and appropriate facilities, materials and equipment need to be provided for students to learn biology in a laboratory and field setting. This is essential at all levels of biology instruction, including elementary school, middle school, high school, college and university. The laboratory space should be (a) available to the teacher during the planning and preparation period and (b) available to students for special projects, makeup laboratories, etc. outside their regular class hours. Each student should have his/her own laboratory work space.

2. **Facility.** The laboratory classroom should be equipped with work areas that have sinks, a water supply, and natural gas and electrical outlets available in sufficient quantity to support a laboratory/field-oriented biology course. Adequate ventilation, fume hoods, and reference materials are also necessary, and the laboratory size must allow all students to participate in real hands-on activities. There should be adequate space for storage of materials and secure areas for storage of solvents, reactants, or potentially hazardous or dangerous chemicals as per guidelines set by the American Chemical Society. Facilities structure and configuration should be inspected for updating every 10 years. There should also be a space (living materials center) dedicated to growing living specimens for study in biology classes.

3. **Materials budget.** The National Science Education Standards address the need for making resources available; allocation of funds must provide opportunities to learn in an inquiry-based curriculum. To that end, biology teachers must be provided with an annual budget sufficient to purchase both expendable material and equipment necessary to conduct inquiry-based learning.

4. **Safety.** Approved guidelines for the safe use, maintenance and storage of laboratory materials must be followed. This includes classroom instruction on safety and emergency procedures. NABT Guidelines for the Use of Live Animals, Working with DNA & Bacteria in Precollege Science Classrooms (or safety guidelines from organizations such as NIH, the American Chemical Society, etc.) and appropriate safety procedures for using plants and microorganisms should be followed. Each laboratory room must be equipped with safety goggles and laboratory aprons for all students, a first-aid kit, a fire blanket, and an all-purpose fire extinguisher. A safety shower and eyewash station should be available within a 20-second walk. Safety goggles, if used by different students, must be disinfected with an alcohol swab wipe before being assigned to another user. The state Texas Education Agency guidelines for safety procedures should be rigorously followed.

5. Class size and supervision. A student-to-instructor ratio in the biology laboratory classroom must permit safe and effective instruction. Class size should be determined by the physical design of the classroom and should not exceed 24 students in a laboratory setting for any reason when students are assigned to a single teacher.

6. Teaching load. Due to the extra time and preparation that laboratory courses require, life science teachers should not be assigned more than five classes per semester. Since each laboratory requires a different repertoire of organisms, equipment, materials, supplies, solutions and planning, and also demands lessons plans and grading time, teaching load should not be more than two process-oriented science course preparations and have no more than 24 students assigned to each class. Teachers should have their own science classrooms and have access to those classrooms during their preparation times. Time must also be allowed within the teaching day for the setup and dismantling of laboratory preparations. Where possible, student or adult laboratory assistance should be provided, and in high school, we strongly recommend that a laboratory manager (or instructional aid) be hired to assist in preparation, setup, and dismantling of laboratory materials for experiential learning lessons.

Curriculum Development:

Most laboratory and field activities used in the schools are prepared commercially; NABT urges these other developers to provide instructional activities that meet the above guidelines. The most productive curricula will be those with an abundance of active learning, such as laboratory and field investigations, upon which the teacher can base further indirect learning experiences, such as lectures, discussions and assignments.

*Adopted by the Board of Directors
September 1990. Revised 1994.
National Association of Biology Teachers.*

THE USE OF HUMAN BODY FLUIDS AND TISSUE PRODUCTS IN BIOLOGY TEACHING

Laboratory activities using human body samples can be important components of biology teaching. The chance that human body samples may transmit serious diseases raises concerns about their use in biology teaching. The National Association of Biology Teachers supports the use of human body samples for teaching biology only if teachers ensure safe conditions that prevent the spread of disease. Teachers should use substitute activities or materials if they cannot guarantee the safe handling, storage, cleanup and disposal of human body samples. Teachers wishing to use human body samples should weigh the potential risks of using these materials against the educational outcomes gained. In addition, teachers should remain sensitive to students desiring not to handle certain body samples.

Human body samples used in high school and college biology pedagogy include blood, cheek cells, feces, mucus, saliva, semen, and urine. All of these should be treated as biological hazards having the potential to spread communicable disease. These samples are generally used in the following acceptable capacities:

Blood

Blood is used for blood typing studies in general biology and anatomy and physiology class activities. It is also used for microscopic and physiological analysis in anatomy and physiology class activities and immunology laboratory sessions.

Cheek Cells

Cheek cells are regularly used in introductory biology classes for microscopic analysis.

Feces

Feces are rarely used in biology instruction. Materials containing feces are sometimes used in microbiology and parasitology class activities.

Mucus

Cultures obtained from respiratory mucus are used in microbiology classes.

Saliva

The enzymes present in saliva are used in general biology class activities. Cells collected with saliva are used for microscopic analysis in general biology and anatomy and physiology class activities. Microbiology class activities use saliva for obtaining oral microorganisms from tooth tartar.

Semen

Samples of semen are used for microscopic analysis in general biology and anatomy and physiology activities.

Urine

Urinalysis in anatomy and physiology classes requires freshly collected urine. Some microbiology laboratory activities entail culturing microorganisms from urine.

Recommendations

NABT offers the following recommendations for teachers wishing to conduct activities requiring the use of human body samples:

Use human body samples only if you know the samples are free of disease. Do not use any samples of unknown origin. It is best to avoid using student samples collected at home or off campus.

Human body samples should only be used if all students, teachers, and other people coming in contact with the samples are following the Universal Precautions for handling human body samples. Proper collection, storage, and disposal methods must be followed. Guidelines for handling human body samples are available from hospitals, clinical laboratories, and public health agencies. They are published in the Code of Federal Register available through government documents libraries.

Whenever possible, try to substitute comparable but safer alternatives for human body samples. Many materials available for purchase mimic the properties of blood, saliva, and urine. In addition, *The American Biology Teacher* and other journals provide information about do-it-yourself fluid substitutes. Disease-free animal samples of blood, feces, and semen can be purchased for microscopic analysis from biological and chemical supply companies. Pure cultures of microorganisms resembling those found in human body samples can also be purchased.

SUGGESTED SAFETY PRECAUTIONS TO FOLLOW WITH HUMAN BODY FLUIDS AND TISSUE PRODUCTS

Teachers wishing to use human body samples should consider the following minimum precautions before conducting laboratory activities:

Handling

Students should not be allowed to collect samples without supervision or advice of the teacher. Samples should be collected, handled, and transferred using proper safety apparel:

- Plastic or latex gloves
- Safety glasses or goggles
- A lab coat or an apron.

Students should always wash their hands after any laboratory activity using any type of human body sample.

Storage

All samples must be used and temporarily stored in labeled, leakproof containers during classroom use. Labeling should include the type of sample, the source of the sample, and the current date. Samples kept for long-term storage must be kept refrigerated in clearly labeled leakproof containers. Again, labeling should include sample type, sample source, and collection date. Samples must never be stored near food or in refrigerators and freezers being used for food storage. Refrigerators used to store human body samples must be labeled with signs that indicate the presence of biohazardous materials or human body samples.

Cleanup and Disposal

In most areas, human body samples may be disposed of in public sewers as long as the samples are free of parasites and highly contagious pathogens. Check with city or other local agencies before doing so. Samples having parasites and highly contagious pathogens must be sterilized, as described below, before disposal. Laboratory materials contaminated with human body samples must be sterilized before reuse or disposal. Reusable materials, like glassware and microscope slides, can be sterilized using an autoclave (pressurized steam heat at 121° C for 20 minutes) or by soaking in a 10% solution (10 mL of bleach added to 90 mL of tap water) of household strength bleach (household bleach is 5% hypochlorite) for 30 minutes. Bleaching should be followed by a warm soap water wash.

Contaminated lancets, needles, or broken glass must be sterilized using an autoclave or bleach treatment before disposal. They must then be discarded in a red “Sharps Container” marked biohazardous materials. Sharps Containers are available from biological and medical supply companies. Lancets and needles must never be reused. Spills must be decontaminated immediately using bleach that has soaked the area for at least 10 minutes. Contaminated broken glass must be handled with cut-proof gloves or a hand broom. All work surfaces should be wiped down with the 10% bleach solution after completion of the activity.

THE USE OF ANIMALS IN BIOLOGY EDUCATION

The National Association of Biology Teachers (NABT) believes that the study of organisms, including non-human animals, is essential to the understanding of life on Earth. NABT recommends the prudent and responsible use of animals in the life science classroom. NABT believes that biology teachers should foster a respect for life. Biology teachers also should teach about the interrelationship and interdependency of all things.

Classroom experiences that involve non-human animals range from observation to dissection. NABT supports these experiences so long as they are conducted within the long established guidelines of proper care and use of animals, as developed by the scientific and educational community.

As with any instructional activity, the use of non-human animals in the biology classroom must have sound educational objectives. Any use of animals, whether for observation or dissection, must convey substantive knowledge of biology. NABT believes that biology teachers are in the best position to make this determination for their students.

NABT acknowledges that no alternative can substitute for the actual experience of dissection or other use of animals and urges teachers to be aware of the limitations of alternatives. When the teacher determines that the most effective means to meet the objectives of the class do not require dissection, NABT accepts the use of alternatives to dissection including models and the various forms of multi-media. The Association encourages teachers to be sensitive to substantive student objections to dissection and to consider providing appropriate lessons for those students where necessary.

To implement this policy, NABT endorses and adopts the “Principles and Guidelines for the Use of Animals in Pre-college Education” of the Institute of Laboratory Animals Resources (National Research Council). Copies of the “Principles and Guidelines” may be obtained from the ILAR (2101 Constitution Avenue, NW, Washington, DC 20418; 202 334-2590).

Adopted by the Board of Directors in October 1995.

This policy supersedes and replaces all previous NABT statements regarding animals in biology education.

NATIONAL SCIENCE TEACHERS ASSOCIATION

POSITION STATEMENTS

GUIDELINES FOR RESPONSIBLE USE OF ANIMALS IN THE CLASSROOM

These guidelines are recommended by the National Science Teachers Association for use by science educators and students. They apply, in particular, to the use of non-human animals in instructional activities planned and/or supervised by teachers who teach science at the pre-college level.

Observation and experimentation with living organisms give students unique perspectives of life processes that are not provided by other modes of instruction. Studying animals in the classroom enables students to develop skills of observation and comparison, a sense of stewardship, and an appreciation for the unity, interrelationships, and complexity of life. This study, however, requires appropriate, humane care of the organism. Teachers are expected to be knowledgeable about the proper care of organisms under study and the safety of their students. These are the guidelines recommended by NSTA concerning the responsible use of animals in a school classroom laboratory:

- Acquisition and care of animals must be appropriate to the species.
- Student classwork and science projects involving animals must be under the supervision of a science teacher or other trained professional.
- Teachers sponsoring or supervising the use of animals in instructional activities—including acquisition, care, and disposition—will adhere to local, state, and national laws, policies, and regulations regarding the organisms.
- Teachers must instruct students on safety precautions for handling live animals or animal specimens.
- Plans for the future care or disposition of animals at the conclusion of the study must be developed and implemented.
- Laboratory and dissection activities must be conducted with consideration and appreciation for the organism.
- Laboratory and dissection activities must be conducted in a clean and organized workspace with care and laboratory precision.
- Laboratory and dissection activities must be based on carefully planned objectives.
- Laboratory and dissection objectives must be appropriate to the maturity level of the student.
- Student views or beliefs sensitive to dissection must be considered; the teacher will respond appropriately.

Adopted by the NSTA Board of Directors in July, 1991
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ELEMENTARY SCHOOL SCIENCE

The National Science Teachers Association supports the notion that investigative science must be a basic in the daily curriculum of every elementary school child at every grade level.

In the last decade, numerous reports have been published calling for reform in education. Each report has highlighted the importance of early experiences in science so that children develop problem-solving skills that empower them to participate in an increasingly scientific and technological world.

1. The elementary science program must provide opportunities for children to develop understandings and skills necessary to function productively as problem-solvers in a scientific and technological world.
2. Elementary school children learn science best when:
 - they are involved in first-hand exploration and investigation and inquiry/process skills are nurtured.
 - instruction builds directly on the child's conceptual framework.

- content is organized on the basis of broad conceptual themes common to all science disciplines.
 - mathematics and communication skills are an integral part of science instruction.
3. The learning environment for elementary science must foster positive attitudes towards self and society, as well as science.
 4. Elementary school children value science best when:
 - a variety of presentation modes are used to accommodate different learning styles, and students are given opportunities to interact and share ideas with their peers.
 - the scientific contributions of individuals from all ethnic origins are recognized and valued.
 - other subject areas are infused into science.
 - inquiry skills and positive attitudes are modeled by the teacher and others involved in the education process.
 5. Teacher preparation and professional development must enable the teacher to implement science as a basic component of the elementary school curriculum.
 6. Teacher preparation and professional development must provide for:
 - experiences that will enable teachers to use hands-on activities to promote skill development, selecting content and methods appropriate for their students, and for design of classroom environments that promote positive attitudes toward science and technology.
 - continuing science inservice programs based on current educational research that encompass content, skills, techniques, and useful materials.
 - participation in workshops, conferences, and meetings sponsored by local, state, and national agencies.
 7. The school administrators must be advocates for elementary science.
 8. Administrators must provide instructional leadership by:
 - building consensus for an elementary science program that reflects these standards.
 - implementing and monitoring the progress of the science program.
 9. Administrators must provide support systems by:
 - supplying appropriate materials, equipment, and space.
 - recognizing exemplary elementary science teaching.
 - encouraging special science events.
 10. The instructional implementation and support system for elementary school science must include the combined efforts of all aspects of the community: parents, educators, businesses, and other organizations.
 11. The community must be advocates for elementary school science by:
 - participating in ongoing planning, assessment, and funding of elementary science programs.
 - promoting informal science learning experiences.
 12. Assessment must be an essential component of an elementary science program.
 13. Assessment must be aligned with:
 - what is of value, i.e., the problem-solving model of instruction: concept application, inquiry, and process skills.
 - the curricular objectives and instructional mode.
 - the purpose for which it was intended: grading, diagnosis, student and/or parent feedback, or program evaluation.
 14. Elementary school science instruction must reflect the application and implementation of educational research.
 15. Elementary school science programs are improved when:
 - teachers keep abreast of appropriate science education research.
 - educational research becomes the premise for change or innovation in elementary school science, and teachers participate in action research in elementary science.

*Adopted by the NSTA Board of Directors in January 1990,
Modified by the NSTA Task Force on Elementary School Science Scope and Sequence, in March, 1991
1991 National Science Teachers Association*

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)
- Preschool/Elementary science should be taught in a classroom with sufficient workspace 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 of 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 workspace 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.

Adopted by the NSTA Board of Directors in January, 1990

LIABILITY OF TEACHERS FOR LABORATORY SAFETY AND FIELD TRIPS

Laboratory investigations and field trips are essential to effective science instruction. Teachers should be encouraged to use these instructional techniques as physical on-site activity important to the development of knowledge, concepts, processes, skills, and scientific attitudes. Inherent in such physical activities is the potential for injury and possible resulting litigation. All such liability must be shared by both school districts and teachers, utilizing clearly defined safety procedures and a prudent insurance plan. The National Science Teachers Association recommends that school districts and teacher adhere to the following guidelines:

- I. School districts should develop and implement safety procedures for laboratory investigations and field trips.
- II. School districts should be responsible for the actions of their teachers and be supportive of the use of laboratory activities and field trips as teaching techniques.
- III. School districts should look to NSTA for help in informing teachers about safety procedures and encouraging them to act responsibly in matters of safety and related liability.
- IV. School districts should provide liability and tort insurance for their teachers.
- V. Teachers, acting as agents of the school districts, should utilize laboratory investigations and field trips as instructional techniques.
- VI. Teachers should learn safe procedures for laboratory activities and field trips and follow them as a matter of policy.
- VII. Teachers should exercise reasonable judgement and supervision during laboratory activities and field trips.
- VIII. Teachers should expect to held liable if they fail to follow district policy and litigation ensues.
- IX. School districts and teachers should share the responsibility of establishing safety standards and seeing that they are adhered to.

Adopted by the NSTA Board of Directors in July 1985

APPENDIX C

AGENCIES AND ASSOCIATIONS

STATE AGENCIES AND ASSOCIATIONS

Alternative Fuels Council
1700 North Congress Avenue
P.O. Box 13047
Austin, Texas 78711

Animal Health Commission
2105 Kramer Lane
P.O. Box 12966
Austin, Texas 78711-2966

Environmental Protection Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

General Land Office
1700 North Congress Avenue
Austin, Texas 78701

Hazard Communication Branch
Texas Department of Health
1100 West 49th Street
Austin, Texas 78756-7111

Health and Human Services
4900 North Lamar
Austin, Texas 78711-3247

National Institute of Occupational Safety
and Health
1200 Main Tower Building
Dallas, Texas 75202

Occupational Safety and Health Administration
Region VI
525 Griffin Square Building
Dallas, Texas 75202

Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Railroad Commission of Texas
1701 North Congress Avenue
Austin, Texas 78711

State Fire Marshall's Office
P.O. Box 149221
Austin, Texas 78714-9221

State Law Library
205 West 14th Street
Austin, Texas 78711-2367

Texas Cancer Council
211 East 7th Street
Suite 710
P.O. Box 12097
Austin, Texas 78711-2097

Texas Commission on Alcohol and Drug Abuse
9001 North Interstate 35
Suite 105
Austin, Texas 78753-5233

Texas Commission for the Blind
4800 North Lamar
Austin, Texas 78756

Texas Commission for the Deaf
and Hard of Hearing
4800 North Lamar
Suite 300
P.O. Box 12904
Austin, Texas 78711

Texas Commission on Fire Protection
12675 Research Boulevard
P.O. Box 2286
Austin, Texas 78768-2286

Texas Department of Licensing & Regulations
920 Colorado
Austin, Texas 78701

Texas Education Agency
1701 North Congress Avenue
Austin, Texas 78701

Texas Ethics Commission
201 East 14th Street
P.O. Box 12070
Austin, Texas 78711-2070

Texas Department of Health
1100 West 49th Street
Austin, Texas 78756-7111

Texas Natural Resource Conservation
Commission
12100 Park 35 Circle
Austin, Texas 78711-3087

Texas Structural Pest Control Board
1106 Clayton Lane
Suite 201
Austin, Texas 78766

Texas Water Development Board
1700 North Congress Avenue
Austin, Texas 78711-3231

APPENDIX D

SAFETY FORMS

Sample Safety Forms

Accident Report
Certificate of Project Compliance
Emergency Medical Information Form
Material Safety Data Sheet
Parent Letter for Field Trips
Permission Form
Science Laboratory Safety Contract

ACCIDENT REPORT

(SAMPLE)

School _____ Date _____ Time _____

Student's Full Name _____

Student's Address _____

Phone _____ Age _____ Sex _____ Grade _____

Nature of the Accident

- Abrasion
- Burn
- Puncture or Cut
- Ingested Material
- Sprain
- Chemical Contact

Region of the Body Injured

- Eye
- Arm
- Leg
- Torso
- Internal

Description of the Accident:

- Location where the accident occurred _____
- List of tools, equipment, or chemicals involved: _____
- First aid treatment administered _____
- Who administered the first aid? _____
- Time Parent Notified _____
- Student sent: Home _____ Doctor _____ Hospital _____
Name of Hospital _____

Principal

Teacher

Nurse

**CERTIFICATION
OF PROJECT
COMPLIANCE**

Distribution to:

District	<input type="checkbox"/>	Architect/Engineer	<input type="checkbox"/>
Contractor	<input type="checkbox"/>	Texas Education Agency	<input type="checkbox"/>
Other	<input type="checkbox"/>	Building Department	<input type="checkbox"/>

1. PROJECT INFORMATION:
(name, address)

ARCHITECT/ENGINEER:

CONTRACTOR:

PROJECT NUMBER:

CONTRACT DATE:

DISTRICT:

DATE DISTRICT AUTHORIZES PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION:

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the enrollment projections, educational specifications and objectives of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT:

BY:

DATE:

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the State Board of Education, July 1992, and as provided by the district.

ARCHITECT/ENGINEER:

BY:

DATE:

5. The Contractor certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer list above.

CONTRACTOR:

BY:

DATE:

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT:

BY:

DATE:

TEA §61.101(D)9.92

EMERGENCY MEDICAL INFORMATION FORM

(SAMPLE)

Name of student _____

Date of birth _____ Age _____

Home address _____

Name of parents or guardian _____

Home phone _____ Business phone _____

Alternate emergency contact _____

Phone number _____

Family doctor _____

Office phone _____ Office address _____

Please describe any health related problems, allergies, or other physical conditions that may limit full participation in the field trip activities.

Please list any medications that the student is required to take during the field trip.

Name: (1) _____ (2) _____ (3) _____

Dosage: (1) _____ (2) _____ (3) _____

In case of an emergency, I hereby authorize the physician selected by school personnel to provide the necessary medical treatment for my child.

Signature _____ Date _____

Print Name _____

THIS FORM MUST BE RETURNED BY _____

MATERIALS SAFETY DATA SHEET

(SAMPLE)

MATERIAL IDENTITY: ETHYL ALCOHOL

- CAS Number: 64-17-5
- Date Prepared: October 28, 2000
- Manufacturer: Jane & John Doe Chemical Company
- Address: Hazardland, Texas 77777
- Information on Chemical: 1-800-111-0000
- Emergency Line: 1-800-111-0001

SECTION I: MATERIAL IDENTIFICATION AND INFORMATION

<u>COMPONENTS</u>	<u>PERCENTAGE</u>	<u>TLV</u>
Ethyl Alcohol (ethanol)	92.4-100	1000 ppm
Water	0-7.6	N/A

SECTION II: PHYSICAL AND CHEMICAL CHARACTERISTICS

- Boiling point: 172°F (78°C)
- Vapor Pressure (mm Hg & temperature): 100mm at 27°C
- Vapor Density (Air = 1): 1.59
- Solubility in water (Completely miscible appearance and odor): Alcohol is clear and has an alcohol odor. Appearance and odor can be modified by non-hazardous components of the mixture.
- Specific Gravity (Water = 1): 0.785 (60°F)
- Melting Point: -130°C
- Evaporation Rate (n-Butyl Acetate = 1): 2.7
- Water Reactive: None

SECTION III: FIRE AND EXPLOSION HAZARD DATA

- Flash Point and Method Used: 55°F c.c.
- Auto-Ignition Temperature: 793°F
- Flammability Limits in Air (% by Volume)
 - ◊ LEL: 3.28%
 - ◊ UEL: 19.00%
- Extinguisher Media (carbon dioxide); alcohol foam Special Fire Fighting Procedures: Use ABC chemical fire extinguisher.
- Unusual Fire & Explosion Hazards: Explosion hazard is moderate when exposed to flame.

SECTION IV: REACTIVITY HAZARD DATA

- Stability: Stable
 - ◊ Conditions to Avoid: Keep away from heat or ignition sources.
- Incompatibility (Materials to avoid): Oxidizing agents such as acetyl chloride, nitric acid & hydrogen peroxide.
- Hazardous Decomposition Products: Carbon dioxide during combustion.
- Hazardous Polymerization: Does not occur.

SECTION V: HEALTH HAZARD INFORMATION

- Primary Route of Entry:
 - ◊ Inhalation
 - ◊ Ingestion
- Carcinogen Listed: Not carcinogens present
- Health Hazards
 - ◊ Acute: Irritation of eyes, nose and throat; headache
 - ◊ Chronic: Drowsiness and lassitude; loss of appetite and inability to concentrate
 - ◊ Medical Conditions Generally Aggravated by Exposure: Unknown
- Emergency First Aid Procedures: Seek medical assistance for further treatment
 - ◊ Eye Contact: Irrigate eyes with water for 15 minutes
 - ◊ Skin Contact: Wash with water
 - ◊ Inhalation: If excessive, notify authorities and seek medical assistance
 - ◊ Ingestion: Gastric lavage, followed by saline catharsis, seek medical care

SECTION VI: CONTROL AND PROTECTIVE MEASURES

- Respiratory Protection: Activated Carbon Respirator
- Protective Gloves: Not required unless when in contact with skin
- Eye Protection: Chemical Splash Goggles
- Ventilation to be Used: Local exhaust sufficient
- Other Protective Clothing or Equipment: If exposure limit is exceeded, use NIOSH approved respirator

SECTION VII: HANDLING, DISPOSAL, AND SPILL PROCEDURES

- If material is spilled or released:
 - ◊ Keep away from ignition sources
 - ◊ Ventilate area
 - ◊ Large quantities may be collected and incinerated
 - ◊ Consult with local and state regulations
- Precautions when handling and storing material
 - ◊ Keep containers closed
 - ◊ Ground containers when emptying

NOTE: This sample is for educational use only. There is no guarantee of the reliability of the data nor liable for damages relating to the use of the information on the MSDS form.

PARENT LETTER FOR FIELD TRIPS

(SAMPLE)

Date

Dear Parent,

On (date of trip), (science teacher's) science classes will be taking a one day field trip to (location of site) to (major objective of trip). Students have been studying (list current topics students have been studying in class so that learning in class connects with the learning on the trip). Students will be observing (list interesting events and features that the students will be seeing and doing on the trip).

We will be leaving at (time of departure) from (where parents are to bring students) and returning at approximately (time of return). Students will be traveling to the site by (list means of transportation). They will be supervised by (list all adult supervisors). We are pleased to have (list an administrator accompanying the students and a parent whose expertise will be used as a resource on the trip) join us.

Students should arrive at (site name) at (approximate time of arrival) and be lead by (name of a professional or representative of the site). We should complete the major portion of our work at 12:00 and will have lunch at the site. During lunch (parent expert) will make a presentation on (related information to the objective of the trip) to the classes. Departure will be at (approximate time of departure).

In an emergency, you can reach your child at (list the site and telephone number if possible). Identify our group as (how the classes will be identified at the site). A list of the students will be given to the office.

Students should wear (list the types of appropriate clothing students should wear). Students will need to bring a lunch (if needed) and a canned drink. Ice chests will be available to keep the food and drinks cold.

Attached to this letter is a Permission Form for students to attend the field trip and a Medical Information Form. Please fill these out, sign, and return them to (teacher) by (deadline for returning the signed form).

We are all very excited about the trip and seeing first hand what we have been learning in class. If you have other questions about the field trip please do not hesitate to call me. I can be reached at (business number) during my planning period from (times you can be reached).

Sincerely,

(teacher's signature)

PERMISSION FORM

(SAMPLE)

(date)

I have read the information concerning (teacher's name) (classes going) field trip to (name of the site) on (date of trip).

I give permission

I do not give permission

for _____ to participate in the activity.
(student's name)

I understand that students and sponsors will be traveling by (kind of transportation) and leaving at (time of departure). I will be at the school at (approximate time of arrival) to meet the returning students at (location at school) of the school.

Parent (print name)

Parent's Signature

Date

PLEASE RETURN THIS PERMISSION FORM NO LATER THAN (date) TO:
(teacher's name)
(school name)

SCIENCE LABORATORY SAFETY CONTRACT

(SAMPLE)

- I will act responsibly at all times in the laboratory.
- I will follow all instructions about laboratory procedures given by the teacher.
- I will keep my area clean in the laboratory.
- I will wear my safety goggles at all times in the laboratory and protective clothing when necessary.
- I know where the fire extinguisher is located in the laboratory and have been trained on its use.
- I will immediately notify the teacher of any emergency.
- I know who to contact for help in an emergency.
- I will tie back long hair, remove jewelry, and wear shoes with closed ends (toes and heels) while in the laboratory.
- I will never work alone in the laboratory.
- I will not take chemicals or equipment out of the laboratory without permission from the teacher.
- I will never eat or drink in the laboratory unless instructed to do so by the teacher.
- I will only handle living organisms or preserved specimens when authorized by the teacher.
- I will not enter or work in the storage room unless supervised by a teacher.

This contract is to be kept by the student.

Students should sign in the appropriate space below and return the bottom portion to the teacher.

I, _____ have read each of the statements in the Science Laboratory Safety Contract and understand these safety rules. I agree to abide by the safety regulations and any additional written or verbal instructions provided by the school district or my teacher.

Student Signature

Date

Parent Signature

Date

APPENDIX E

CHECKLISTS AND GUIDES

Checklists

A Checklist for Science Field Investigations
Required Tools for Inquiry and Investigations
Science Facility Safety Checklist

Guides

Microscale Chemistry Guide
Poisonous Plant Guide

A CHECKLIST FOR SCIENCE FIELD INVESTIGATIONS

(√) General Preparations

- Has a representative from the site granted permission?
- Is the site accessible for physically challenged students?
- Has a date been established?
- Has an alternate date been established?
- Have sponsors been selected?
- Has the sponsor/student ratio been established?
- Have students been checked for eligibility and a discipline record?
- Are there other requirements that the site requests?
- Are admission fees required?
- Are there bathrooms and an area to eat meals at the site?
- Is it necessary for students to bring their own food?
- Will copies of the Permission Forms and a student list be left with an administrator?
- Will the Emergency Medical Forms be taken with the teacher?
- Is there a portable phone for emergency use?
- Are emergency procedures in place for handling an injured student or sponsor?
- Has the school district approval been received?
- Is it necessary to have a meeting with parents?

(√) Purpose of the Investigation

- Have objectives (TEKS) for the investigation been determined?
- Does the field investigation integrate with other subjects?
- Do students have sufficient background knowledge to be successful?
- Are activities planned so students will be actively engaged in learning?
- If students miss other classes, have their teachers been notified?

(√) Transportation Requirements

- Will school district or public transportation be used?
- Is it necessary to raise money to pay for transportation?
- Has transportation information been given to parents?
- Are transportation permission field trip forms required by the school district?
- Is additional insurance required by the school district for field trips?
- Have arrangements been made if a vehicle breaks down?

(√) Student Preparations

- Have students been notified of the type of clothing and shoes to wear?
- Has an information letter been sent to parents?
- Have medical forms, parental consent forms, etc. been given to students?
- Are deadlines for returning forms been set?
- Have student behavior expectations been established?

MICROSCALE CHEMISTRY GUIDE

A pilot study, conducted by the Tyler Junior College chemistry department (the site of the South Central Regional Microscale Chemistry Center, SCRMC), involved using a microscale technique in place of the macroscale procedure for determining boiling points which had been in their laboratory manual for a number of years. Due to the large number of students in the program (approximately 200/semester), the original experiment, which called for 5 milliliters of both a known and unknown (to the student) organic liquid generated almost 2 liters of organic waste. The semester that the microscale technique was used, less than 50 milliliters total of organic waste was collected. The experimental accuracy appeared to be at least as good if not better than the previous macroscale procedure.

To illustrate the advantages of using the microscale technique, a boiling point investigation is included paralleling the original macroscale procedure previously used with a microscale procedure.

EQUIPMENT REQUIREMENTS

Using Hot Plates as Heat Source		Using Bunsen Burners as Heat Source	
Equipment	Quantity	Equipment	Quantity
Thermometer	24	Iron ring	24
Ring stand	24	Wire gauze	24
Test tube clamp	24	Bunsen burner	24
Stirring rod	24	Rubber tubing (2')	24
Capillary tube	24	Strikers	24
Hot Plate	24		
Test tube	24		
Beaker	24		

(these materials not needed if using hot plates)

COMPARISON OF APPROXIMATE COST

Materials	Quantity	Cost	Materials	Quantity	Cost
16 x 150mm test tube	24	\$0.55	6 x 50mm test tube	24	\$0.04
400mL beaker	24	\$3.95	50mL beaker	24	\$3.03
	Subtotal	\$90.00		Subtotal	\$68.60

SAFETY ADVANTAGES

The microscale setup uses approximately 25mL of water in the hot water bath where the macroscale requires approximately 250mL of hot water. This reduces the danger of burns from hot water bath spills. Air quality is greatly improved because of the reduction in organic chemicals being vaporized. This should be important to the teacher who is exposed to chemicals during each laboratory period.

In addition, the time required to heat 25mL to the correct temperature takes approximately 1/10 the time required to heat 250mL of water to the same temperature.

CHEMICAL QUANTITY AND COST COMPARISON

Macroscale Technique			Microscale Technique		
Materials	Quantity	Cost	Materials	Quantity	Cost
Acetone (known)	120mL	\$0.55	Acetone (known)	5.0mL	\$0.16
Methanol	25mL	0.35	Methanol	1.0mL	0.04
Isopropanol	25mL	1.25	Isopropanol	1.0mL	0.02
t-Butanol	25mL	0.34	t-Butanol	1.0mL	0.05
Ethanol	25mL	1.00	Ethanol	1.0mL	0.02
Acetone	25mL	1.00	Acetone	1.0mL	0.04
Total	245mL	\$8.94	Total	10mL	\$0.29

POISONOUS PLANT GUIDE

Common Name	Scientific Name	Poisonous Plant Part
Milkweed, Broadleaf	<i>Aesclepias latifolia</i>	sap and young shoots
Milkweed, Antelope Horn	<i>Aesclepias asperula</i>	sap and young shoots
Century Plant	<i>Agave</i> spp.	sap—any part of plant
Ragweed	<i>Ambrosia artemisiifolia</i>	leaves and pollen
Trumpet Creeper	<i>Campsis radians</i>	leaves and flowers
Virgin's Bower	<i>Clematis virginiana</i>	leaves
Water Hemlock	<i>Circuta maculata</i>	roots and young plants
Bull Nettle	<i>Cnidoscopus stimulosus</i>	stinging hairs
Texas Bull Nettle	<i>Cnidoscopus texanus</i>	stinging hairs
Lady's Slipper Orchid	<i>Cypripedium</i> spp.	leaves
Jimsonweed	<i>Datura stramonium</i>	leaves and flowers
Wild Carrot	<i>Dacus carota</i>	leaves
Larkspur	<i>Delphinium ajacis</i>	leaves and seeds
Horsetail	<i>Equisetum</i> spp.	all parts
Daisy Fleabane	<i>Erigeron canadensis</i>	leaves
Spurge	<i>Euphorbia</i> spp.	milky juice
Wild Poinsettia	<i>Euphorbia heterophylla</i>	milky juice
Yellow Jessamine	<i>Glesemium sempervirens</i>	leaves and stems
Ginko	<i>Ginko biloba</i>	seeds
Western Stinging Nettle	<i>Hesperocnide</i> spp.	stinging hairs
St. John's Wort	<i>Hypericum perforatum</i>	leaves
Juniper	<i>Juniperus virginiana</i>	leaves
Osage Orange	<i>Malcura pomifera</i>	milky juice
Red Mulberry	<i>Morus rubra</i>	leaves, stem
Oleander	<i>Nerium oleander</i>	leaves
Redbird-cactus	<i>Pedilantus tithymaloides</i>	sap

Common Name	Scientific Name	Poisonous Plant Part
Mayapple	<i>Podophyllum peltatum</i>	roots
Primrose	<i>Primula</i> spp.	all parts
Buttercup	<i>Ranunculus</i> spp.	leaves
Dock	<i>Rumex</i> spp.	leaves
Mexican Flame Vine	<i>Senecio confusus</i>	all parts
Poison Oak	<i>Toxicodendron quercrifolia</i>	leaves
Poison Ivy	<i>Toxicodendron radicans</i>	leaves
Poison Sumac	<i>Toxicodendron vernix</i>	all parts
Clover, Alsike	<i>Trifolium hybridum</i>	leaves
Chinese Tallow	<i>Sapium sebiferum</i>	leaves and berries
Cardinal Flower	<i>Lovelia cardinalis</i>	all parts
Carolina Horsenettle	<i>Solanum carolinense</i>	all parts
Silver Nightshade	<i>Solanum eleagnifolium</i>	all parts
Elderberry	<i>Sambucus canadensis</i>	all green parts
Mescal Bean	<i>Sophora secundiflora</i>	all parts
Mistletoe	<i>Phoradendron serotinum</i>	all parts
Oak	<i>Quercus</i> spp.	young shoots and acorns
Peyote	<i>Lophophora williamsii</i>	cactus tops
Pokeweed	<i>Phytolacca americana</i>	all parts
White Snakeroot	<i>Eupatorium rugosium</i>	all parts
Virginia Creeper	<i>Parthenocissus quinquefolia</i>	all parts
Yaupon Holly	<i>Ilex vomitoria</i>	berries

TOOLS FOR INQUIRY AND INVESTIGATIONS REQUIRED IN THE TEXAS ESSENTIAL KNOWLEDGE AND SKILLS FOR SCIENCE

*Required Tools	Grade Level								
	K	1	2	3	4	5	6	7	8
Balances	√	√	√	√	√	√	√	√	√
Beakers							√	√	√
Bowls	√								
Calculators				√	√	√	√	√	√
Cameras				√	√	√			
Clocks		√	√	√					
Collecting Nets						√			
Compasses				√	√	√	√	√	
Computers	√	√	√	√	√	√	√	√	√
Computer Probes							√	√	√
Cups	√								
Dissecting Equipment							√	√	√
Field Equipment							√	√	√
Graduated Cylinders							√	√	√
Hand Lenses	√	√	√	√	√	√			
Hot Plates						√	√	√	√
Magnets				√	√	√	√	√	
Measuring Cups			√						
Meter Sticks			√	√	√	√	√	√	√
Microscopes				√	√	√	√	√	√
Petri Dishes							√	√	√
Rulers			√	√	√	√			
Safety Goggles				√	√	√	√	√	√
Spring Scales							√	√	√
Sound Recorders				√	√	√	√		
Telescope							√	√	√
Thermometers		√	√	√	√	√	√	√	√
Test Tubes							√	√	√
Timing Devices					√	√	√	√	√
Water Testing Kits									√
Weather Instruments							√	√	√

*The tools required from Kindergarten through Grade 8 are specified in Knowledge and Skills (4) of the Texas Essential Knowledge and Skills (TEKS) for Science. These tools are necessary for students to know and understand the science concepts and be able to do the science processes required at a grade level.

SCIENCE FACILITY SAFETY CHECKLIST

The science facilities in your school should be checked annually to ensure a safe learning environment for you and your students. A copy of the Science Facility Safety Checklist should be filed with the building principal and district science coordinator so that appropriate action can be taken to correct any problem.

Notification should be made in writing if a hazard is identified that could jeopardize the safety of an individual.

ACCESSIBILITY STANDARDS (IDEA)

Facilities	√	√	√
	Yes	No	N/A
• Eye/face wash station compliant			
• Safety shower compliant			
• Laboratory work station compliant			

COMMUNICATION SYSTEM

	√	√	√
	Yes	No	N/A
• Intercom system available			
• Phone accessible and nearby			

FIRE PROTECTION

	√	√	√
	Yes	No	N/A
Fire Extinguishers			
• Combination ABC dry chemical extinguisher in laboratory rooms			
• Combination BC extinguisher in preparatory rooms			
• Extinguishers checked quarterly with safety seal intact			
• Located near exit, clearly visible, and marked with a sign			
Class D Fire Extinguishing (flammable solids)			
• Extinguisher properly charged			
• Extinguisher present in laboratory rooms using metals (sodium, potassium)			
Fire Blankets			
• Standard fire proof woolen blankets in each laboratory room			
• Blankets located eye-level, clearly visible, and marked with a sign			
Fire or Emergency Exits			
• Two emergency exits in each laboratory room			
• Two emergency exits in chemical storage and preparatory rooms			
• Emergency exits unobstructed and unlocked to traffic moving out of the room			
Other Fire Protection			
• Exit signs clearly visible			
• Emergency lights available in rooms without exterior windows			
• General fire alarm system functioning for building			
• Posted fire drill procedures in laboratory and classrooms			
• 4-9 liter container of dry sand or cat litter in laboratory rooms			

CHEMICAL STORAGE ROOM

	√	√	√
	Yes	No	N/A
General Chemical Storage Areas			
• Combination BC dry chemical extinguisher in chemical storage rooms			
• Extinguishers checked quarterly with safety seal intact			
• Located near exit, clearly visible, and marked with a sign			
Class D Fire Extinguishing (flammable solids)			
• Extinguisher properly charged			
• Extinguisher present in rooms using metals (sodium, potassium)			
Fire Blankets			
• Standard fire proof woolen blankets in each chemical storage room			
• Blankets located eye-level, clearly visible, and marked with a sign			
Fire or Emergency Exits			
• Two emergency exits in chemical storage and preparatory rooms			
• Emergency exits unobstructed and unlocked to traffic moving out of the room			
Other Fire Protection			
• Exit signs clearly visible			
• Emergency lights available in rooms without exterior windows			
• General fire alarm system functioning for building			
• Posted fire drill procedures in storage rooms			
• 4-9 liter container of dry sand or cat litter in laboratory rooms			
• Utility carts available to transport chemicals			

PREPARATION AND EQUIPMENT STORAGE ROOMS

	√	√	√
	Yes	No	N/A
General Storage Requirements			
• Combination BC extinguisher in preparatory rooms			
• Work surface of nonporous chemical resistant materials			
• Large sink with hot water available			
• Emergency shower accessible			
• Materials Safety Data Sheets (MSDS) available			
• Room well lighted and clutter free			
• Space to store chemicals			
• Chemical waste container and broken glass container available			
• Doors with locks			
• Smoke detectors present			
• Refrigerator marked "For Chemical Storage Only--No Food Allowed"			
• Adequate storage space (15 square feet/student recommended)			

LABORATORY ROOM

	√	√	√
	Yes	No	N/A
Laboratory Work Stations			
• Number of students do not exceed the number of work stations			
• Work surfaces nonporous and chemical resistant			
• Movement is unobstructed around work stations (one ADA compliant)			
Master Utility Controls			
• Natural gas shut-off valve present, labeled with room identification			
• Electrical shut-off valve present, labeled with room identification			
• Water shut-off valve present, labeled with room identification			
Fume Hood			
• In laboratory rooms where hazardous chemicals used (ADA compliant)			
• Hood not used for storage			
• Correct air movement provided at hood face			
• Hood vented to outside above roof level away from vents			
• Located away from doors and windows			
Spill Control Kits			
• Chemical spill kits available			
• Bucket of sand or absorbent clay (cat litter) present			
Sinks			
• One available for every 4 students (15" x 15" minimum size)			
• One equipped with hot water			
• 5% of sinks ADA compliant			
Ventilation			
• Forced floor to ceiling			
• 6 changes per hour			
• Emergency exhaust fan available			
General Safety Requirements			
• 45 square feet/student of space			
• Safety rules posted and visible			
• Space for chemical storage			
• Materials Safety Data Sheets readily accessible			
• Broken glass container present			
• Doors equipped with locks			
• Appropriate safety signs posted			
• Facilities available for handicapped students			

PERSONAL PROTECTION

	√	√	√
	Yes	No	N/A
Emergency Showers			
• Shower (ADA compliant) present in chemistry laboratory rooms			
• Shower unobstructed			
• Valve handle functional			
• Floor drain present			
Eye/face wash Stations			
• Available in all laboratory rooms			
• Stations clearly marked			
• Provides simultaneous tepid (60-90°F) water treatment to both eyes			
• Stations flushed for 5 minutes each week			
Protective Clothing			
• Laboratory aprons or coats available for each student and teacher			
• Gloves (acid resistant & heat resistant) available			
Safety Goggles			
• Approved ANSI safety goggles available for each student and teacher			
• Means of disinfecting goggles after use available			
• Face shields available when necessary			
First Aid			
• Kits available in each laboratory room			
• Kits clearly marked and visible			
• Kits checked on a regular basis and supplies replenished			
• Located near a sink			

ELECTRICAL SAFETY

	√	√	√
	Yes	No	N/A
Electrical System			
• Electrical outlets equipped with grounding connections (GFCI)			
• Sufficient electrical outlets to eliminate extension cords			
• Electrical outlets located away from water source (faucets, sinks)			
• Electrical system equipped with accessible circuit breaker box			
• Circuit breakers identified by area or item control			

This information represents an assessment of the school's science facilities.

teacher

date

APPENDIX F

HAZARDOUS CHEMICALS LIST

The Environmental Protection Agency
Acutely Hazardous Chemicals List

THE ENVIRONMENTAL PROTECTION AGENCY'S ACUTELY HAZARDOUS CHEMICALS LIST

CAS Number	Chemical Name	CAS Number	Chemical Name
107-20-0	Acetaldehyde, chloro-	506-77-4	Cyanogen chloride
591-08-2	Acetamide, N-(aminothioxomethyl)-	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
640-19-7	Acetamide, 2-fluoro-	542-88-1	Dichloromethyl ether
62-74-8	Acetic acid, fluoro-, sodium salt	696-28-6	Dichlorophenylarsine
591-08-2	1-Acetyl-2-thiourea	60-57-1	Dieldrin
107-02-8	Acrolein	692-42-2	Diethylarsine
116-06-3	Aldicarb	311-45-5	Diethyl-p-nitrophenyl phosphate
309-00-2	Aldrin	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
107-18-6	Allyl alcohol	55-91-4	Diisopropylfluorophosphate (DFP)
20859-73-8	Aluminum phosphide	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-
2763-96-4	5-(Aminomethyl)-3-isoxazolol		1,4,4a,5,8,8a,-hexahydro-, (1alpha, 4alpha, 4abeta, 5alpha, 8alpha, 8abeta)-
504-24-5	4-Aminopyridine	465-73-6	1,4,5,8-Dimethanonaphthalen, 1,2,3,4,10,10,hexa-chloro-
131-74-8	Ammonium picrate		1,4,4a,5,8,8a-hexahydro-, (1alpha, 4alpha, 4abeta, 5beta, 8beta, 8abeta)-
7803-55-6	Ammonium vanadate	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexa-chloro-
506-61-6	Argentate (1-), bis(cyano-C)-, potassium		1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta, 6beta,6aalpha,7beta,7aalpha)-
7778-39-4	Arsenic acid	72-20-8	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-
1327-53-3	Arsenic oxide		1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha, 6alpha,6abeta,7beta,7aalpha)-& metabolites
1303-28-2	Arsenic pentoxide	60-51-5	Dimethoate
1327-53-3	Arsenic trioxide	122-09-8	alpha,alpha-Dimethylphenethylamine
692-42-2	Arsine, diethyl-		4,6-Dinitro-o-cresol, & salts
696-28-6	Arsonous dichloride, phenyl-	534-52-1	2,4-Dinitrophenol
151-56-4	Aziridine	51-28-5	Dinoseb
75-55-8	Aziridine, 2-methyl-	88-85-7	Diphosphoramide, octamethyl-
542-62-1	Barium cyanide	152-16-9	Diphosphoric acid, tetraethyl ester
106-47-8	Benzeneamine, 4-chloro-	107-49-3	Disulfoton
100-01-6	Beneneamine, 4-nitro-	298-04-4	Dithiobiuret
100-44-7	Benzene, (chloromethyl)-	541-53-7	Endosulfan
51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-	115-29-7	Endothal
12-09-8	Benzeneethanamine, alpha, alpha-dimethyl-	145-73-3	Endrin & metabolites
108-98-5	Benzenethiol	72-20-8	Epinephrine
100-44-7	Benzyl chloride	51-43-4	Ethanedinitrile
7440-41-7	Beryllium powder	460-19-5	Ethanimidothioic acid
598-31-2	Bromoacetone	16752-77-5	Ethyl cyanide
357-57-3	Brucine	107-12-0	Ethyleneimine
39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-O-[(methylamino)carbonyl]oxime	151-56-4	Famphur
592-01-8	Calcium cyanide	52-85-7	Fluorine
75-15-1	Carbon disulfide	7782-41-4	
75-44-5	Carbonic dichloride		
107-20-0	Chloroacetaldehyde		
106-47-8	p-Chloroaniline		
5344-82-1	1-(o-Chlorophenyl)thiourea		
542-76-7	3-Chloropropionitrile		
544-92-3	Copper cyanide		
	Cyanide salts (soluble)		
460-19-5	Cyanogen		

HAZARDOUS CHEMICALS LIST

Appendix F

CAS Number	Chemical Name	CAS Number	Chemical Name
640-19-7	Fluoroacetamide	dinitro-	
62-74-8	Fluoroacetic acid, sodium salt	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt
628-86-4	Fulminic acid, mercury(2+) salt	62-38-4	Phenylmercury acetate
76-44-8	Heptachlor	103-85-5	Phenylthiourea
757-58-4	Hexaethyl tetraphosphate	298-02-2	Phorate
79-19-6	Hydrazinecarbothioamide	75-44-5	Phosgene
60-34-4	Hydrazine, methyl-	7803-51-2	Phosphine
74-90-8	Hydrocyanic acid	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
74-90-8	Hydrogen cyanide	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
7803-51-2	Hydrogen phosphide	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)methyl] ester
465-73-6	Isodrin	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2 oxoethyl]ester
2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
62-38-4	Mercury, (aceto-O)phenyl-	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
628-86-4	Mercury fulminate	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
62-75-9	Methanamine, N-methyl-N-nitroso-	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
624-83-9	Methane, isocyanato-	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
542-88-1	Methane, oxybis(chloro-	78-00-2	Plumbane, tetraethyl-
509-14-8	Methane, tetranitro-	151-50-8	Potassium cyanide
75-70-7	Methanethiol, trichloro-	506-61-6	Potassium silver cyanide
115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexafluoro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	116-06-3	Propanal, 2-methyl-2-(methylthio)-O-[(methylamino)carbonyl] oxime
76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	107-12-0	Propanenitrile
16752-77-5	Methomyl	542-76-7	Propanenitrile,3-chloro
60-34-4	Methyl hydrazine	75-86-5	Propanenitrile, 2-hydroxy-2-methyl
624-83-9	Methyl isocyanate	55-63-0	1,2,3-Propanetriol, trinitrate
75-86-5	2-Methylactonitrile	598-31-2	2,Propanone, 1-bromo
298-00-0	Methyl parathion	107-19-7	Propargyl alcohol
86-88-4	alpha-Naphthylthiourea	107-02-8	2-Propenal
13463-39-3	Nickel carbonyl	107-18-6	2-Propen-1-ol
557-19-7	Nickel cyanide	75-55-8	1,2-Propylenimine
54-11-5	Nicotine & salts	107-19-7	2-Propyn-1-ol
10102-43-9	Nitric oxide	504-24-5	4-Pyridinamine
100-01-6	p-Nitroaniline	54-11-5	Pyridine,3-(1-methyl-2-pyrrolidinyl)- & salts
10102-44-0	Nitrogen dioxide	12039-52-0	Selenious acid, dithallium (1+) salt
10102-43-9	Nitrogen oxide	630-10-4	Selenourea
55-63-0	Nitroglycerine	506-64-9	Silver cyanide
62-75-9	N-Nitrosodimethylamine	26628-22-8	Sodium azide
4549-40-0	N-Nitrosomethylvinylamine	143-33-9	Sodium cyanide
20816-12-0	Osmium oxide	57-24-9	Strychnidin-10-one, & salts
20816-12-0	Osmium tetroxide	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
145-73-3	7-Oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid	57-24-9	Strychnine, & salts
56-38-2	Parathion	7446-18-6	Sulfuric acid, dithallium (1+) salt
131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-		
51-28-5	Phenol, 2,4-dinitro-		
534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts		
88-85-7	Phenol, 2-(1-methylpropyl)-4,6-		

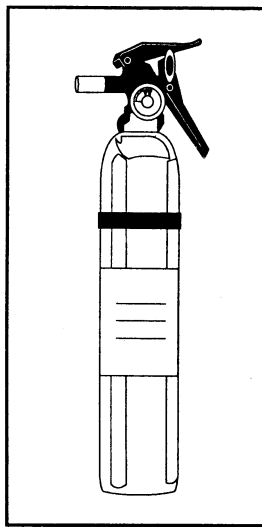
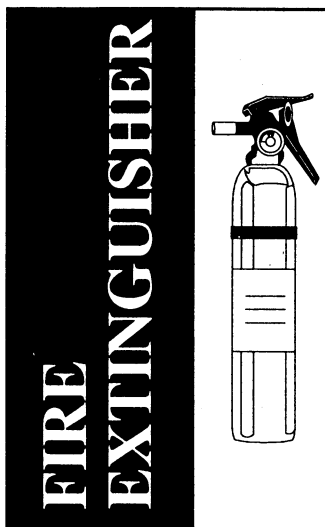
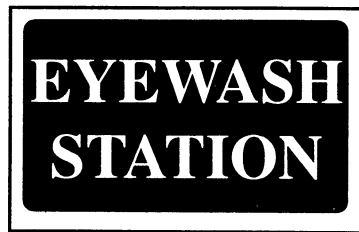
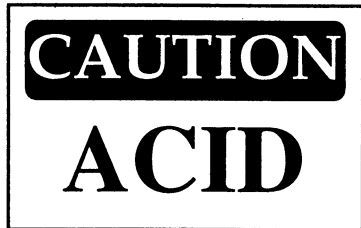
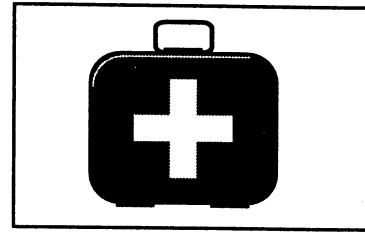
CAS Number	Chemical Name	CAS Number	Chemical Name
3689-24-5	Tetraethyldithiopyrophosphate		
78-00-2	Tetraethyl lead		
107-49-3	Tetraethyl pyrophosphate		
509-14-8	Tetranitromethane		
757-58-4	Tetraphosphoric acid, hexaethyl ester		
1314-32-5	Thallic oxide		
12039-52-0	Thallium(I) selenite		
7446-18-6	Thallium(I) sulfate		
3689-24-5	Thiodiphosphoric acid, tetraethyl ester		
39196-18-4	Thiofanox		
541-53-7	Thioimidodicarbonic diamide		
108-98-5	Thiophenol		
79-19-6	Thiosemicarbazide		
5344-82-1	Thiourea, (2-chlorophenyl)-		
86-88-4	Thiourea, 1-naphthalenyl-		
103-85-5	Thiourea, phenyl-		
8001-35-2	Toxaphene		
75-70-7	Trichloromethanethiol		
7803-55-6	Vanadic acid, ammonium salt		
1314-62-1	Vandium oxide		
1314-62-1	Vanadium pentoxide		
4549-40-0	Vinylamine, N-methyl-N-nitroso-		
81-81-2	Warfarin, & salts, greater than 0.3%		
557-21-1	Zinc cyanide		
1314-84-7	Zinc phosphide		

APPENDIX G

SAFETY SYMBOLS

Examples of Common Safety Symbols
Fire Extinguishers and Agents
National Fire Protection Association (NAFPA) Hazard Labels

EXAMPLES OF COMMON SAFETY SYMBOLS



FIRE EXTINGUISHERS AND AGENTS



Class A
Extinguishers
(green triangle)



Class B
Extinguishers
(red square)















Class C
Extinguishers
(blue circle)



Class D
Extinguishers
(yellow star)

Fire Extinguishers and Agents

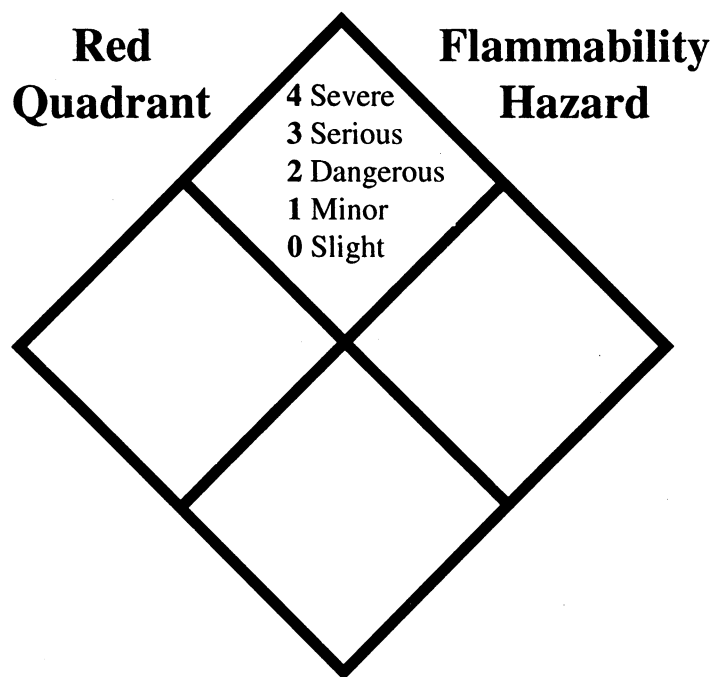
Suitable for Use on This Type Fire	Agent Characteristics	Horizontal Range	Discharge Time
	Regular Dry Chemical Sodium Bicarbonate Discharges white cloud Leaves residue Non-freezing	5-20'	8-25 seconds
 or 	Multipurpose Dry Chemical Ammonium Phosphate Discharges Yellow cloud Leaves residue Non freezing	5-20'	8-25 seconds
	Purple-K Dry Chemical Potassium Bicarbonate Discharges blue cloud Leaves residue Non-freezing	5-20'	8-25 seconds
	KCl Dry Chemical Potassium Chloride Discharges white cloud Leaves residue Non-freezing	5-20'	8-25 seconds
	Carbon Dioxide Inert carbon dioxide gas Discharges cold white cloud Leaves no residue Non-freezing	3-8'	8-30 seconds
	Halogenated Agent Halogenated hydrocarbons Discharges white vapor Leaves no residue Non-freezing	4-8'	8-10 seconds

Suitable for Use on This Type Fire	Agent Characteristics	Horizontal Range	Discharge Time
	Water Tap water with corrosive inhibitor Discharges spray or stream Leaves yellow residue Protect from freezing	30-40'	1 minute
	Anti-freeze Solution Calcium Chloride Discharges spray or stream Leaves residue Non-freezing	30-40'	1 minute
	Loaded Stream Alkali-Metal-Salt Discharges spray or stream Leaves residue Non-freezing	30-40'	1 minute
	Foam Water and Detergent Discharges foamy solution Leaves powder residue Non-freezing	10-15'	24 minutes
	Dry Powder Special Compound Sodium Chloride or Graphite materials Discharges in stream Leaves residue Non-freezing	5-20'	25-30 seconds

Using a Fire Extinguisher

1. Extinguishers must be located and marked to be easily seen and the area around the extinguisher must be kept clean
2. Regular inspections and tagging or marking of inspection dates is essential.
3. Gauges should be checked for readings to insure that unit is functional.
4. Pressurized units are considered as "unfired pressure vessels" and require periodic static pressure tests in accordance with NFPA Codes.
5. Users must be well trained in their use. This requires hands-on and repeated training.
6. Water-type extinguishers must never be used on electrical or metal fires.

National Fire Protection Association NFPA Hazard Label



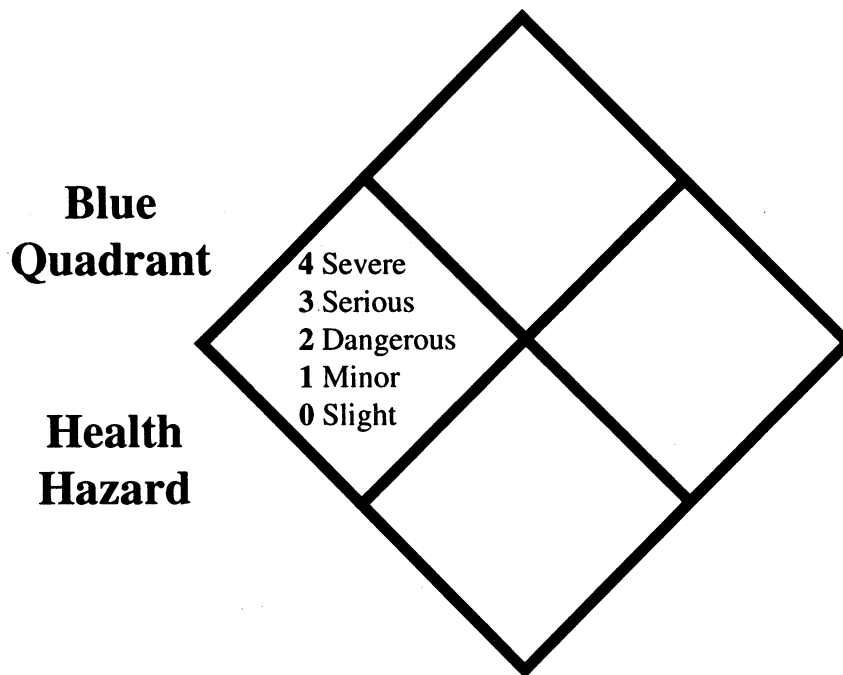
NFPA Hazard Ratings: Flammability

NFPA Rating	Description	Flash Point
4	Materials that will rapidly or completely vaporize at atmospheric pressure and normal temperatures or that are readily dispersed in air, and that will burn readily. This rating includes: <ul style="list-style-type: none"> • very flammable gases • extremely volatile liquids • dust that readily burns or explodes when dispersed in the air 	below 22.8° C
3	Liquids and solids that can be ignited under all temperature conditions. These produce hazardous atmospheres with air under all temperatures. This rating includes: <ul style="list-style-type: none"> • liquids which vaporize enough to ignite under normal conditions • solids that ignite spontaneously 	between 22.8° C and 37.7° C
2	Materials that must be moderately heated or exposed to high temperatures before ignition occurs. These materials would not form hazardous atmospheres under normal conditions. This rating includes: <ul style="list-style-type: none"> • liquids which must be moderately heated to ignite. • solids and semisolids that readily give off flammable vapors. 	liquids between 37.7° C and 200° C
1	Materials that must be preheated before ignition can occur. These require considerable preheating, under all temperature conditions. This rating includes most ordinary combustible materials.	200° C
0	Materials that do not burn. This rating includes materials that will not burn in air or when exposed to a temperature of 1500° C for a period of 5 minutes.	1500° C

National Fire Protection Association

NFPA

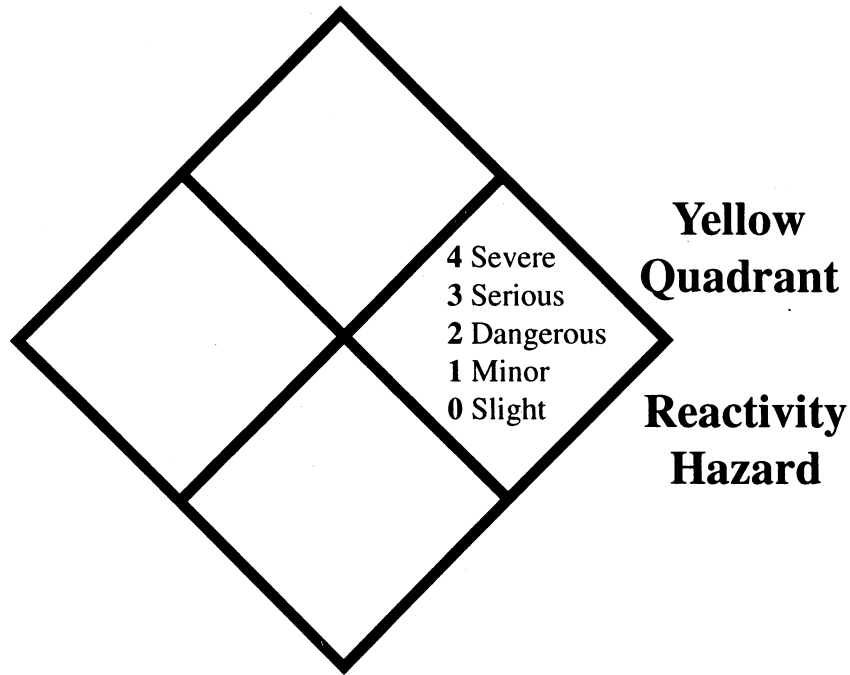
Hazard Label



NFPA Hazard Ratings: Health

NFPA Rating	Description
4	Materials that could cause death or major residual injury. This rating includes: <ul style="list-style-type: none"> • materials that can penetrate ordinary rubber protective clothing. • materials, under normal conditions or fire conditions, give off gases that are toxic or corrosive through inhalation or contact with the skin.
3	Materials that, upon short exposure, could cause serious temporary or residual injury. This rating includes: <ul style="list-style-type: none"> • materials giving off highly toxic combustion products. • materials corrosive to living tissue or toxic by skin absorption.
2	Materials, that on intense or continued exposure, cause temporary incapacitation or residual injury. This rating includes: <ul style="list-style-type: none"> • materials giving off toxic combustion products. • materials giving off highly irritating combustion products. • materials under normal conditions or fire conditions, give off toxic vapors.
1	Materials that on exposure cause irritation by only minor residual injury. This rating includes: <ul style="list-style-type: none"> • materials under fire conditions would give off irritating combustion products. • materials on the skin cause irritation without destruction of tissue.
0	Materials that on exposure under fire conditions would offer no hazard beyond that of combustible material.

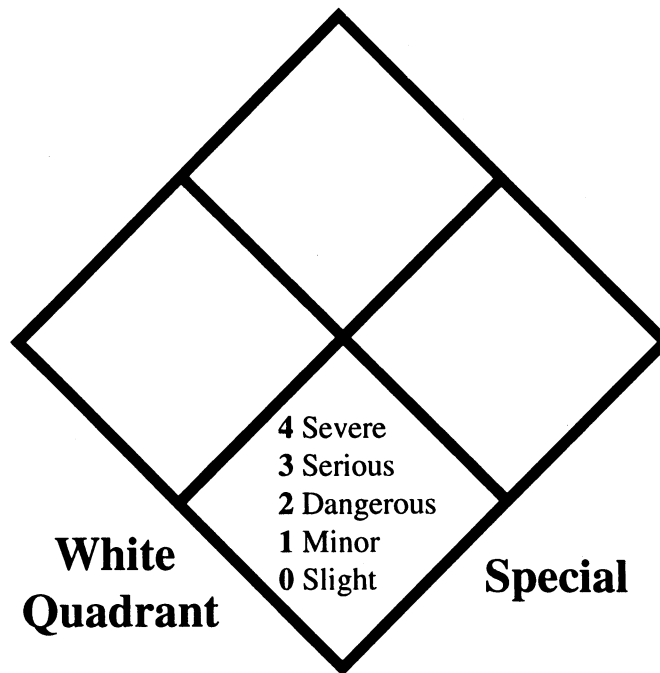
National Fire Protection Association NFPA Hazard Label



NFPA Hazard Ratings: Reactivity

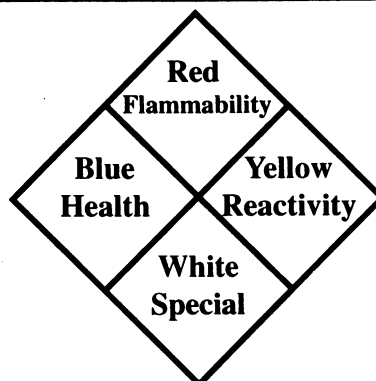
NFPA Rating	Description
4	Materials that are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. This rating includes materials that are sensitive to thermal shock at normal temperatures and pressures.
3	Materials that are capable of detonation or explosive reaction but that require a strong initiating source or that must be heated under confinement before initiation. This rating includes materials that are sensitive to shock at elevated temperatures and pressures or that react explosively with water without requiring heat or confinement.
2	Materials that are normally unstable and readily undergo violent chemical change but do not detonate. This rating includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures or undergo violent chemical change at elevated temperatures and pressures. Also includes materials that react violently with water or which may form potentially explosive mixtures with water.
1	Materials that are normally stable, but that can become unstable at elevated temperatures and pressures or that may react with water with some release of energy by not violently.
0	Materials that are normally stable, even under fire exposure conditions and are not reactive with water.

National Fire Protection Association NFPA Hazard Label



NFPA Hazard Ratings: Special

NFPA Rating	Description
OX	Denotes materials that are oxidizing agents. These compounds give up oxygen readily, remove hydrogen easily, remove hydrogen from other compounds, or attract negative electrons.
W	Denotes materials that are water-reactive. These compounds undergo rapid energy releases on contact with water.



APPENDIX H

MATERIALS AND SAFETY EQUIPMENT

Elementary Lists

Kindergarten
Grade 1
Grade 2
Grade 3
Grade 4
Grade 5

Middle School Lists

Grade 6
Grade 7
Grade 8

High School Lists

Integrated Physics and Chemistry
Biology
Chemistry
Physics
Geology, Meteorology, Oceanography

KINDERGARTEN MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balances (1 per 2 students)
- Bowls, plastic (1 per student)
- Computers (1 per classroom)
- Cups, paper or plastic (1 per student)
- Hand lenses (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium and accessories (1 per classroom)
- Clock (1 per classroom)
- Egg incubator (1 per classroom)
- Terrarium and accessories (1 per classroom)

Small Equipment

- Beakers, plastic, 250 mL (2 per student)
- Cars, toys with removable parts (1 per 2 students)
- Construction set (1 per 4 students)
- Eye droppers, plastic (1 per 2 students)
- Colored geometric shapes set (1 set per 2 students)
- Lamp or light source (1 per 4 students)
- Magnet sets (1 per 2 students)
- Thermometer with backing, non-rolling, non-mercury (1 per student)
- Various noise making devices (1 per student)

Consumables

- Aluminum foil
- Bags, plastic with zipper seals
- Crayons, wax
- Nails, small
- Paper, construction
- Paste
- Scissors, primary
- Soil samples
- Soil, potting
- Spoons, plastic
- String for measurement
- Textured materials, such as sand paper, silk, etc. (1 set per 2 students)

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Audio-Visuals

- Graph, personal growth

Safety Equipment

Required

- Eyewash (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Materials Safety Data Sheets (1 set per school)
- Safety goggles (1 pair per student)
- Goggle disinfecting equipment or materials: soap and water, bleach solution, hot water (1 set per classroom)

Recommended

- Transport cart (1 per classroom)
- Sink (1 per classroom)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

FIRST GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Hand lenses (1 per student)
- Clock with second hand (1 per classroom)
- Computers (at least 1 per classroom)
- Balances (1 per 2 students)
- Thermometer with backing, non-rolling, non-mercury (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Egg incubator (1 per classroom)
- Terrarium and accessories (1 per classroom)

Small Equipment

- Beakers, plastic, 250 mL (1 per student)
- Bodkin needle and thread (1 per 2 students)
- Bowls, plastic (1 per student)
- Construction blocks (1 set per 2 students)
- Eyedroppers, plastic (1 per student)
- Geometric shapes set, colored (1 set per 2 students)
- Lamp or light source (1 per 4 students)
- Magnet set (1 set per 2 students)
- Metal samples including iron (1 set per 2 students)
- Various noise-making devices (1 per student)
- Metric rulers (1 per student)

Living/Preserved Specimens

- Animals and plants
- Seeds such as peas, corn and beans

Audio-Visuals

- Graph, pictorial (1 per classroom)
- Video, Sources of Water (1 per classroom)

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Consumables

- Aluminum foil
- Bags, plastic with zipper seals
- Bowls, plastic
- Crayons, wax
- Cups, paper
- Cups, plastic
- Ice source
- Nails, small
- Measuring objects (string, paper clips, washers)
- Paper, construction
- Paste
- Rock samples (1 set per 2 students)
- Scissors, primary
- Soil, potting
- Spoons, plastic
- Soil samples: sand, silt, clay, loam (1 set per 2 students)
- Textured objects, such as sand paper, silk, wax paper (1 set per 2 students)

Safety Equipment

Required

- Eyewash (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Safety goggles (1 pair per student)
- Goggle disinfecting materials or equipment, including soap and water, bleach solution, hot water (1 set per classroom)
- Materials Safety Data Sheets (1 set per school)

Recommended

- Transport cart (1 per classroom)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

SECOND GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balances (1 per 2 students)
- Clock, with second hand (1 per classroom)
- Computers (at least 1 per classroom)
- Hand lenses (1 per student)
- Measuring cups (1 set per 4 students)
- Meter sticks (1 per 4 students)
- Rulers, metric (1 per student)
- Thermometer, non-mercury (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Egg incubator (1 per classroom)
- Terrarium and accessories (1 per classroom)

Small Equipment

- Beakers, plastic, 250 mL (2 per student)
- Cars, toy (1 set per classroom)
- Eyedroppers, plastic (1 per student)
- Fan, small (1 per classroom)
- Flashlight with batteries and bulb (1 per 2 students)
- Lamp or other light source (1 per 2 students)
- Magnet sets (1 per 2 students)
- Musical instruments, rhythm band (1 set per classroom)
- Nail and hammer (1 per classroom)
- Rock sample set: sedimentary, igneous, and metamorphic (1 per 2 students)
- Thermometer, outdoor (1 per classroom)

Audio-Visuals

- Chart - Constellation, simple
- Chart - Growth
- Chart - Water cycle
- Chart - Wind speed
- Graphs, pictorial

Living/Preserved Specimens

- Animals and plants
- Seeds such as peas, corn and beans

Consumables

- Aluminum foil
- Bags, plastic with zipper seals
- Crayons, wax
- Cups, paper
- Measuring objects, including paper clips, string, washers, bolts
- Nails, small
- Paper, construction
- Paste
- Scissors, primary (1 per student)
- Soil, potting
- Spoons, plastic
- Soil samples: clay, loam, silt, sand (1 set per 2 students)

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Safety Equipment

Required

- Eyewash (2 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Safety goggles (1 pair per student)
- Goggle disinfecting materials or equipment, including soap and water, bleach solution, hot water (1 set per classroom)
- Materials Safety Data Sheets (1 set per school)

Recommended

- Sink (1 per 4 students)
- Transport cart (1 per classroom)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

THIRD GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balances, pan (1 per 2 students)
- Calculators (1 per student)
- Cameras, disposable (1 per 2 students)
- Clock with second hand (1 per classroom)
- Compasses, magnetic (1 per 2 students)
- Computer (at least one per classroom)
- Hand lenses (1 per student)
- Magnet sets (1 per 2 students)
- Meter sticks (1 per 4 students)
- Microscopes (1 per 4 students)
- Rulers, metric (1 per student)
- Sound recorders (1 per classroom)
- Thermometer, non-mercury (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Egg incubator, egg (1 per classroom)
- Inclined plane (1 per 4 students)
- Microscopes, stereo (1 per 2 students)
- Planetarium, hand-held (1 per classroom)
- Terrarium with accessories (1 per classroom)

Small Equipment

- Beakers, graduated, plastic, 250 mL (2 per student)
- Car, wooden toy (1 per 2 students)
- Cylinders, graduated, plastic, 100 mL (1 per 2 students)
- Eye dropper (1 per student)
- Graphing boards (1 per classroom)
- Graphing mats (1 per classroom)
- Lamp, aluminum reflector and bulb (1 per 4 students)
- Rock and mineral samples (1 per 2 students)
- Hardness test, triangular file (1 per 2 students)
- Thermometers, outdoor (1 per classroom)
- Yo-yo (1 per 2 students)

**Recommended Equipment

Living/Preserved Specimens

- Animals and plants
- Seeds such as peas, corn and beans

Audio-Visuals

- Charts - Growth
- Charts - Renewable, non-renewable and inexhaustible resources
- CD-ROM, Video - earthquakes and/or glaciers

Consumables

- Aluminum foil
- Bags, plastic with zipper seal
- Balloons
- Clay, modeling
- Crayons, wax
- Cups, paper
- Glue, school
- Magazines for cutting
- Measuring objects: washers, paper clips, chalk
- Nails, small
- Paper, construction
- Paste
- Pencils, colored
- Scissors
- Soil, potting
- Soil samples (1 set per 2 students)
- Spoons, plastic

Safety Equipment

Required

- Eyewash (2 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Goggle disinfecting materials or equipment
- Materials Safety Data Sheets (1 set per school)
- Safety goggles (1 pair per student)

Recommended

- Sink (1 per 4 students)
- Transport cart (1 per classroom)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

FOURTH GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balances (1 per 2 students)
- Calculators (1 per student)
- Cameras, disposable (1 per 2 students)
- Clock with second hand (1 per classroom)
- Compasses, magnetic (1 per 2 students)
- Computer (at least one per classroom)
- Meter sticks (1 per 4 students)
- Microscopes, stereoscopic (1 per 4 students)
- Rulers, metric (1 per student)
- Sound recorders (1 per classroom)
- Thermometer, non-mercury (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Hot plate (1 per classroom)
- Incubator, egg (1 per classroom)
- Terrarium with accessories (1 per classroom)

Consumables

- Aluminum foil
- Bags, plastic with zipper seal
- Clay, modeling
- Crayons, wax
- Cups, paper
- Glue, school
- Nail, small
- Paper, construction
- Paste
- Pencil, colored
- Salt and water for concentrations
- Scissors (1 per student)
- Soil, potting
- Soil samples: clay, loam, sand, silt (1 set per student)
- Spoons, plastic
- Straws
- Sugar cubes

Small Equipment

- Electric circuit kit including knife-blade switch, lamp and base (1 per 2 students)
- Beakers, plastic, graduated:
 - 1000 mL (5 per classroom)
 - 250 mL (2 per student)

- Graphing mat (1 per classroom)
- Lamp, aluminum reflector (1 per 4 students)
- Magnet set (1 set per 2 students)
- Mirrors, plastic (1 per 2 students)
- Spinning top with pump action (1 per 4 students)
- Rocks, limestone samples (1 per student)
- Thermometers, outdoor (1 per classroom)
- Weather vane (1 per classroom)

Living/Preserved Specimens

- Animals and plants
- Seeds such as peas, corn and beans

Charts

- Water cycle
- Clouds
- Geologic time tables
- Wind speed
- Constellations
- Life-cycle of butterfly
- Vinegar

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Videos

- Dinosaurs or other animals from the past
- Video - Streams and rivers
- Video - Volcanoes
- Video - Tides and/or hurricanes

Safety Equipment

Required

- Eyewash (2 per classroom)
- Fire blanket (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Goggle disinfecting materials or equipment
- Materials Safety Data Sheets (1 set per school)
- Safety goggles, splash-proof (1 per student)

Recommended

- Sink (1 per 4 students)
- Transport Cart

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

FIFTH GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balance, triple beam (1 per 2 students)
- Calculator (1 per student)
- Cameras, disposable (1 per 2 students)
- Clock with second hand (1 per classroom)
- Collecting nets(1 per student)
- Compass, magnetic (1 per 2 students)
- Computer (1 per classroom)
- Hand lens (1 per student)
- Hot plate (1 per 4 students)
- Magnet (1 set per 2 students)
- Meter stick (1 per 4 students)
- Microscope, stereoscopic (1 per 4 students)
- Sound recorder (1 per classroom)
- Rulers, metric (1 per student)
- Thermometer, non-mercury (1 per student)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Globe, Earth (1 per classroom)
- Globe, lunar (1 per classroom)
- Egg incubator (1 per classroom)
- Planetarium, hand-held (1 per classroom)
- Terrarium with accessories (1 per classroom)

Small Equipment

- Electric kit: knife-blade switch, lamp and base, electric bell, copper wire, nail (1 per 4 students)
- Beakers, plastic, graduated, 400 mL (1 per student)
- Beakers, Pyrex, graduated:
 - 250 mL (1 per 2 students)
 - 600 mL (1 per 4 students)
- Burner, propane or Bunsen burner (1 per classroom)
- Conductometer (1 per classroom)
- Cylinders, plastic, graduated, 100 mL (1 per 2 students)
- Battery, dry cell, 6 volt (1 per 4 students)
- Eye dropper (1 per student)
- Geologic cross-cut diagram (1 per classroom)
- Iron filings (1 package per 2 students)
- Lamp with aluminum reflector (1 per 4 students)
- Lens, 2 convex (1 set per 2 students)
- Mineral set (1 per 2 students)
- Mirrors, plastic (1 per student)
- pH paper (1 vial per classroom)
- Prism (1 per 2 students)
- Rock sets: sedimentary, igneous, and metamorphic (1 per 2 students)

- Thermometer, outdoor (1 per classroom)
- Tree ring samples (1 set per 4 students)
- Tuning fork and rubber hammer (1 per 2 students)

Consumables

- Aluminum foil
- Bags, plastic with zipper seal
- Baking soda
- Beef bouillon cubes
- Coal
- Coffee can with lids
- Fertilizers
- Glue, school
- Paper, construction
- Paper, simple graphing
- Pencils, colored
- Pots, plants
- Salt
- Scissors
- Soil, potting
- Solar tinting sheets for windows
- Source of ice
- Spoons, plastic
- Sugar
- Vinegar

Living/Preserved Specimens

- Animals and plants
- Seeds such as peas, corn and beans

Charts

- Water cycle
- Carbon cycle
- Coal and oil formation
- Life cycle of tree
- Lunar phases
- Nitrogen cycle
- Tidal schedule

Videos

- Adaptive characteristics of organisms
- Rain forest
- Serengetti

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Safety Equipment

Required

- Aprons (1 per student)
- Eyewash (2 per classroom)
- Fire Blanket (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Goggle disinfecting materials or equipment (1 set per classroom)
- Materials Safety Data Sheets (1 set per school)
- Safety goggles, splash-proof (1 per student)

Recommended

- Sink (1 per 4 students)
- Transport cart (1 per classroom)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

SIXTH GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balances, triple beam (1 per 2 students)
- Beakers, plastic, graduated:
 - 100 mL (1 per student)
 - 250 mL (1 per student)
 - 400 mL (1 per student)
- Calculators (1 per student)
- Compasses, magnetic (1 per 2 students)
- Computer probes (1 set per computer)
- Computers (at least 1 per classroom)
- Field equipment:
 - Insect collecting nets (1 per 2 students)
 - Insect killing jar (1 per 2 students)
 - Insect pins (2 boxes per classroom)
- Graduated cylinders, plastic, graduated:
 - 10 mL (1 per 2 students)
 - 100 mL (1 per 2 students)
- Hot plates (1 per 4 students)
- Magnets (1 set per 2 students)
- Meter sticks (1 per 4 students)
- Microscopes (1 per 4 students)
- Petri dishes (1 set of 4 per 4 students)
- Safety goggles (1 pair per students)
- Spring scales (1 per 4 students)
- Telescope (1 per class)
- Test tubes (6 per 4 students)
- Thermometer, non-mercury (1 per student)
- Timing devices (clocks, stop watches)
- Weather instruments (outdoor thermometer, barometer, sling psychrometer)

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Computer probes (1 per classroom)
- Electric fan (1 per classroom)
- Globe, Earth (1 per classroom)
- Inclined plane with force mechanism (1 per 2 students)
- Lamp, aluminum reflector (1 per 2 students)
- Model, Animal cell (1 per classroom)
- Model, Human torso (1 per classroom)
- Model, Lung (1 per classroom)
- Model, Plant cell (1 per classroom)
- Planetarium showing tilt of Earth on axis (1 per classroom)
- Planetarium, illuminated, hand-held (1 per classroom)
- Steam engine (1 per 4 students)
- Electric generator (1 per 4 students)
- Terrarium with accessories (1 per classroom)
- Incline plane (1 per 2 students)

Small Equipment

- Compasses, magnetic (1 per 2 students)
- Eye droppers (1 per 2 students)
- Games, Food web (1 per classroom)
- Herbarium paper (5 sheets per 2 students)
- Herbarium paste (2 bottles per classroom)
- Hot hands (1 per 2 students)
- Metric rulers (1 per student)
- Microscope slides, blank (2 boxes per classroom)
- Microscope slides, depression (1 per 2 students)
- Microscope cover slips, plastic (2 boxes per classroom)
- pH paper or litmus paper (2 vials per classroom)
- Plant press (1 per classroom)
- Rock samples: sedimentary, igneous, and metamorphic (1 set per 2 students)
- Rods, stirring (1 per 2 students)
- Scissors (1 per student)
- Test tube holder (1 per 2 students)
- Test tube racks (1 per 2 students)
- Thermometer, outdoor (1 per classroom)

Living/Preserved Specimens

- Meal worms, aquatic snails or earthworms
- Plants seeds
- Microscope slides, prepared:
 - muscle cells
 - blood cells
 - nerve cells
 - plant and animal
 - chromosomes stained

Consumables

- Aluminum foil
- Bags, plastic with zipper seal
- Brush, artist
- Clay, modeling
- Compost pile
- Glue, school
- Kitchen chemicals - lemon juice, vinegar, baking soda, ammonia, liquid detergent, carbonated drink, tea, coffee
- Pans, aluminum pie
- Paper, construction
- Paper, simple graphing
- Pencils, colored
- Pots, plant
- Soil, potting
- Spoons, plastic
- Water filtering kit or plastic beakers and filtering material

Videos and CD-ROMs

- Mountain Building
- Volcanic activity
- Solar system: meteorites, comets, asteroids
- Space travel

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Charts and Transparencies

- Energy pyramid
- Rock cycle
- Atmospheric composition
- Clouds
- Composing
- Food pyramid
- Human organ systems
- Production of energy for human use
- Solar system

Safety Equipment**Required**

- Aprons (1 per student)
- Eyewash (3 per classroom)
- Fire blanket (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom))
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 set per classroom)
- Materials Safety Data Sheets (1 set per building)

Recommended

- Sink (1 per 4 students)
- Transport cart (1 per classroom)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

SEVENTH GRADE MATERIALS AND SAFETY EQUIPMENT

*Required Equipment

- Balance, triple beam (1 per 2 students)
- Beakers, plastic
 - 100 mL (1 per student)
 - 250 mL (1 per student)
 - 400 mL (1 per student)
- Calculators (1 per student)
- Compasses, magnetic (1 per 2 students)
- Computer probes (1 set per computer)
- Computers (at least 1 per classroom)
- Dissecting equipment (1 kit per 2 students)
- Field equipment
- Graduated cylinders, plastic
 - 10 mL (1 per 2 students)
 - 100 mL (1 per 2 students)
- Hot plates (1 per 4 students)
- Magnets (1 set per 2 students)
- Meter sticks (1 per 4 students)
- Microscopes, compound (1 per 4 students)
- Plant press (2 per classroom)
- Petri dishes (1 set of 4 per 4 students)
- Safety goggles (1 pair per students)
- Spring scales, 10 N (1 per 4 students)
- Telescopes (1 per class)
- Test tubes (5-6 per 4 students)
- Thermometer, non-mercury (1 per student)
- Timing devices (e.g., clocks, stop watches)
- Weather instruments (1 per classroom)
 - outdoor thermometer
 - barometer,
 - sling psychrometer
 - wind vane
 - rain gauge

Chemicals

- Iron filings
- Sulfur

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

**Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Anemometer (1 per classroom)
- Cart, Mechanical or Dynamic (1 per 2 students)
- Computer probes (1 per classroom)
- Lever system kit (using meter sticks) (1 per 4 students)

- Model, cell (1 per classroom)
- Model, Human skeleton (1 per classroom)
- Model, Human torso (1 per classroom)
- Model, Lung demonstration (1 per classroom)
- Planetarium, hand-held (1 per classroom)
- Pulley kit with suspension system (1 per 4 students)
- Respirometer (1 per classroom)
- Stethoscope (1 per 2 students)
- Stream table kit (1 per classroom)
- Terrarium (1 per classroom)
- Tracks, potential and kinetic (1 per 4 students)

Small Equipment

- Brushes, beaker (1 per 4 students)
- Compasses, magnetic (1 per 2 students)
- Dissecting kit (1 per 2 students)
- Dropping Bottles (1 per student)
- Eye droppers (1 per student)
- Field Guides: Wildflower, Insect, etc. (1 per classroom)
- Flask, Erlenmeyer, 1000 mL (4 per classroom)
- Herbarium paper (5 sheets per 2 students)
- Herbarium paste (2 bottles per classroom)
- Hot hands (1 per 2 students)
- Insect nets (1 per 2 students)
- Insect killing jar (1 per 2 students)
- Insect pins (2 boxes per classroom)
- Lamp, aluminum reflector (1 per 4 students)
- Metric rulers (1 per student)
- Microscope cover slips, plastic (2 boxes per classroom)
- Microscope slides (2 boxes per classroom)
- Microscope slides, depression (1 per 2 students)
- Petri dishes (1 per student)
- Rods, glass, stirring (1 per 2 students)
- Test tube holder (1 per 2 students)
- Test tube racks (1 per 2 students)

Living/Preserved Specimens

- Fish and other animals
- Paramecium and other protists
- Seeds, bulbs, plant cuttings, rhizomes
- Microscope slides, prepared
 - blood cells
 - sperm cells
 - cheek cells

Consumables

- Bags, plastic with zipper seal
- Bottles, thermos (1 per classroom)
- Lamp, aluminum reflector (1 per 4 students)
- Pots
- Soil
- Steel wool (1 bundle per classroom)

- Thermometers, oral, disposable sleeve (1 per 2 students)
- Wood splints

CD-ROM or Video (1 per classroom)

- Emergence of Seeds or Flow of Blood

Charts (1 per classroom)

- Asexual and sexual reproduction
- Ecological succession
- Human body system (digestive, circulatory)
- Periodic Table of Elements
- Photosynthesis
- Renewable/non-renewable/inexhaustible Energy
- Solar system

Safety Equipment**Required**

- Aprons (1 per student)
- Fire blanket (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Materials Safety Data Sheets (1 set per classroom)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 set per classroom)
- Eyewash (3 per classroom)

Recommended

- Transport cart (1 per classroom)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

EIGHTH GRADE MATERIALS AND SAFETY EQUIPMENT

***Required Equipment**

- Balances, triple beam (1 per 2 students)
- Beakers
 - 100 mL (1 per student)
 - 250 mL (1 per student)
 - 400 mL (1 per student)
- Calculators (1 per student)
- Computer probes (1 set per computer)
- Computers (at least 1 per classroom)
- Dissecting equipment (1 kit per 2 students)
- Field equipment
- Graduated cylinders, plastic
 - 10 mL (1 per 2 students)
 - 100 mL (1 per 2 students)
- Hot plates (1 per 4 students)
- Meter sticks (1 per 4 students)
- Microscopes, compound (1 per 4 students)
- Petri dishes (1 set of 4 per 4 students)
- Spring scales, 10N (1 per 4 students)
- Telescope (1 per class)
- Test tubes, 20 mL (6 per 4 students)
- Thermometer, non-mercury (1 per student)
- Timing devices (e.g., clocks, stop watches)
- Water test kits (1 per 4 students)
- Weather instruments

Chemicals

- Acid, dilute Nitric
- Acid, dilute Sulfuric
- Baking soda
- Calcium Chloride
- Phenol Red
- Vinegar

Living/Preserved Specimens

- Invertebrates such as brine shrimp
- Plants, variety
- Seeds with known genetic ratios

Consumables

- Bags, plastic with zipper seal
- Soil, potting

****Recommended Equipment**

Large Equipment

- Anemometer (1 per classroom)
- Aquarium and accessories (1 per classroom)
- Astrolabes (13) (1 per 2 students)
- Globe, Earth (1 per classroom)
- Inclined plane, Hall's carriage, weight hangers and slotted weights (1 per 4 students)
- Lamp, aluminum reflector

- Map of Northern Hemisphere (1 per classroom)
- Collision Ball Demonstrator (1 per classroom)
- Rain gauge (1 per classroom)
- Sling Psychrometer (1 per classroom)
- Stream table and accessories (1 per classroom)
- Terrarium (1 per classroom)
- Thermometer, outdoor (1 per classroom)
- Wind vane (1 per classroom)

Small Equipment

- Calculators (1 per 2 students)
- Dissecting kit (1 per 2 students)
- Eye droppers (1 per student)
- Field Guides (1 set per classroom)
- Flask, 1000 ml (4 per classroom)
- Herbarium paper (2 pug per classroom)
- Herbarium paste (2 per classroom)
- Hot hands (1 per 2 students)
- Insect killing jar (1 per 2 students)
- Insect nets (1 per 2 students)
- Insect pins (2 boxes per classroom)
- Metric rulers (1 per student)
- Microscope cover slips (2 boxes per classroom)
- Microscope slides (2 boxes per classroom)
- Microscope slides, depression (1 per 2 students)
- Plant press (2 per classroom)
- Rock types set (1 set per 2 students)
- Rods, stirring (1 per 2 students)
- Slinky and wave demonstration rope (1 per classroom)
- Static electricity kit (1 per 2 students)
- Test tube holder (1 per 2 students)
- Test tube racks (1 per 2 students)
- Thermometer, oral with disposable sleeves (1 per 2 students)

Charts (1 per classroom)

- Earth's Climatic Zones
- Earth's Prevailing Winds
- Lunar Cycle
- Nitrogen, Carbon, and Water Cycles
- Ocean Currents
- Periodic Table of Elements
- Tides

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Safety Equipment

Required

- Aprons (1 per student)
- Eyewash (3 per classroom)
- Fire blanket (1 per classroom)
- Fire Extinguisher (1 per classroom)
- First Aid Kit (1 per classroom)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment
- Materials Safety Data Sheets (1 set per school)

Recommended

- Transport cart (1 per classroom)
- Sink (1 per classroom)

*Required lists are specified by TEKS at each grade level.

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INTEGRATED PHYSICS AND CHEMISTRY

MATERIALS AND SAFETY EQUIPMENT

*Recommended Equipment

Large Equipment

- Ammeter (1 per 2 students)
- Balance, triple beam (1 per 2 students)
- Ball and ring (1 per classroom)
- Bimetallic strip (1 per classroom)
- Bunsen burners (1 per 2 students)
- Calculator, graphing (1 per 2 students)
- Clock with second hand (1 per classroom)
- Computer, resident (1 or more per classroom)
- Computer probes, light, sound, temperature, magnetic, photogate (1 of each per classroom)
- Conductivity tester (1 per 2 students)
- Conductometers (1 per 2 students)
- Density block sets (1 per 2 students)
- Dynamic carts (1 per 2 students)
- Friction blocks (1 per 2 students)
- Hall's Carriage (1 per 2 students)
- Hammer, rubber (1 per 2 students)
- Hot plate (1 per 4 students)
- Inclined planes with pulley attachment (1 per 2 students)
- Interference tubes (1 per 2 students)
- Lamp, aluminum reflector (1 per 2 students)
- Lever system kit (using meter sticks) (1 per 2 students)
- Magnets, pair of bar (1 per 2 students)
- Mass sets, hooked (1 per 2 students)
- Optics kit (1 per 2 students)
- Optics bench kit (1 per 4 students)
- Overflow cans (1 per 2 students)
- Power supply (or dry cell) (1 per 4 students)
- Prism (1 per 2 students)
- Pulley kit with suspension system (1 per 4 students)
- Resonance apparatus (1 per 4 students)
- Ring stand with 4" ring (1 per 2 students)
- Ripple tank generator for overhead (1 per classroom)
- Slinky spring (1 per classroom)
- Stop watch (1 per 2 students)
- Tuning fork set, various frequencies (1 per classroom)
- Tuning forks, same frequency (1 per 2 students)

Small Equipment

- Scale, spring, 10 N capacity (1 per 2 students)
- Scale, spring, 2.5 N capacity (1 per 2 students)
- Beakers
 - 100 mL (1 per student)
 - 250 mL (1 per student)
 - 600 mL (1 per 4 students)
 - 1000 mL (4 per classroom)
 - 2000 mL (4 per classroom)

- Bottles, plastic wash (1 per 2 students)
- Bunsen burners, wing tips (1 per 2 students)
- Copper insulated wire (1 roll per classroom)
- Alligator clips for electric circuit (1 per 2 students)
- Cork borer set and sharpener (1 per classroom)
- Cylinder, graduated
 - 10 mL (1 per 2 students)
 - 100 mL (1 per 2 students)
 - 1000 mL (2 per classroom)
- Dropping bottles (2 per student)
- Eye droppers (2 per student)
- Flask, Erlenmeyer
 - 250 mL (1 per student)
 - 1000 mL (4 per classroom)
 - 2000 mL (2 per classroom)
- Friction pad, fur (1 per 2 students)
- Friction pad, silk (1 per 2 students)
- Friction pad, wool (1 per 2 students)
- Funnels, short stem (1 per 2 students)
- Iron filings (1 can per classroom)
- Knife blade switch (1 per 2 students)
- Lamp base and bulb for circuit (1 per student)
- Litmus paper (1 vial per 2 students)
- Meter sticks (1 per 2 students)
- Metric rulers (1 per student)
- Mortar and pestle (1 per 2 students)
- pH paper (1 vial per 2 students)
- Pith balls, pair coated in graphite and metal (1 per 2 students)
- Polarized lens set (1 per 2 students)
- Prism (1 per 2 students)
- Protractor (1 per 2 students)
- Voltmeter (1 per 2 students)
- Wave demonstration spring (1 per classroom)
- Samples: elements, compounds, and mixtures (1 per 2 students)
- Sets of substances of varying densities (1 per 2 students)
- Solar cell (1 per classroom)
- Spatulas (1 per 2 students)
- Spectroscopes, quantitative analysis (1 per 2 students)
- Steel spheres (1 per 2 students)
- Stirring rods (1 per 2 students)
- Stop watches (1 per 4 students)
- Stoppers, rubber and cork (assorted) to fit flasks and test tubes (1 per 2 students)
- Test tube holder (1 per 2 students)
- Test tube rack (1 per 2 students)
- Test tubes, 15 X 125 (5 per student)
- Test tubes, 20 X 150 (5 per student)
- Thermometer, metal back, alcohol, calibrated (1 per student)
- Tongs, beaker (1 per 2 students)
- Triangular file (2 per classroom)

- Watch glasses (1 per 2 students)
- Wire screen, ceramic centered (1 per 2 students)

Living/Preserved Specimens

- Microorganisms for acid rain investigation

Chart

- Periodic Table of Elements (1 per classroom)

Consumables

- Salt for density solutions

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals
- Rod, glass (1 per 2 students)
- Rod, rubber (1 per 2 students)

Safety Equipment**Required**

- Aprons (1 per student)
- Fire blanket (1 per laboratory)
- Fire Extinguisher (1 per laboratory)
- First Aid Kit (1 per laboratory)
- Materials Safety Data Sheets (1 set per building)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 per laboratory)
- Eyewash (2 per laboratory)

Recommended

- Transport cart (1 per laboratory)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

BIOLOGY

MATERIALS AND SAFETY EQUIPMENT

*Recommended Equipment

Large Equipment

- Aquarium with accessories (1 per classroom)
- Autoclave (1 per classroom)
- Balance, triple beam (1 per 4 students)
- Bird feeder (1 per classroom)
- Bunsen burners (1 per 2 students)
- Calculator, graphing (1 per 2 students)
- Clock with second hand (1 per classroom)
- Computer probes (1 per classroom)
- Computer, resident (1 or more per classroom)
- Cork borer set and sharpener (1 per classroom)
- Dissecting kit (1 per 2 students)
- Dissecting pan (1 per 2 students)
- Hot plate (1 per 4 students)
- Incubator for eggs (1 per classroom)
- Incubator oven (1 per classroom)
- Microscope, compound (1 per 2 students)
- Microscope, stereo (1 per 2 students)
- Mobile, plant (1 per classroom)
- Model, Human Torso (1 per classroom)
- Model, Meiosis (1 per classroom)
- Model, Mitosis (1 per classroom)
- Plant press (2 per classroom)
- Ring stand (1 per 2 students)
- Ring stands, 3" ring (1 per 2 students)
- Ring stand clamp (1 per 2 students)
- Stirrer, magnetic (1 per classroom)
- Survey collection, animals (1 per classroom)
- Survey collection, plants (1 per classroom)
- Terrarium with accessories (1 per classroom)
- Test tube basket (1 per 6 students)
- Test tube racks (1 per 2 students)

Small Equipment

- Agar plates, starch
- Beakers, Pyrex
 - 100 mL (2 per student)
 - 250 mL (2 per student)
 - 400 mL (1 per student)
 - 600 mL (1 per student)
 - 1000 mL (1 per 4 students)
 - 2000 mL (1 per 4 students)
- Brush, flask (1 per 4 students)
- Brushes, beaker (1 per 4 students)
- Clamps, pinch (1 per student)
- Cylinder, graduated
 - 10 mL (1 per 2 students)
 - 100 mL (1 per 2 students)
 - 500 mL (1 per 4 students)
- Dichotomous keys (1 per 2 students)
- Dishes, culture (1 per student)
- DNA structure and protein synthesis activity kit (1 per 2 students)

- Dropping bottles, 10 ml (4 per student)
- Eye droppers (2 per student)
- File, triangular (2 per classroom)
- Flask, Erlenmeyer
 - 125 mL (1 per student)
 - 250 mL (1 per student)
 - 500 mL (1 per 2 students)
 - 1000 mL (1 per 4 students)
 - 2000 mL (1 per 4 students)
- Funnels, short stem (1 per 2 students)
- Herbarium labels (1 package per 4 students)
- Herbarium paper (2 package per classroom)
- Herbarium paste (2 jars per classroom)
- Inoculating loops (1 per 2 students)
- Insect killing jar (1 per 2 students)
- Insect nets (1 per 2 students)
- Insect pins (2 boxes per classroom)
- Lens, hand (1 per student)
- Meter sticks (1 per 2 students)
- Metric rulers (1 per student)
- Microscope cover slips, plastic (2 boxes per classroom)
- Microscope slides (2 boxes per classroom)
- Microscope slides, depression (1 per student)
- Mortar and pestle (1 per 2 students)
- Nets, insect collecting (1 per 2 students)
- Pens, wax marking (1 per 2 students)
- Petri dishes (1 per student)
- Pipet, 1 mL graduated (1 per 2 students)
- Pipet, 10 mL graduated (1 per 2 students)
- Pipet, 5 mL graduated (1 per 2 students)
- Pots, planting, plastic (2 per student)
- Rods, glass stirring (1 per 2 students)
- Spatulas, 4" stainless (1 per student)
- Sphygmomanometer (1 per 2 students)
- Stethoscope (1 per 2 students)
- Stopper, rubber, assorted to fit flasks and test tubes
- Test tube brushes, regular (1 per 4 students)
- Test tube brushes, small (1 per 4 students)
- Test tube holders (1 per 2 students)
- Test tubes, Pyrex 20 X 150 mm (3 per student)
- Test tubes, Pyrex 10 X 75 mm (3 per student)
- Thermometer, oral with disposable sleeve (1 per 2 students)
- Thermometers, alcohol 10 - 110° C (1 per 2 students)
- Tongs, beaker (1 per 2 students)
- Trays, dissecting (1 per 2 students)
- Tubing, dialysis (1 roll per classroom)
- Variation and evolution kit (2 per classroom)

Living/Preserved Specimens

- Aquatic plants, Elodea
- Brine shrimp
- Cultures
 - Bacillus cereus
 - Bacillus subtilis
 - Escherichia coli
- Living plant and animal specimens
- Protist cultures
- Seeds for DNA studies
- Slides, prepared
 - animal cells and tissues
 - plant cells and tissues
- Yeast suspension

CD ROMs and Videos (1 per classroom)

- Cell structure and function
- Classification
- Evolution processes
- Location and function of body systems
- Meiosis
- Mitosis
- Plant anatomy and physiology
- Photosynthesis, respiration and cellular energy
- Planting flats, plastic (1 per 2 students)

Charts (1 per classroom)

- Bacteria
- Human body systems
- Prokaryotic and eukaryotic cells
- Viruses
- Carbon, oxygen, nitrogen and water cycles

Consumables

- Cotton swabs
- Food coloring
- Food products for testing
- Kidney from meat market
- Lamp, aluminum reflector (1 per 4 students)
- Milk
- Nitrogen fertilizer
- Scissors
- Starch

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals
- Greenhouse

Safety EquipmentRequired

- Aprons (1 per student)
- Eyewash (1 per laboratory)
- Fire blanket (1 per laboratory)
- Fire Extinguisher (1 per laboratory)
- First Aid Kit (1 per laboratory)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 per laboratory)
- Materials Safety Data Sheets (1 set per school)

Recommended

- Transport cart (1 per laboratory)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

CHEMISTRY

MATERIALS AND SAFETY EQUIPMENT

Recommended Equipment

Large equipment

- Balance, electronic (1 per 4 students)
 - Barometer (1 per classroom)
 - Burner, Bunsen or Tirrill (1 per 2 students)
 - Calculators, graphing (1 per 2 students)
 - Calorimeter (1 per 2 students)
 - Centrifuge (1 per classroom)
 - Clock, with second hand (1 per classroom)
 - Computer (1 or more per classroom)
 - Computer probes (1 per classroom)
 - temperature
 - pH
 - barometric pressure
 - Geiger Miller tube
 - Condensers (1 per 2 students)
 - Conductivity apparatus (1 per classroom)
 - DC source, 0-12 v. 5 amp with leads (1 per classroom)
 - Desiccator (1 per classroom)
 - Drying oven (1 per classroom)
 - Electrolysis apparatus (1 per classroom)
 - Geiger counter (1 per classroom)
 - Hot plate (1 per 4 students)
 - Magnetic stirrer (1 per 4 students)
 - pH meter, hand (1 per 4 students)
 - Spectrophotometer (1 per classroom)
 - Spectroscope (1 per student)
 - Spectrum tubes (1 of each element per classroom)
 - Spectrum tube power supply (1 per classroom)
- #### Small Equipment
- Beakers
 - 100 mL (2 per student)
 - 250 mL (1 per student)
 - 400 mL (1 per student)
 - 600 mL (1 per student)
 - 1000 mL (1 per 2 students)
 - Bottles, dropper, 10 mL (3 per student)
 - Bottles, dropper, 30 mL (3 per student)
 - Burets, 50 mL (1 per student)
 - Ceramic square (1 per 2 students)
 - Clamps (1 per 2 students)
 - test tube
 - 3 prong jaw
 - buret, double
 - pinch
 - utility
 - Cobalt-blue glass (1 per 2 students)
 - Condenser (1 per 4 students)
 - Cork borer (1 set per classroom)
 - Crucible (1 per 2 students)
 - Crucible cover (1 per 2 students)
 - Cup, plastic foam, 16 oz (1 per student)
 - Cylinder, graduated (1 per 2 students)
 - 10 mL
 - 50 mL
 - 100 mL
 - 1000 mL
 - Cutter, metal (1 per classroom)
 - Droppers, medicine (3 per student)
 - Droppers, pipet (1 per student)
 - Evaporating dish (1 per student)
 - File, triangular (2 per classroom)
 - Flask, distilling, 250 mL (1 per 2 students)
 - Flask, filter, 500 mL (1 per 2 students)
 - Flask, volumetric
 - 100 mL (1 per 4 students)
 - 1000 mL (1 per classroom)
 - 250 mL (1 per 4 students)
 - 500 mL (1 per 8 students)
 - Flasks, Erlenmeyer
 - 100 mL (1 per 2 students)
 - 1000 mL (1 per 4 students)
 - 250 mL (1 per 2 students)
 - 500 mL (1 per 2 students)
 - Funnels, long stem (1 per student)
 - Funnels, short stem (1 per student)
 - Lighter, burner (1 per 4 students)
 - Litmus, red & blue (6 boxes per classroom)
 - Meter stick (1 per 2 students)
 - Molecular model set (1 per 4 students)
 - Mortar and pestle (1 per 4 students)
 - Paper, chromatography (1 box per classroom)
 - Paper, filter, assorted sizes (1 box each per classroom)
 - Paper, pH (6 boxes per classroom)
 - Parafilm (1 roll per classroom)
 - Pencils, glass marking (1 per 2 students)
 - Pipets, glass, 1 ml, graduated (1 per 2 students)
 - Pipets, glass, 10 ml, graduated (1 per 2 students)
 - Pipets, glass, 5 ml, graduated (1 per 2 students)
 - Ring support with clamp -2" & 4" (1 per 2 students)
 - Ring stand, 20" (1 per 2 students)
 - Ring stand screen (1 per 2 students)
 - Rubber policeman (1 per student)
 - Rubber suction bulb (1 per 2 students)
 - Ruler, metric (1 per student)
 - Small rubber bands (1 box per classroom)
 - Spatula/scopula (1 per student)
 - Spot plate (1 per 2 students)
 - Stirring rod, glass (1 per student)
 - Stoppers, cork, assorted
 - Stoppers, rubber, 1 hole and 2 hole, assorted
 - Stoppers, rubber, solid, assorted
 - Test tube holder (1 per student)

- Test tube rack (1 per 2 students)
- Test tubes, large (5 per student)
- Test tubes, medium (5 per student)
- Test tubes, small (5 per student)
- Thermometers, -20°C to 150 (1 per student)
- Thermometers, electronic (1 per 4 students)
- Tong, crucible (1 per 2 students)
- Tongs, beaker (1 per 2 students)
- Triangle, 1 1/2", clay-covered (1 per 2 students)
- Tubing, plastic connecting (50' per classroom)
- Tubing, rubber connecting (50' per classroom)
- Tubing, capillary, glass, melting point (1 vial per classroom)
- Tubing, glass, assorted
- Tubing, rubber, 1/4" ID (100' per classroom)
- Tweezers or forceps (1 per 2 students)
- Wash bottles, plastic (1 per 2 students)
- Watch glass (1 per 2 students)
- Weighing bottle (1 per 2 students)
- Wire gauze, ceramic center, 5" x 5" (1 per 2 students)
- Wire, nichrome or platinum (1 per 2 students)

Charts (1 per classroom)

- Common ions
- Oxidation-reduction potential
- Periodic Table of Elements
- Spectrum

Safety Equipment

Required

- Aprons (1 per student)
- Eyewash (2 per laboratory)
- Fire blanket (1 per laboratory)
- Fire Extinguisher (1 per laboratory)
- First Aid Kit (1 per laboratory)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 set per laboratory)
- Materials Safety Data Sheets (1 set per school)

Recommended

- Transport cart (1 per classroom)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

PHYSICS

MATERIALS AND SAFETY EQUIPMENT

Recommended Equipment

Large Equipment

- Ammeter triple range: 0 - 1.5, 3 (1 per 2 students)
- Balance, triple beam (1 per 2 students)
- Bunsen Burner (1 per 2 students)
- Clamps 4" (1 per 2 students)
- Calculator, graphing (1 per 2 students)
- Caliper, micrometer (1 per 2 students)
- Caliper, vernier (1 per 2 students)
- Calorimeter (1 per 2 students)
- Cart, dynamics set (1 per 2 students)
- Cathode ray tube, sealed with screen (1 per classroom)
- Clock with second hand (1 per classroom)
- Cloud chamber (1 per 2 students)
- Collision Apparatus-two dimensions (1 per 2 students)
- Computer probes tube (1 per classroom)
 - sound
 - light
 - temperature
 - Geiger Miller
 - magnetic
 - photogate
 - pendulum
- Computer (1 or more per classroom)
- Conservation of Momentum Apparatus (1 per classroom)
- Coulomb's Law Apparatus (1 per 2 students)
- Discharge tubes, vacuum (1 per classroom)
- Electroscope, measuring (1 per 2 students)
- Galvanometer, center zero (1 per 2 students)
- Hall's carriage (1 per 2 students)
- Hammer, rubber (1 per 2 students)
- Hot plate (1 per 2 students)
- Inclined plane (1 per 2 students)
- Induction coil (1 per classroom)
- Lab masses set, brass (1 per 2 students)
- Lab masses set, hooked (1 per 2 students)
- Lamps, aluminum reflector (1 per 2 students)
- Light source, intense for ripple tank (1 per classroom)
- Magnets, strong, bar, pair (1 per classroom)
- Magnets, strong, horseshoe (1 per classroom)
- Optical bench set (1 per 2 students)
- Optics Kit (1 per 2 students)
- Pendulum support (1 per 2 students)
- Power supply: AC, DC (1 per 2 students)
- Pulley with clamp for table edge (1 per 2 students)
- Resonance tube, 50 cm (1 per 2 students)
- Ring clamp (1 per 2 students)
- Ring stand (1 per 2 students)
- Ring stand screen (1 per 2 students)
- Ring, 4" (1 per 2 students)

- Ripple tank assembly, complete (1 per classroom)
- Ripple tank wave generator (1 per classroom)
- Slotted weights set (1 per 2 students)
- Stop watch (1 per 2 students)
- Stroboscope (1 per classroom)
- Trajectory apparatus (1 per 2 students)
- Tuning fork set, 256 Hertz and above (1 per 2 students)
- Voltmeter triple range: 0-1.5, 3, 30A (1 per 2 students)
- Weight hangers (1 per 2 students)

Small Equipment

- Ball and ring (1 per classroom)
- Beakers, Pyrex, 400 mL (1 per 2 students)
- Beakers, Pyrex, 600 mL (1 per 2 students)
- Bimetallic strip (1 per classroom)
- Carbon paper (2 packages per classroom)
- Compasses, magnetic (2 per student)
- Cylinder, graduated, 10 mL (1 per 2 students)
- Cylinder, graduated, 50 mL (1 per 2 students)
- Cylinder, graduated, 500 mL (1 per 6 students)
- Cylinder, graduated, 1000 mL (1 per 6 students)
- Eye dropper (1 per student)
- Friction block with hook (1 per 2 students)
- Friction pads, fur (1 per 2 students)
- Friction pads, silk (1 per 2 students)
- Friction pads, wool (1 per 2 students)
- Handbook of Physical Constants (1 per classroom)
- Iron filings (1 box per classroom)
- Magnet, horseshoe (1 per classroom)
- Magnets, bar (1 per student)
- Magnets, bar, pair (1 per classroom)
- Mass, known specific heat, metal, small (1 per 2 students)
- Mass, unknown specific heat, metal, small (1 per 2 students)
- Nail, large iron (1 per 2 students)
- Nylon thread (1 spool per classroom)
- Paper clips (10 per student)
- Paper, white craft (1 roll per classroom)
- Pendulum bob (1 per 2 students)
- Pith ball pair, graphite or metal coated (1 per 2 students)
- Polarized lens (1 per classroom)
- Prism (1 per classroom)
- Protractor (1 per 2 students)
- Recorder timer (1 per 2 students)
- Recorder timer carbon discs (1 package per 2 students)
- Recorder timer tape (1 per 2 students)

- Resistors 2 @ 5 ohms power rating, 5 - 10 watts (1 per 2 students)
- Resistors 2 @ 10 ohms power rating, 5 - 10 watts (1 per 2 students)
- Resistors 2 @ 15 ohms power rating, 5 - 10 watts (1 per 2 students)
- Resistors 2 @ 30 ohms power rating, 5 - 10 watts (1 per 2 students)
- Rods, rubber (1 per 2 students)
- Rods, glass (1 per 2 students)
- Ruler, metric (1 per 2 students)
- Scale, spring 2.5N (1 per 2 students)
- Scale, spring 10N (1 per 2 students)
- Scale, spring, 20N (1 per 2 students)
- Screw driver (1 per 2 students)
- Slinky (1 per 2 students)
- Switch, knife blade (1 per 2 students)
- Tag board (1 per 2 students)
- Thermometers, Celsius, -2 - 110 degrees, alcohol (1 per 2 students)
- Tracing paper (1 per 2 students)
- Twine, heavy cotton (1 ball per classroom)
- Wave motion rope (1 per 2 students)
- Wire, Copper, insulated, 18 gauge (100 m per classroom)

CD ROM (1 set per classroom)

- Illustrations of Laws of Thermodynamics
- Photo Electric Effect
- Role of electromagnetic spectrum

Chart (1 per classroom)

- Electromagnetic spectrum
- Periodic table of elements
- Meter stick (1 per 2 students)

Consumables

- Dry ice
- Sheets of cardboard
- Wax

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Safety Equipment

Required

- Aprons (1 per student)
- Fire blanket (1 per classroom)
- Fire Extinguisher (1 per laboratory)
- First Aid Kit (1 per laboratory)
- Materials Safety Data Sheets (1 per school)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 set per laboratory)
- Eyewash (2 per laboratory)

Recommended

- Transport cart (1 per laboratory)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

GEOLOGY, METEOROLOGY, OCEANOGRAPHY

MATERIALS AND SAFETY EQUIPMENT

Recommended Equipment

Large Equipment

- Balances, triple beam (1 per 2 students)
- Calculators, and software (1 per student)
- Clock with second hand (1 per classroom)
- Computer probes (1 per 2 students)
 - temperature
 - light
 - magnetic
- Computer (1 or more per classroom)
- Containers for hot water baths (3 per classroom)
- Hot plate (1 per classroom)
- Stream table kit (1 per classroom)

Small Equipment

- Air pollution kit (1 per 2 students)
- Beakers, 250 mL Pyrex (1 per student)
- Beakers, 400 mL Pyrex (1 per student)
- Eye dropper (1 per student)
- Cylinder, graduated, 100 mL (1 per 2 students)
- Lamps, aluminum reflector (1 per 2 students)
- Mineral cleavage kit (1 per 2 students)
- Mineral samples (1 set per 2 students)
- Moh's hardness sample kit (1 per 2 students)
- Overflow can (1 per 2 students)
- Rock Type Sets: sedimentary, igneous, and metamorphic (1 set per 2 students)
- Rock samples: dolomite, limestone (1 per 2 students)
- Rulers, metric (1 per student)
- Streak plates (1 per student)
- Syracuse staining dish, 64 mm (1 per 2 students)
- Thermometers, alcohol (2 per student)
- Tongs, beaker (1 per 2 students)

Living and Preserved Specimens

- Aquatic and terrestrial plants

Software and CD-ROMs (1 per 4 students)

- Historical development of Earth's formation
- Historical development of plate tectonics and methods of verification
- Origin of fossil fuels and their environment and economic impact
- Space Age discoveries about planets
- Tides, bores and tsunamis

Audio-Visuals

- Charts, Ocean Floor (1 per classroom)
- Earthquake Epicenter Bulletin, U.S. Government Printing Office (1 subscription per classroom)
- Map, wall, Earthquake watch kit, Pacific-centered, (1 per classroom)
- Map, climatic data from cities in each climatic zone (1 per student)
- Map, local water resources, average annual rainfall, etc. (1 per classroom)
- Map, World, relief (1 per classroom)
- Map, Earth's climatic zones (1 per classroom)

Consumables

- Clay, modeling
- Containers, plastic or glass, circular
- Cups, Styrofoam
- Food coloring
- Phenyl Salicylate, (100 grams per classroom)
- Salt
- Soil, potting
- Straws, clear

Outdoor Field Area

- Natural site for observation
- Local area: native plants, including trees, shrubs, grasses, with a water source for animals

Safety Equipment

Required

- Aprons (1 per student)
- Fire blanket (1 per laboratory)
- Fire Extinguisher (1 per laboratory)
- Materials Safety Data Sheets (1 set per laboratory)
- First Aid Kit (1 per laboratory)
- Goggles, splash-proof (1 per student)
- Goggle disinfecting materials or equipment (1 set per laboratory)
- Eyewash (3 per laboratory)

Recommended

- Transport cart (1 per laboratory)
- Sink (1 per 4 students)

*Required lists are specified by TEKS at each grade level.

**Recommended lists were generated by analyzing the concept TEKS at each grade level. We encourage teams of teachers at local levels to make decisions regarding the needs of their individual science programs.

APPENDIX I

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TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

- (1) acceptance policies on student transfers from other school districts;
- (2) operation of school bus routes or runs on a nonsegregated basis;
- (3) nondiscrimination in extracurricular activities and the use of school facilities;
- (4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;
- (5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;
- (6) nondiscriminatory practices relating to the use of a student's first language; and
- (7) evidence of published procedures for hearing complaints and grievances.

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