

Science **Facilities** Standards

Kindergarten through
Grade 12



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Charles A. Dana Center

SCIENCE FACILITIES STANDARDS

Kindergarten
through
Grade 12

**A Guide for
Designing
Indoor Facilities and
Outdoor Learning Areas
for Texas Schools**

January 2002

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Introduction

The Texas Essential Knowledge and Skills require students in kindergarten–grade 8 and in every high school science course to use scientific inquiry methods to conduct field and laboratory investigations following safe procedures. Our schools must provide well-equipped classrooms and laboratories, as well as access to outdoor space, so that students can do investigations using scientific inquiry.

“Inquiry is a multifaceted activity that involves observations; posing questions; examining books and other resources of information to see what is already known; planning and conducting investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions, and communicating the results.”

National Research Council, *National Science Education Standards*, 1996

Why It Is Important to Have Good Science Facilities

Good science facilities are necessary in order for teachers to provide the quality of instruction that is expected in today’s education system. As more demands are placed on our teachers to improve student performance and schools are held accountable for the level of student performance, the need for modern, well-equipped science facilities becomes increasingly important. Research has proven that students learn and understand science concepts better when all of their senses are stimulated during the learning process. Nowhere can they acquire this level of understanding better than during laboratory and field investigations.

Small laboratory rooms with overcrowded student workstations, a lack of safety equipment, and inadequate supplies and materials can no longer be tolerated in our schools. In order for teachers to be able to guide students to the expected levels of achievement, school districts must build safe, modern science facilities and renovate old, inadequate facilities. School designs should be sustainable in order to maximize the efficient use of natural resources and minimize potential damage to the environment.

The purpose of this manual is to provide teachers, school administrators, and architects contractors with standards for designing facilities that will help students achieve their full potential.

Thirteen Considerations for a Sustainable School Design

1. Ecology Education

Design your sustainable school to be a teaching tool by incorporating the environment into the education program.

2. Site Planning and Landscape Design

Evaluate the regional impacts of the school on the environment, and protect and retain existing landscaping and natural features. Incorporate environmentally friendly design solutions—sound erosion control, storm water retention, and xeriscape landscaping principles

3. Environmentally Sensitive Building

Maximize the use of recycled and enviro-friendly products that reduce the polluting effects of construction on the environment.

4. Energy-Efficient Building Shell

Maximize energy efficiency by using light colors for roofing and wall finish materials; high R-value wall and ceiling insulation; minimal glass on east and west exposures; and more glass on north and south exposures.

5. Solar Energy Systems

Consider the use of solar energy systems as a means to reduce peak electrical demand. Incorporate the technology in the school's ecology education program.

6. Indoor Air Quality

Eliminate sources of harmful contaminants and discomfort by minimizing building materials and furnishings that contain toxins. Use natural ventilation wherever possible.

7. Energy-Efficient Mechanical and Ventilation Systems

Consider low-energy mechanical systems such as solar heating and cooling, double-effect absorption cooling, or geothermal heat pumps.

8. Daylighting

Develop strategies to provide natural daylight for at least two-thirds of the day, minimizing the need for artificial light in the learning areas. Recognize the limitations associated with perimeter daylighting and the benefits associated with roof monitors (large skylights).

9. Water Conservation

Collect rainwater for site irrigation and toilet flushing using separate plumbing to channel this gray water. Minimize wastewater by installing waterless urinals, using low-flow and water conserving fixtures, and insulating piping to reduce hot water waste.

10. Energy-Efficient Lighting and Electrical Systems

Include motion sensors tied to dimmable lighting controls to reduce utility costs. Fiber-optic lighting maximizes efficiency, reduces overheating, and eases lamp replacement in areas that are difficult to reach.

11. Recycling Systems and Waste Management

Facilitate recycling by providing central locations for collection that are convenient to students and staff. Include recycling chutes for multistory schools.

12. Transportation

Discourage single-car travel by providing easy access to the school via public transportation, bicycle paths, and walkways. Consider alternatives such as electric service vehicles and buses.

13. Commissioning and Maintenance

Develop a commissioning process that helps ensure the proper operation of mechanical, electrical, and solar systems. Recognize the need to educate students and staff so they can make the most of their sustainable school.

A recent publication by the Charles A. Dana Center, *An Analysis of Laboratory Safety in Texas*, presented the results of a statewide survey on safety in science classrooms and laboratories. The report listed the following conclusions based on the data collected from the survey.

1. As class sizes increase, the occurrence of both major and minor accidents increases.
2. As student enrollments increase, so does the occurrence of minor accidents.
3. Low numbers of teachers are completing professional development activities focused on laboratory safety
4. Many schools are not conforming to laws and regulations regarding the availability and use of safety equipment, the proper storage of chemicals, laboratory size, and the existence of ventilation and communication systems.

As a result of the findings of this report, the Texas Education Agency (TEA) has made the following recommendations.

- Strengthen state safety regulations, and resume the systematic monitoring of science facilities and safety procedures in public schools by the Texas Education Agency.

Evidence in the report shows that many science teachers and students lack access to required safety equipment. Strengthening regulations and regular monitoring can assist schools in identifying deficiencies and encourage prompt compliance with regulations.

- Texas school districts constructing or remodeling school buildings should provide safe science laboratories of the appropriate size and with appropriate storage space and ventilation.

Further evidence suggests that accidents can be reduced or avoided by having appropriate physical facilities for science teaching and the handling of science materials. Facility planners should follow TEA recommendations regarding science laboratory floor space and storage facilities.

- Reduce the teacher-student ratio in middle and high school science classes.

Teacher reports of accidents in science classes indicate a positive and direct relationship between the number of students in a science class and the number of accidents that occur. Research suggests that an appropriate limit to the student-teacher ratio for science instruction is 25 to 1.

The information and standards presented in this manual reflect the findings of the Dana Center's safety survey report. It is important that construction and renovation in Texas public schools progress toward providing safe and effective learning environments for our students.

The Texas Education Agency reported that during the 1999–2000 school year, 7,395 school campuses in 1,041 school districts and 142 charter schools employed 267,922 full-time teachers. These teachers had the responsibility of educating approximately 4 million students required to learn science concepts and do science investigations. Each year approximately 1,638 high school campuses, 1,420 middle and junior high school campuses, and 4,337 elementary school campuses are required to provide adequate science facilities for their teachers and students.

Who Should Be Included in the Planning Process?

The planning of a science facility should involve representatives from the school district’s administration, including—but not limited to—the director of school facilities, the kindergarten–grade 12 curriculum coordinator, the science supervisor, the technology coordinator, the principal, the science teacher, a maintenance personnel, and a representative from a science equipment and furniture manufacturer. In addition, the architect will bring his or her knowledge of engineering and building codes (local, state, and federal) and the construction team for the project.

One of the most valuable members of the committee (but often not included) is the science teacher, who has the responsibility of teaching in the new facility. The science teacher must be able to function effectively in the science classroom and laboratory and can provide valuable insights to the committee about what should be taught and how it should be taught. Architects sometimes fail to recognize the importance of including teachers, who may spend up to twenty years of their lives working in these facilities.

What Should Be Included in Science Facilities?

Determining what should be included in a science classroom, laboratory room, storage room, preparatory room, or field site is a complex process that should not be rushed. Too often, after the construction is complete a teacher will realize that certain things should have been included or are in the wrong place in the room—too late. Checklists are often helpful when deciding what to include in a room. It is sometimes easier to cross items off a list than to try to remember what should be included on the list. The following chapters are designed to assist with the following:

- | | |
|--------------------------------|-----------------------------------|
| • floor space requirements | • lecture/laboratory room designs |
| • types and styles of fixtures | • preparation room designs |
| • laboratory furniture | • equipment storage room designs |
| • classroom designs | • chemical storage room designs |
| • technology requirements | • science department designs |
| • laboratory room designs | • outdoor learning area designs |

A convenient facilities and equipment checklist for elementary, middle, and high schools is included in Appendix C and may be helpful when you are planning for your facilities. However, it is not intended as a final list of what should be included in a science room.

Be flexible in your designs. The state’s mandated science standards will change in the future, and your facilities must be able to change to meet the new needs of our students.