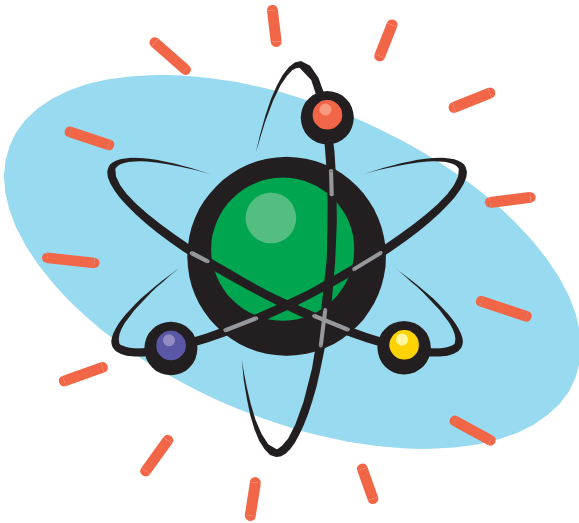


Texas

INFORMAL SCIENCE:

Guidelines for Supporting the Improvement of Science, Mathematics, and Technology Education in Texas



The Texas Statewide Systemic Initiative
at The Charles A. Dana Center
The University of Texas at Austin

Texas



Guidelines for Supporting the Improvement of Science, Mathematics, and Technology Education in Texas

**A product of the Informal Science Education Association
Supported by the Texas Statewide Systemic Initiative**

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This document was written by members of the Texas SSI Action Team on
Expanding the Learning Community by Bridging Informal and
Formal Science Education

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**TEXAS SSI ACTION TEAM
ON EXPANDING THE LEARNING COMMUNITY
BY BRIDGING INFORMAL AND
FORMAL SCIENCE EDUCATION**

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Texas Informal Science: Guidelines for Supporting the Improvement of Science, Mathematics, and Technology Education in Texas

PREFACE

This document is the result of work supported by the Texas Statewide Systemic Initiative (SSI), which provides resources for local Texas communities to implement contemporary, rigorous, and engaging science, mathematics, and technology education for all students. Over the last four years, the SSI has been involved in the development of the state's new frameworks for mathematics and science, the Texas Essential Knowledge and Skills (TEKS). Serving as contractor to the Texas Education Agency, the SSI organized and managed a broad-based, open process of identifying what students must know and be able to do in mathematics and science classrooms statewide.

One of the many constituencies identified by the SSI as key to the successful development and implementation of its science, mathematics, and technology improvement efforts is the state's extraordinarily rich and diverse informal science community, represented by museums, parks, nature centers, science technology centers, botanical centers, public television stations, zoological parks, aquariums, planetariums, and other free-choice learning institutions. Recognizing that informal science institutions can play an important role in supporting students' learning outside of the formal school setting, the SSI began to explore and draw upon this unique resource.

The Texas SSI Informal Science Education (ISE) Action Team was formed in the summer of 1996. An action team is a broad-based leadership group constructed to reflect the state's ethnic,

geographic, and political diversity. Members of the team include informal science educators, classroom teachers, school administrators, and representatives from regional education service centers, university systems, parent-family organizations, and an Urban Systemic Initiative. The ISE Action Team was designed as a learning community, drawn from the state's regional and cultural diversity and representative of the educational partners that exist beyond the formal classroom. The knowledge and experience of the 23 members reflect the variety of science, mathematics, and technology resources available in local communities that offer families and schools expanded learning opportunities.

During its first phase, the ISE Action Team researched current national, state, and local models of informal-formal linkages. They examined the SSI's ongoing reform efforts within the formal education community and identified focus areas that represent the strongest opportunities for bridging the gap between schools and informal science resources. The ongoing process of disseminating these guidelines to an emerging statewide network will support the establishment of an invaluable infrastructure with the promise of connecting more Texas schools, families, and children with their local informal science institutions.

INTRODUCTION

The Texas Statewide Systemic Initiative (SSI) Informal Science Education (ISE) Action Team defines informal science education as providing unique learning environments that increase appreciation and understanding of science, mathematics, and technology and their applications through voluntary and often self-directed experiences for individuals of all ages and backgrounds. Informal science education is generated throughout the state at sites such as museums, parks, nature

centers, science technology centers, botanical centers, public television stations, zoological parks, aquariums, planetariums, and other free-choice learning institutions. Informal science education networks, in collaboration with other institutions and community organizations, increase the potential for significant improvement in science, mathematics and technology education.

Informal Science Education: Guidelines for Supporting the Improvement of Science, Mathematics, and Technology Education in Texas was developed by the ISE Action Team of the Texas SSI to assist informal science institutions in their efforts to work with members of the formal education community. The following core strategies were recognized by the ISE Action Team as highly effective and necessary components of systemic improvement in science, mathematics, and technology education.

- I. Informal science institutions must build their relationship with formal education as codevelopers of innovative programs that improve science education, inquiry learning, and teaching strategies.
- II. Informal science institutions must provide important learning opportunities that feature exhibits and programs designed to promote interaction between parent and child for families of all cultural and educational backgrounds.
- III. Informal science institutions must provide valuable learning opportunities for both pre-service and inservice teachers through professional development programs, institutes, and opportunities to observe learning in science-rich environments. Providers of informal science education have the freedom to explore and develop programs without the requirements placed on formal educators by local, state, and national policies. This role offers the opportunity to collaborate with members of the local educational system in order to meet the challenge of creating a better system of teaching and learning.

Inquiry is a multifaceted activity that involves making observation; posing questions; examining books and other sources of information to see what is already known; planning 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. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.

National Science Education Standards, 1996

I. Organizational Quality

Goal: Informal science institutions build their ability to connect and align with all the community's educational partners to improve science, mathematics, and technology education.

To accomplish this goal, we suggest several action steps.

OPTIMIZE RESOURCES

Science rich institutions collectively have vast resources for expanding the experiential background of all citizens.

These resources are optimized when . . .

- the community recognizes and utilizes collections, exhibitions, unique environments, and staff and volunteers of the institutions as real-life opportunities for learning.
- the institutions accommodate different learning styles.
- individuals and groups in the community share their expertise.

STRENGTHEN PARTNERSHIPS

Strong partnerships lead to systemic improvement of education.

Partnerships are strengthened when . . .

- informal science institutions provide a “neutral ground,” bringing together diverse constituencies to discuss education improvement issues.
- long-term partnerships utilize each partner's particular strengths, unique resources, and expertise.
- partners share authority, responsibility, and benefits.
- partnerships develop over time and are based on trust, mutual respect, and effective communication.

CREATE INQUIRY-LEARNING OPPORTUNITIES

Inquiry experiences (which involve forming questions, investigation, and discovery) are the basis of learning and are provided by informal science institutions' programs and exhibitions.

Inquiry-learning opportunities are strengthened when . . .

- informal science institutions stimulate curiosity beyond the visit.
- institutions support and assist educators in continuing inquiry-learning experiences beyond the informal setting.

Investments in informal science institutions result in exhibit, programmatic, or human resources that endure over time.

Exhibits, programs, and environments are accessible and attractive to all members of the community, of different ages, ethnic backgrounds, and levels of interest or experience.

Institutions answer how much, by whom, for how long, in what ways, and for what purposes, are programs and exhibits being used.

A Framework for Evaluation & Research: Science Instruction and Relationship
Mark St. John and Deborah Perry

The Houston Museum District Association

The goal of HMDA is to further develop and refine the Museum District as a cultural, educational, and scientific attraction.

For further information about HMDA, contact Cheryl McCallum, Director of Education, Children's Museum of Houston, 1500 Binz, Houston, Texas 77004, phone 713-522-1138 ext. 220.

- learning research is utilized in developing exhibits and programs.

PRESERVE IDENTITY

Informal science institutions must preserve their unique identity in order to maintain their strength as they undertake collaborative projects.

Identity is preserved when . . .

- informal science institutions keep their mission intact.
- informal science institutions do not feel obligated to program outside the boundaries of their expertise.

PROMOTE NETWORKING

Networking creates information-sharing opportunities.

Networking is promoted when . . .

- links between informal science institutions promote information sharing.
- professional development support is available for informal science institution staff and volunteers to network and learn about successful programs.

- successful formal-informal collaborations are recognized and supported by the formal education community.

CUSTOMIZE MATERIALS

Informal science exhibition materials and program-support materials, developed in collaboration with formal educators, improve informal science learning.

Materials are customized when . . .

- informal science institutions solicit and value teacher involvement as part of program development.
- materials that link the exhibits and programs to the Texas Essential Knowledge and Skills (TEKS) and to the national standards are provided to teachers.
- the materials reflect the nature, character, and interests of the local community.

EMPHASIZE EVALUATION

Efforts must be continually evaluated in order to develop effective programs in support of the improvement of science, mathematics, and technology education.

Evaluation is emphasized when . . .

The Vintage Flying Museum Education Resource Center

The Vintage Flying Museum in Fort Worth partnered with the FAA to produce a free public resource center, the FAA Aviation Education Resource Center. This also includes education programs for students and teacher workshops.

For more information, contact Chuckie Hospers, Vintage Flying Museum, 505 N.W. 38th St. Hanger 33 South, Ft. Worth, Texas 76106, phone 817-624-1935.

The Dallas Zoo and The Dallas Museum of Art “Animals in African Art”

The Dallas Zoo and the Dallas Museum of Art collaborated on the traveling exhibit “Animals in African Art.” The institutions cross-trained their volunteers and hosted cooperative family days and field trips between both institutions. Participants were able to experience live animals in their art classes and discover important links between art and science.

For more information, contact Chris Seifert, Dallas Zoo, 650 South R.L. Thornton Fwy., Dallas, Texas 75203, phone 214-670-7543.

- feedback is collected in a variety of ways.
- evaluation results are used to improve programs and materials.

II. Family Learning and Public Awareness

Goal: Informal science institutions provide opportunities for family learning and public awareness to help all children and adults become more literate in science, mathematics, and technology.

To accomplish this goal, we suggest several action steps.

ENGAGE THE COMMUNITY

Informal science institutions benefit when the entire community is involved in promoting science, mathematics, and technology literacy.

The community is engaged when . . .

- school, community, and informal science institutions collaborate to conduct family learning events.
- members of the community provide resources and support for events and programs in recognition of contributions to the community.

CREATE FAMILY-FRIENDLY ENVIRONMENTS

Informal science institutions provide families with rich learning environments for science, mathematics, and technology.

Environments are family-friendly when . . .

- families are given opportunities to make personal connections to everyday science, mathematics, and technology.
- experiences increase the family’s desire to learn more about science, mathematics, and technology together.
- systems (such as lending libraries, periodic events, learning kits, exhibits, programs, and materials) are in place to provide families with resources to assist in learning.
- information materials reach all ages and are presented in varied formats.
- connections to the Texas Essential Knowledge and Skills (TEKS) and other guidelines for students in science, math, and technology are available to families.

Pre-service teachers are prospective teachers enrolled in either a college or university teacher training program or are participants in an alternative certification program.

Pre-service providers are educational institutions such as two and four year colleges and universities, regional service centers and school districts that offer programs for training prospective teachers.

The Houston Arboretum and Nature Center “Community Center Program”

The Houston Arboretum and Nature Center collaborated with the Houston Parks and Recreation Department, along with a local corporation, to create a program where children from local community centers are able to visit the nature center in the afternoons. The partnership with the corporation allows for daily bus transportation. This successful collaboration has since led to further partnerships with the Parks and Recreation Department.

For more information, contact Carol Huelbig, Houston Arboretum and Nature Center, 4501 Woodway, Houston, Texas 77024, phone 713-681-8433.

IMPROVE ACCESS

Equitable access to programs is possible when barriers are removed.

Access is improved when . . .

- staff and boards reflect the diversity of our community.
- operating hours are considerate of diverse family structures.
- events and programs are held in a variety of locations.
- fee structures are sensitive to all economic groups.
- oral and written communications are varied in approach, including the use of different languages, Braille, and universal pictures on signs.
- facilities are designed to accommodate all age groups (e.g., diaper changing tables are available in restrooms and seating is available for the elderly).

III. Teacher Preparation and Professional Development

Goal: Informal science institutions utilize their rich resources to improve pre-service teacher preparation and teacher professional development in science, mathematics, and technology.

To accomplish this goal, we suggest several action steps.

ESTABLISH ISE ROLE

The informal science institutions are an important stakeholder in teacher education pre-service programs.

The ISE role is established when . . .

- the community recognizes informal science institutions and teaching professionals as integral resources to teacher preparation and professional development.
- a collaboration on teacher education occurs between informal science institutions, families, the local community, and businesses.

ENRICH PRE-SERVICE LEARNING

Informal science institutions provide

Ollie Moen Children’s Discovery Center Strecker Museum Complex

The Children’s Discovery Center offers family learning nights for Waco Head Start chapters. Using Texas Red, the Wonder Wolf™ kits, children and parents come once a week to explore science.

For further information, contact Jill Barrow, Director, Ollie Mae Moen Discovery Center, 815 Columbus, Waco, Texas 76701, phone 254-757-0922.

**Texas State
Aquarium H-E-B
Televentures:
“Wonders Under
the Sea”**

H-E-B Televentures is a series of live, interactive, electronic field trips from the Texas State Aquarium, the Houston Museum of Natural Science, the Art Museum of South Texas, and the Witte Museum. H-E-B Televentures brings the exciting world of natural science and arts into the home or classroom through a collaboration between H-E-B, the informal science institutions, and the local PBS stations.

For further information, contact Tara Schultz, Education Director, Texas State Aquarium, 2710 North Shoreline, Corpus Christi, Texas 78402, phone 512-881-1204.

opportunities for pre-service teacher learning.

Pre-service learning is enriched when . . .

- the pre-service provider acknowledges, utilizes, and values the capability of informal science institutions to provide opportunities for experiential learning.
- the pre-service provider recognizes that informal science institutions use current learning theories and instructional strategies.
- pre-service teachers observe children learning in an informal science environment.

ENRICH TEACHER DEVELOPMENT

Informal science institutions offer experiences and resources that enhance an understanding of science, mathematics, and technology.

Teacher development is enriched when . . .

- Information about informal science rich resources are available for educational institutions.
- a partnership is established with educational institutions to give pre-service and in-service teachers

experiences outside the classroom and within an informal setting.

- successful collaborative programs between informal science resources and pre-service programs are identified to exemplify positive impact.
- informal science institutions provide opportunities for educators to involve themselves in inquiry learning experiences.
- informal science institutions provide support and enhance school-based experiences for teachers and students with outreach programs.
- informal science institutions support educators as life-long learners.
- educators take advantage of professional growth and development experiences provided by informal science institutions.

**Austin Children’s
Museum
“Community
Night”**

Austin Children’s Museum hosts “Community Night” one night a week. Admission is free for everyone, and museum visitors benefit from increased programming and performances during these hours.

For further information, contact Aina Olomo, Austin Children’s Museum, 201 Colorado, Austin, Texas 78701, phone 512-472-2499.

The Fort Worth Museum of Science and History hosts the “Lone Star Dinosaur Field Institute,” where teachers participate in a week-long hands-on experience with an authentic dinosaur dig. Inquiry is the main focus of the institute. Teachers work on the dig site, interact with paleontology experts, prepare specimens for transport, discuss current issues involving fossils and other historical and scientific facts, and develop plans for implementing the institute in their classrooms.

For further information, contact Colleen Blair, Fort Worth Museum of Science and History, 1501 Montgomery St., Fort Worth, Texas 76107, phone 817-255-9338.

An NSTA Position Statement Informal Science Education

PREAMBLE

NSTA recognizes and encourages the development of sustained links between the informal institutions and schools. Informal science education generally refers to programs and experiences developed outside the classroom by institutions and organizations that include:

- Children’s and natural history museums, science-technology centers, planetaria, zoos and aquaria, botanical gardens and arboreta, parks, nature centers and environmental education centers, and scientific research laboratories
- Media, involving print, film, broadcast, and electronic forms
- Community-based organizations and projects, including youth organizations and community outreach services

A growing body of research documents the power of informal learning experiences to spark curiosity and engage interest in the sciences during school years and throughout a lifetime. Informal science education institutions have a long history of providing staff development for teachers, and enrichment experiences

for students and the public. Informal science education accommodates different learning styles and effectively serves the complete spectrum of learners: gifted, challenged, non-traditional, and second language learners.

DECLARATION

NSTA strongly supports and advocates informal science education because we share a common mission and vision articulated by the National Science Education Standards:

- Informal science education complements, supplements, deepens, and enhances classroom science studies. It increases the amount of time participants can be engaged in a project or topic. It can be the proving ground for curriculum materials.
- The impact of informal experiences extends to the affective, cognitive, and social realms by presenting the opportunity for mentors, professionals, and citizens to share time, friendship, effort, creativity, and expertise with youngsters and adult learners.
- Informal science education allows for different learning styles and multiple intelligences and offers supplementary alternatives to science study for non-traditional and second language learners. It offers unique to

The Fort Worth Museum of Science and History collaborates with area school districts to host “Family Science Nights” for elementary and middle schools. The schools send a team of teachers to the museum to plan an event for their school. Pre- and post-activities are included and family packets are distributed at the event.

For further information, contact Colleen Blair, Fort Worth Museum of Science and History, 1501 Montgomery St., Fort Worth, Texas 76107, phone 817-255-9338.

The Panhandle-Plains Historical Museum and West Texas A&M University: Teacher Pre-Service Program

The Panhandle-Plains Historical Museum has partnered with West Texas A&M University to help pre-service teachers discover how to utilize the museum's collections for scientific applications. Student teachers meet twice with the museum's education director to investigate the methodology of inquiry learning and objects-based education.

For further information, contact Katherine Baker, PPHM, Box 967 WTAMU, Canyon, Texas 79016, phone 806-651-2245.

opportunities through field trips, field studies, overnight experiences, and special programs.

- Informal science learning experiences offer teachers a powerful means to enhance both professional and personal development in science content knowledge and accessibility to unique resources.
- Informal science education institutions, through their exhibits and programs, provide an effective means for parents and other careproviders share moments of intellectual curiosity and time with their children.
- Informal science institutions give teachers and students direct access to scientists and other career role models in the sciences, as well as to opportunities for authentic science study.
- Informal science educators bring an emphasis on creativity and enrichment strategies to their teaching through the need to attract their noncompulsory audiences.
- NSTA advocates that local corporations, foundations, and institutions fund and support informal science education in their communities.
- Informal science education is often the only means for continuing science learning in the general public beyond the school years.

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Members of the NSTA Informal Science Advisory Board

NATIONAL SCIENCE FOUNDATION

The National Science Foundation defines informal science by asking where people get their understanding of science and mathematics. Exposure to concepts of science, math, engineering, and technology (SMET) education can come from conversations, classrooms, Science television programs, special events, and other sources. Our understanding is not

Houston Arboretum and Nature Center "Project Aquatic WILD Teacher Workshops"

The Houston Arboretum and Nature Center collaborated with Texaco Corporation to host a successful teacher workshop on aquatic communities, Project Aquatic WILD. Texaco is also funding the building of a small habitat sanctuary with a pond on the grounds of an elementary school.

For more information, contact Carol Huelbig, Houston Arboretum and Nature Center, 4501 Woodway, Houston, Texas 77024, phone 713-681-8433.

Cibolo Wilderness Trail “PRISM”

Through the Principals’ Initiative for Science and Math (PRISM), area school children are able to visit the Outdoor Classroom at Cibolo Wilderness Trail. A CWT science consultant assists elementary teachers in developing and using inquiry methods for pre- and post-visit activities.

Through this same program, Boerne ISD contracts with the Southwest Education Development Laboratory (SEDL) to provide 6–8 days of science in-service workshops, coordinating with CWT to help K–5 teachers align their curriculum with TEKS.

For more information contact Jan Wrede, Cibolo Wilderness Trail, 28 Fabra Oaks, Boerne, Texas 78006, phone 830-249-4616.

attributable to a single source and is certainly not solely the domain of classrooms and laboratories. Many people are motivated by intrinsic interests outside of formal learning settings. In fact, a common memory of an early science-related experience is likely to be that of an informal science event like visiting a zoo or science exhibit, seeing a science program on television, talking to a scientist about his or her work, exploring nature in the backyard, or even doing kitchen “experiments.”

A major goal of the National Foundation (NSF) is to “promote the discovery, integration, dissemination, and employment of new knowledge in service to society” (National Science Foundation, 1995, p. 13, NSF #95-24). One strategy for achieving this goal is to “infuse education with the joy of discovery and an awareness of its connection to exploration.”

Informal science education is voluntary, self-directed, and lifelong. It is learning that provides an experiential base and motivation for further activity and learning. NSF’s Informal Science Education (ISE) program supports projects in which “learning is . . . motivated mainly by intrinsic interests, curiosity, exploration, manipulation, fantasy, task completion, and social

interaction. This informal learning can be linear or nonlinear and often is self-paced and visual- or object-oriented” (National Science Foundation, 1997, p. 8, NSF #97-20).

Informal science learners—people of all ages, interests, and backgrounds—are discovering science in places outside of schools, with materials and activities initially not developed for school use or as part of a curriculum. Participants in informal science education activities engage with science on their own initiative and not as part of a mandated school experience. Participation reaps several benefits: a better understanding of concepts, topics, processes, and thinking in scientific and technical discipline; increased knowledge about career opportunities in these fields; and increased appreciation and understanding of science and mathematics, and their applications.

“Direct observation at nature centers led to my first feeling of intense interest and curiosity; [I] developed a need and interest in ‘knowing’ and ‘exploring’ for answers.”

An individual with a science-related career

Fort Worth Museum of Science and History Hands-on Inquiry Lab

On weekdays, this permanent exhibit is used by Texas Christian University Education Department to train pre-service teachers in hands-on inquiry-based science. Pre-service teachers have the opportunity to interact and observe local elementary school students under the supervision of college professors and practicing veteran teachers. On evenings and weekends, this exhibit is open to the museum public for family learning and investigation.

For more information, contact Colleen Blair, Director of Special Services, Fort Worth Museum of Science and History, Fort Worth, Texas 76107, phone 817-255-9338.

Brazos Valley Museum of Natural History “Pre-Service Science Partners”

The Brazos Valley Museum of Natural History has collaborated with Bryan ISD, Blinn College, and Texas A&M University in “Pre-Service Science Partners.” They have designed a unique summer course in entomology focusing on strengthening science background knowledge and enhancing child-centered teaching experiences for pre-service and in-service teachers alike.

For further information, contact Richard Huey, Brazos Valley Museum, 3232 Briarcrest Dr., Bryan, Texas 77802, phone 409-776-2195.

Television series and programs for youth or the general public; films on science and mathematics topics; exhibits or educational programs at science and natural history museums, science-technology centers, aquariums, nature centers, biological gardens, arboretums, zoological parks, and libraries; and educational programs and activities at community and youth centers are all part of informal science education.

Cumulative experiences in and through these environments provide interaction and reinforcement, influenced by family, school, peers and community.

Many people with science-related careers credit their initial interest in SMET to informal rather than formal exposure, identifying museums and science centers as the most important stimulants to their childhood interest.

A Report on the Evaluation of the National Science Foundation’s Informal Science Education Program
1997

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Stussey, C., & Thomas, J.A. (1998). *Elementary teachers do science: Guidelines for teacher preparation programs*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

The Lady Bird Johnson Wildflower Center Teacher In-Service Program

Teachers participate in a full-day workshop where they are introduced to the “Exploring the Native Plant World” curriculum, participate in pre-field trip and post-field trip activities, and engage in hands-on multi-disciplinary activities that they will do on-site when they return with their students. The teachers can then return with their students on unlimited visits at no charge and receive a backpack with activity materials for their use.

For further information, contact Cappy Manly, Lady Bird Johnson Wildflower Center, 4801 LaCrosse, Austin, Texas 78739, phone 512-292-4200.

**Sites Visited
by the Texas SSI Informal Science
Education Action Team**

Austin Children’s Museum	<i>Austin</i>
Austin Nature and Science Center	<i>Austin</i>
Centennial Museum, University of Texas at El Paso	<i>El Paso</i>
Children’s Museum of Houston	<i>Houston</i>
Cibolo Nature Center	<i>Boerne</i>
Don Harrington Discovery Center	<i>Amarillo</i>
Fort Worth Museum of Science and History	<i>Fort Worth</i>
Gladys Porter Zoo	<i>Brownsville</i>
Houston Museum of Natural Science	<i>Houston</i>
Houston Zoological Garden	<i>Houston</i>
Insights-El Paso Science Museum	<i>El Paso</i>
McAllen International Museum	<i>McAllen</i>
Museum of Health and Medical Science	<i>Houston</i>
Panhandle-Plains Historical Museum, West Texas A&M University	<i>Canyon</i>
Sabal Palm Grove Sanctuary	<i>Brownsville</i>
Santa Ana Wildlife Refuge	<i>Alamo</i>
Space Center Houston	<i>Houston</i>
Texas Parks and Wildlife Headquarters	<i>Austin</i>
Texas State Aquarium	<i>Corpus Christi</i>
University of Texas Marine Science Institute	<i>Port Aransas</i>
Wilderness Museum	<i>El Paso</i>
Witte Museum	<i>San Antonio</i>